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1920.

It is with no feeling of regret that we write the epitaph of 1920. Its immediate predecessor was bad enough, and twelve months ago we were looking forward hopefully to a new epoch—to the reaping of the harvest of peace and prosperity for which the seed had been sown in sorrow and adversity. But our fond hopes were doomed to disappointment. Then we said: "Nationalisation demands, incessant agitations for higher wages and shorter hours, efforts to secure 'control,' the railway strike and struggle with the community, the continued increase in the cost of living, the serious developments in rates of exchange, the ever-growing burden of national finance—these are some of the leading questions of the year." Substituting "mining" for "railway," precisely the same paragraph would equally hold good for 1920. *Plus ça change, plus c'est la même chose.* The turnover from war work to peaceful production completed, we looked for a vast output and universal progress towards renewed prosperity, foretelling for the electrical industries "a boom . . . if the menace of industrial unrest and financial stress do not assume serious shape." Unfortunately, that essential condition was not fulfilled; unrest there has been in plenty, and the crushing burden of the excess profits duty, income tax, and other imposts has bled industry white, while the exchanges impose an immense handicap upon our foreign trade. Thanks to the high cost of labour, resulting also in high cost of materials, and the uncertainty as to the future, not only of wages but also of output, British manufacturers could not quote either fixed prices or definite dates for delivery, and here again they were at a heavy disadvantage in competition with other countries. And now, to crown the tale of woe, a wave of unemployment has swept over the land, necessitating further expenditure on unproductive works in order to stave off starvation and disorder.

But are we Britishers downhearted? Surely not! The darkest hour comes before the dawn, and we are confident that we are not mistaken in our interpretation of various signs, individually of small moment, but in the aggregate of great import, that the worst has been passed and things are on the mend. The cost of commodities is decreasing; according to the *Times* of January 1st, the total fall in wholesale prices was 11 per cent. in November and 6.7 per cent. in December. The average level of food values declined 7.5 per cent. in November and 4.8 per cent. in December, and as there has been a steady fall since April, prices are down almost to the level of December, 1918. The reduction in the index number during the year was 19 per cent., mainly due to a fall of 32 per cent. in the prices of raw materials, the index numbers being for December 31st, 1919, 296.9, and for the end of 1920, 240.3 (at December 31st, 1913. 100). In July last the highest point was reached (305.8). Further reductions are imminent, and though it takes some time for them to reach the retail consumer, it is unquestionable that food and clothing in particular are materially cheaper than they have been. Copper, lead, and spelter are almost down to the pre-war level, and rubber is far below it; coal and coke, unfortunately, remain at a high price.

Turning to taxation, it cannot be doubted that the earnest protests and appeals of manufacturers against the excess profits duty, and the disappointing results obtained from it, will secure its withdrawal in the coming Budget; purely a war-time tax, it has not merely proved unsuitable to the conditions obtaining since the war, it has produced a disastrous effect upon industry. At any time it affords a direct incentive to extravagance, for a manufacturer is prone to regard an extra outlay of £100 as only £40 out of his own pocket and £60 out of the Exchequer; we do not commend this attitude of mind—we merely record the fact that in many quarters it undoubtedly exists. But apart altogether from this feature, the duty has pressed with crushing weight upon the patriotic firms who recognise the necessity of taxation, but are faced with the facts that their working capital nowadays must be trebled in comparison with pre-war requirements, that new capital is almost unobtainable, and that they must provide the money out of revenue. The situation is an impossible one, and clearly E.P.D. must go, if our industries are to survive the strain.

With regard to labour, again the prospects are brighter than they were a year ago. There is now manifest a marked disinclination on the part of the trade unions to resort to the strike weapon, and a disposition to discuss the situation with the employers. Obviously, in the face of growing unemployment and vanishing profits, to strike for higher wages would be the height of folly. Every encouragement should be given to the tendency towards friendly discussion across the table, and the fullest information should be furnished to the accredited representatives of the workers; nothing more effectively nourishes suspicion and dissatisfaction than undue reticence on the part of the employers, who are so commonly believed to be amassing wealth at the expense of the workers. Experience on the Whitley Councils has abundantly proved that frank and open conversation softens asperities, smooths away misunderstandings, and enables both parties to acquire that confidence in and respect for each other as men, which goes so far towards the maintenance of cordial relations. Lack of mutual trust is perhaps the greatest of all hindrances to hearty collaboration.

That the restriction of output has played a great part in the development of the present situation cannot be seriously disputed. Although far-seeing Labour leaders have pointed out that increased production is the key to the problems of industry, the workers have not followed their lead—fearing that the result would be unemployment. Well—they have tried their own way, and they have found that it leads directly to the danger that they sought to avoid; will they not now be willing to make trial of the other path? Surely it is a matter of plain common-sense. When one finds oneself in a fog walking towards the brink of a precipice, one naturally turns round and hastens in the opposite direction. Unfortunately, it is much easier to go downhill than uphill; a year ago we were on the crest of the hill, in sight of a world crying out for supplies of manufactured goods; we no longer have that fair prospect before our gaze—the world, appalled at the prices of commodities, has closed its purse. It will be a hard struggle to regain our commanding position—but the world's demand, though now restrained, remains unsatisfied. Immense developments await the restoration of normal conditions, and it should be our earnest endeavour to turn out the maximum quantity of goods at the lowest possible prices. That is what the Germans are doing already. Let us beware lest, beaten in war, they defeat us in the arts of peace.

What is needed to remedy the evils under which we labour is a change of spirit. We hear much about "rights," but little about "duties." As in wartime, so now in peacetime, the spirit of self-sacrifice is the key to the welfare of the nation. So long as each strives for his own advancement regardless of the happiness of others, so long shall we flounder in the depths of depression. Let us rather all strive after mutual understanding, good-fellowship, and cheerfulness, and let each "do his bit" to make the world a better place for his fellows to live in. By so doing all will benefit, and the dawn of a new era will shine forth.

Wages Agreement, Greater London Industrial Council.

We notice that this much-discussed agreement has drawn down upon it a veritable broadside of criticism from the *Financial Times*. The article is headed "Tyranny of Labour" and "New Stranglehold on Industry." We can hardly agree to the first of these titles, since, after all, the agreement is a joint one of both sides of the Greater London (No. 10) Industrial Council, and the sub-heading also is perhaps somewhat too emphatic, however much the agreement may tie up the undertakings! The essence of the agreement is that an increase of wages shall take place with every complete ten points rise over the 150 per cent. cost of living, and that this shall be taken off with the fall of the ten points. The agreement is supposed to bind all the undertakings in the Greater London area. It is, of course, a serious compact to enter into, but on the other hand, any alternative is also serious, even that of maintaining the *status quo*.

There is one point in the *Financial Times* criticism which certainly merits serious consideration, namely, the suggestion that big London undertakings will still be as vulnerable as ever to a strike. The agreement states in the preamble that its one purpose is "that the supply of electricity may be carried on continuously without interruption." But there is nothing in the agreement which gives any guarantee whatever. The *Financial Times*, in fact, thinks that the danger is increased, since if one or two small undertakings in the London area do not put it into operation, the trade unions give no guarantee that they will not call a strike on the big undertakings in order to coerce the recalcitrant ones, and, of course, no one can shut his eyes to the possibility of London being used as a lever on other occasions. This being so, would it not be possible for the National Council, when the agreement comes before it for final approval, to agree to some sort of clause which shall provide a safeguard to those London undertakings which faithfully carry out the provisions? Otherwise, if no such safeguard is embodied in the agreement, it is difficult to see how the agreement by itself will prevent strikes in London.

So far as the other District Industrial Councils are concerned, their view seems to be that the agreement should not be ratified by the National Council until they have had an opportunity of considering it, since if a similar agreement were presented to the District Councils they would feel their case prejudiced if the trade unions brought it forward with the claim that such agreement had already been approved by the National Council. It is indeed difficult to see how the approval of the National Council to the London agreement could be so given as not to constitute an approval covering the principle as well as the detail and individual application, and if the National Council approved the principle, the District Councils would seem to have no option but to accept. We understand, however, that the air will be somewhat cleared before the National Council has to give its verdict, since in the interim the employers' sides of the various District Councils will have an opportunity of considering the matter in conference, and submitting a consensus of opinion to the National Council.

Joint Electricity Authorities.

With regard to the thirteen electricity districts which have been provisionally delimited, the schemes for most of these are not due for consideration for at least a few months. When these schemes are forthcoming, it will be interesting to see whether all of them include the formation of a Joint Electricity Authority. It will be remembered that under the Electricity (Supply) Act, 1919, any schemes can be brought forward which purport to improve the "organisation of the supply of electricity in any district." These schemes may or may not, under Section 6 of the Act, provide for the establishment of a Joint Electricity Authority. An article on this subject appeared in a recent issue of the

Times Engineering Supplement, in which the pros and cons with regard to the formation of such authorities were weighed. Under Section 6, of course, the Joint Authority may exercise "all or any of the powers of the authorised undertakers within the electricity district," and it may also have transferred to it "the whole or any part of the undertakings of any of those undertakers." A good many arguments were advanced in the article mentioned against the formation of such fully operative Joint Authorities.

We may suggest that there is a middle course by which, although a scheme might be carried on jointly by certain undertakers in the area, perhaps merely one or two, a Joint Authority might still be formed as a regulating and supervising board which would be representative of the various interests enumerated in Section 6, but which would have only administrative functions, that is, it would not become the trading body. This would seem to be a likely solution in some areas. In the Electricity (Supply) (No. 2) Bill, Section 11 provides that where a generating station or main transmission line becomes transferred to or is acquired by a Joint Authority, the said authority may (subject to the approval of the Electricity Commissioners) delegate to the former owner the working and maintenance thereof on behalf of the authority, by mutual agreement; and Section 12 enables the authority to delegate the whole of its powers and duties as regards the generation and supply of electricity to any authorised undertakers, subject to a special order being obtained. The great difficulty of discussing the question broadly is that every district is in a different position, and what may suit one district may not be at all applicable to another. The wisdom of the Act in leaving open the exact system of reorganisation in each district to be settled for each district separately will gradually be more and more fully appreciated. Indeed, the chief requirement in settling what has to be done in each district is that there should be no fixed theoretical model which each is supposed to follow. Each district is, as it were, in a different state of evolutionary development. They are like humanity in being of all sizes and conditions, and hence requiring, not a ready-made Government suit, but something cut to measure.

More Municipal Trading.

In days gone by we have often had occasion to deal with the question of municipal trading. The Legislature, for good or ill, has frequently authorised this form of enterprise, but it is interesting to notice that the Courts are not inclined to allow local authorities to exceed their statutory powers. The recent case of *Attorney-General v. Fulham Corporation*, reported in *The Times* of December 3rd and 4th, is a useful illustration. It seems that the Fulham Borough Council, having power to establish baths and wash-houses and to afford facilities by which persons might, in wash-houses, do their own washing, sought to extend the sphere of operations.

On the recommendation of the Establishment Committee, the Council inaugurated a scheme by which the washing was to be done by servants of the Council itself. The Attorney-General, at the instance of a ratepayer, brought an action to restrain it from exercising these extended powers. Mr. Justice Sargant, in giving judgment against the Corporation, pointed out that in considering what the powers of a Corporation were, it was necessary to remember what Lord Selborne had said as to the doctrine of *ultra vires* (that is to say, the doctrine according to which a Corporation must not exceed the powers conferred upon it by statute) in *Ashbury Railway Co. v. Riche* (L.R. 7 H.L. 653). His Lordship had said: "this doctrine ought to be reasonably and not unreasonably understood or applied, and that whatever may fairly be regarded as incidental to, or consequent upon those things which the Legislature has authorised, ought not (unless expressly prohibited) to be held by judicial construction to be *ultra vires*." Applying that doctrine, he could not hold that power to provide washing apparatus for the ratepayers could be held to confer power to wash clothes for others. It may be useful for those who are concerned with the supply of electricity to have this case in mind, having regard to the attempts which are sometimes made by local authorities to exercise powers for which there is no sanction. It should be mentioned that it was long since decided (viz., in the case of the *Attorney-General v. Corporation of Leicester*, 1910, 2 Ch. 359) that in the absence of statutory authority municipal electricity supply undertakers could not provide lamps, fittings, motors, or apparatus other than meters which were provided for by various clauses in the schedule to the Electric Lighting (Clauses) Act, 1899. Such statutory authority was given in the Act of 1919, Section 23, which enables all municipal supply authorities to provide, let for hire, connect, repair, maintain, and remove all kinds of electrical apparatus, but explicitly forbids them to manufacture or sell the same ("unless expressly authorised to do so" by their special Acts or orders).

The Law of Nuisance.

The recent case in which Mr. Justice Astbury granted an injunction to restrain a firm of builders from causing a nuisance by noise draws attention to the fact that all who carry on their business in a residential district are bound to have regard to the nerves of their neighbours. To this rule those who supply electricity are no exception.

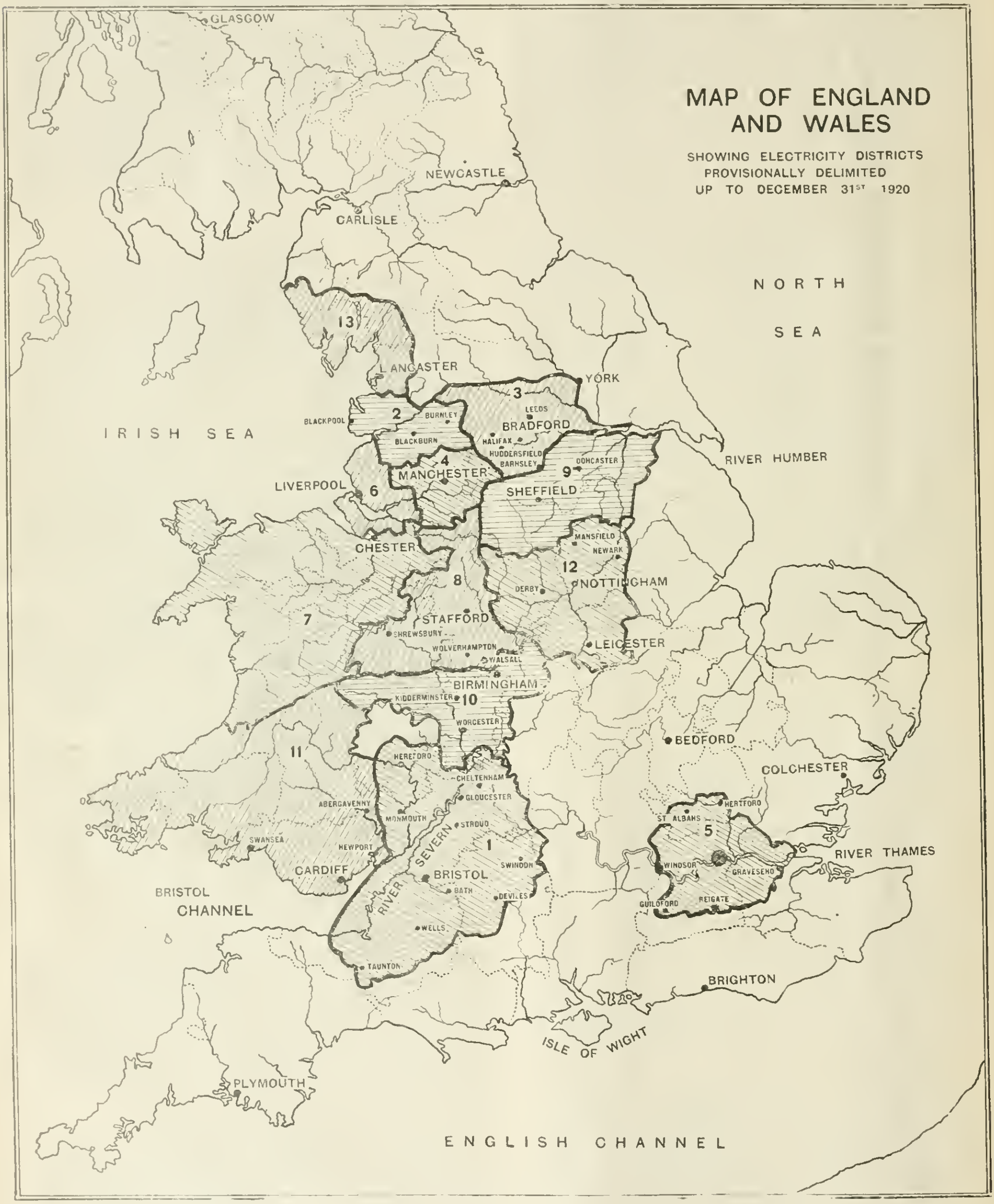
Time was when our columns frequently contained the reports of cases in which electricity supply authorities were made defendants to actions for nuisance. It would seem, however, that people's nerves are not quite so susceptible to this kind of disturbance in these later days, for such actions are seldom heard of at the present time. Improvements in machinery have undoubtedly contributed to this result. The production of unnecessary noise means a futile waste of energy, and improvements have taken place in this direction. Again, the gradual suppression of small generating stations has led to a diminution in the number of houses which are within reach of noise or vibration. There is probably a disposition on the part of the public to regard any nuisance which does arise in the course of generating electricity as a necessary evil. It is also a well-recognised fact that long habit will accustom a man to any form of noise. We recall the case of a Welsh doctor whose quarters were situated close to a colliery engine house. Year in, year out, a great ventilating engine was at work, and the exhaust pipe made a roaring sound at regular intervals outside his bedroom window. He grew quite used to it. On one occasion he woke up suddenly in the night thinking it was a night call, only to find that the cause of his awakening was a sudden cessation of the familiar sound.

While actions for nuisance have become more rare of late, the possibility of trouble and litigation on this ground cannot be altogether removed from the purview of the station engineer. In this connection it is well to mention that by S. 81 of the Schedule to the Electric Lighting (Clauses) Act, 1899, it is provided that: "Nothing in the special order shall exonerate the undertakers from any indictment, action, or other proceedings for nuisance in the event of any nuisance being caused or permitted by them."

By virtue of this section undertakers are liable to an injunction and damages if they cause a nuisance, whether by noise or vibration, in working their generating station or by the escape of electricity from their mains, or by smoke, water, coal dust, &c., quite apart from negligence, and it is no defence to an action for the company to prove that the person complaining took up his residence in the district long after the works were established, and in such circumstances that he must have known of the existence and probable continuance of the nuisance.

THE ELECTRICITY DISTRICTS.

In their endeavours to reorganise the supply of electricity, the Electricity Commissioners have up to the present provisionally delimited 13 separate electricity districts for the purposes of Sec. 5 of the Electricity (Supply) Act, 1919, and a number of local inquiries are to be held from this month onwards with a view to permanently determining the area to be included in each district. At the inquiries consideration will also be given to the schemes which have been submitted for effecting improvements in the existing organisations for the supply of electricity in, and for the formation of Joint Electricity Authorities to control, the various districts, the location of which is indicated on the accompanying map. Any interested body or person may attend the inquiries, either in person, or by his agent, legal or other representative, and for information regarding the jurisdiction of the Electricity Commissioners, p. 739 of our December 10th, and p. 646 of our May 21st, issues may be consulted. The districts are enumerated below in the order in which they were provisionally determined by the Electricity Commissioners.



Map of Electricity Districts Provisionally Delimited by the end of 1920.

1. *The West of England, or Lower Severn, Electricity District* (pp. 624 and 646 of our May 14th and 21st issues) was not only the first one to be provisionally specified, but also promises to be the first to be permanently

defined. A local inquiry for that purpose will take place on January 11th and subsequent days, and a draft proposal for the formation of a Joint Authority is to be put forward by the Bristol City and other interested authorities. Incidentally, the Severn Barrage, which the Ministry of Transport has proposed to build to enable tidal energy to be utilised to generate electricity (pp. 705 and 713 of our December 3rd, and p. 762 of our December 10th issues), if it is ever realised, will be situated in this district.

The outstanding electricity supply undertaking in this large district is that owned by the Bristol Corporation, having a plant capacity of over 24,000 kW. Hereford is worthy of notice both on account of its interesting rural supply network, and of being second in size with a capacity of 4,610 kW. Next comes the Cheltenham undertaking, which is followed by Swindon and Gloucester City. The City of Bath apparently does not wish to commit itself in the formation of a Joint Authority. Another station is situated at Weston-super-Mare. In addition there is a number of small stations generally supplying d.c. scattered over the area. As it is proposed that the voting power of the various members forming the Joint Authority shall be proportional to the number of units sold per annum, it will be recognised that the Bristol undertaking will be the dominating one in this area.

2. *The Mid-Lancashire Electricity District* (see p. 720 of our June 4th, and p. 764 of our June 11th, 1920, issues), in contrast to the above-mentioned one, is a thickly populated industrial area, though not so large as the Bristol area. Blackburn and Preston form practically the centre of the district. The former undertaking has a capacity of 8,000 kW ; the common periodicity of 50 is shared with Preston, which has a capacity of 3,190 kW, and is the only important company-owned concern in the area. Burnley has a 5,250-kW capacity, and a considerable traction load, while the well-known summer resort, Blackpool, has 6,950 kW of plant. In July last the foundation stone of the new Whitebirk station at Blackburn was laid, and it was proposed to build a second station on the River Ribble at Preston, where a dam was to be constructed. The demand for electricity is increasing so rapidly, owing to the electrification of mills, factories, &c., that most of the additional output that will be available, when the various extensions that are in hand are completed, has already been allocated.

3. In the *West Riding (Aire and Calder) Electricity District* (see p. 815 of our June 25th issue), including, as it does, one of our principal manufacturing districts, it is essential that the best use should be made of the available supply. A large number of power stations are situated in this area ; the Yorkshire Electric Power Co. has two stations, one at Dewsbury and the other at Barnsley, and supplies a large number of local authorities, collieries, factories, &c., in addition to bulk supplies to other authorities. Amongst the municipal undertakings in the area are those at Leeds, Bradford, Halifax, Huddersfield, Wakefield, &c.

4. *The South-East Lancashire Electricity District* (p. 815 of our June 25th issue) includes some very important municipal undertakings, such as those at Manchester and Salford, between which there is a 33,000-V underground interconnecting line (see p. 355 of our March 19th issue). Manchester's application for permission to construct a new station at Barton, to have a possible ultimate capacity of 150,000 kW, has been sanctioned. A number of county boroughs have their own electricity supply undertakings, while several urban districts are served by the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board, and others by the Lancashire Electric Power Co. One or two authorities have obtained Provisional Orders enabling them to supply electricity in certain areas, which powers have, however, not as yet been exercised.

5. *The London and Home Counties Electricity District* (see p. 106 of our July 23rd, 1920, issue), demands careful consideration not only by reason of its inclusion of the whole of the Metropolis and "Greater London," but also because of the large number of electricity supply undertakings involved. A tentative proposal for the formation of a Joint Authority for the district has been put forward by the London County Council (see our issues of October 15th, p. 481 ; November 12th, p. 610 ; December 3rd, p. 706, and 10th, p. 744), and the inquiry which will be held in connection with this area should be the most interesting of all. The conditions obtaining in London differ widely from those in any other electricity district, and the various interests involved will need very careful consideration if a scheme is to be evolved which will be satisfactory to all concerned.

6. *The Mersey and West Lancashire Electricity District* (see our issue of July 23rd, p. 106) includes about half-a-dozen large electricity generating stations, in addition to a number of smaller ones. The Liverpool undertaking is probably the most important one, and a scheme for the formation of a Joint Authority has been submitted to the Electricity Commissioners. A rival scheme has also been put forward, by which it is proposed to split up the area and to form a separate area to be termed the Wirral Electricity District, which will include the south-western portion only of the district that has been provisionally determined by the Commissioners (see p. 11 of this issue). All the schemes for the constitution of Joint Authorities that have so far been submitted are in the main similar, differing only in minor points.

7. *The North Wales and Chester Electricity District* (p. 107, July 23rd) includes only one county borough, namely, that of Chester, which is of interest on account of its hydro-electric plant with a capacity of 2,170 kW, which was inaugurated in 1913. A scheme for the constitution of a Joint Authority to control the district has been prepared by the Corporation and the North Wales Power and Traction Co., but not yet published. There are several small electricity supply undertakings situated within the area, which also possesses in the aggregate considerable potential water power ; several parts of the district are, nevertheless, not well off as far as public supplies of electricity are concerned, indeed several districts have no supplies whatever.

8. *The North-West Midlands Electricity District* (p. 370 of our September 17th issue) is of interest, inasmuch as the Shropshire, Worcestershire and Staffordshire Electric Power Co. has power to supply a large part of the area, although its power stations are located at Dudley, Smethwick and Kidderminster, which towns are just outside the scheduled district. It is unnecessary to emphasise the importance of this area, including as it does mines, potteries, ironworks, and other great industries ; it will suffice to record that several important municipal undertakings are situated within the district, namely, those at Wolverhampton, Walsall, West Bromwich, Stafford, and Stoke-on-Trent.

9. *The North-East Midlands Electricity District* (p. 434 of our October 1st issue) needs no introduction, being already world-famed for its steel production, cutlery and allied trades. During the war period the increase in the demand for electricity in the area was phenomenal, and electric furnaces were adopted freely in the manufacture of munitions of war. The two outstanding electricity supply undertakings in the district are those at Sheffield and Rotherham, the former with a capacity of 68,700 kW, and the latter with 70,500 kW. Rotherham recently inaugurated a new generating station, being the first "super-station" to be placed in commission in this country, in which the largest turbo-generator set yet used in this country is installed—namely, a 30,000-kW machine. There are several other stations in the area, but mention need only be made of those at Chesterfield, Mexborough, and Doncaster ; it also includes the well-known health resort of Buxton.

10. *The South-West Midlands Electricity District* (p. 434 of our October 1st issue) includes in its southern portion the celebrated fruit orchards of Pershore and Evesham, while the beautiful Malvern Hills and the health resorts of Droitwich and Worcester are too well known to escape notice. From a technical point of view, however, the centre of interest will undoubtedly be Birmingham, in the north-east portion of the area. The municipal undertaking has a capacity of 67,666 kW, and those who know the city and its adjacent area will appreciate the existing and potential demand for electricity in the neighbourhood. As mentioned above, the border line of this area just takes in the three stations owned by the Shropshire, Worcestershire, and Staffordshire Electric Power Co.

11. In the *South Wales Electricity District* (p. 591 of our November 5th issue) a commencement has just been made towards the formation of a Joint Authority (p. 809, December 24th issue). The district is an important coal-producing centre, and the Ebbw Vale Iron and Coal Co., with its extensive undertakings, will probably exercise substantial influence on the formation of a Joint Authority. Of the electricity supply undertakings affected, the South Wales Electrical Power Distribution Co. deserves notice, not only because it is probably the largest, but also because it operates a considerable mileage of both underground and overhead transmission lines. Of the municipal undertakings involved, those at Cardiff, Newport (Mon.), and Swansea may be noted, and there is, in addition, quite a number of other stations, some of which are privately owned, such as that belonging to the Ebbw Vale Co., which is of considerable size, and numerous smaller ones.

12. *The East Midlands Electricity District* (p. 591, November 5th) is of interest in view of the recent inquiry into the application of the Nottingham Corporation for permission to erect a large new generating station (p. 155, July 30th, and p. 401, September 24th). It will be remembered that the Electricity Commissioners decided in favour of the municipal proposition and against the opposition scheme which was put forward by the Derbyshire and Nottinghamshire Electric Power Co. At Derby and Leicester are located two other large stations, while, in addition to the above-mentioned company, the Leicestershire and Warwickshire Electric Power Co. has power to supply portions of the area under consideration; its stations are, however, outside the boundary of the district.

13. *The North Lancashire and South Cumberland Electricity District* (p. 721, December 3rd) neither includes a large area nor many large public generating stations; by far the largest is Barrow-in-Furness, round which town is grouped the chief industrial area of the district. The only other undertakings of any importance are those at Lancaster and Morecambe. The picturesque lake districts of Ulverston, Windermere, Ambleside, and Grasmere are in this district.

In conclusion, it may be pointed out that an interesting discovery has been made as a result of outlining the provisional boundaries of the separate districts on a single map. It will be seen that District 1 includes the Rural District and City of Hereford, but, curiously enough, the other part of the County of Hereford which is bounded by Districts 1, 10 and 11 is in none of them, and appears to have been left out in the cold.

GEARING CONSTANTS OF ELECTRICITY METERS.

By G. W. STUBBINGS.

The operation of testing an electricity meter by a revolution or speed test consists in determining the relation between the angular speed of the rotor and the load passing through the meter, and comparing the constant representing this relation of proportionality with the "testing constant" as furnished by the makers of the meter. It is at once apparent that these two constants are quite different in physical significance, the one determined by the revolution test is a characteristic of the meter, and although a constant, or approximately so, with regard to the particular test, this characteristic is liable to change over long intervals of time. The constant furnished by the makers, however, is a property of the gearing of the meter counter, and the operation of calibrating the meter is either to modify the characteristic of the meter to suit the gearing constant, or alternatively to alter the gearing constant to suit the meter characteristic.

Although the testing constant of a meter is always furnished by the makers, it is often advisable to check the information so given by an examination of the gearing. Although this would not seem a very difficult matter, there are many to whom it would give considerable trouble, and the general problem is not made easier by the fact that the testing constant is given by various makers in several different forms. The following examples, in which the numerical connection between the values of the wheel trains and meter constants of various types is worked out in detail, it is hoped may be of use to meter repairers and testers, to whom these matters have not been any too clear.

The fundamental constant of an electricity meter is the number of revolutions executed by the rotor during the passage of one unit. If the meter is to register correctly, it is obvious that this number must be identical with the number of revolutions of the rotor required for one revolution of the $\frac{1}{10}$-unit spindle of the counter. The gearing ratio between the rotor and the $\frac{1}{10}$-unit spindle must, therefore, be equal to the number of revolutions per unit as determined by the speed test. It is to be observed that the quantity "revolutions per unit" has a different significance with a watt-hour meter from what it has with an ampere-hour meter calibrated to register units. In the case of a watt-hour meter, this constant is the number of revolutions of the rotor corresponding to the actual passage of one unit. In the case of the ampere-hour meter the constant is the number of revolutions corresponding to a quantity Q such that 1,000 Q V = 1 where V is the rated voltage of the meter. Since the ampere-hours corresponding to one unit are 1/1,000 V, the "revolutions per unit" constant, and therefore the gearing constant, will vary according to the rated voltage of the meter.

If the testing constant of the meter is given in the "revolutions per unit" form, this constant can at once be checked by calculating the gearing constant, it being remembered that the velocity ratio of toothed gearing is inversely proportional to the respective numbers of teeth in the wheels engaging, and that the ratio of a worm-and-worm-wheel pair is the reciprocal of the number of teeth in the worm wheel for a single worm.

Although the "revolutions per unit" constant is really the fundamental one, it is not the one best adapted for testing purposes. A very usual constant for ampere-hour meters is the ampere seconds per revolution ratio. "Revolutions per unit" is related to ampere-seconds per revolution in a very simple way—

Since units = amps. × secs. × V 3,600,000,
K = revs./units = revs. × 3,600,000/amps. × secs. × V,
and amps. × secs./revs. = 3,600,000 K × V.

To illustrate this the case of the counter train of a Chamberlain & Hookham meter may be considered. An eight-tooth pinion on the rotor spindle gears with a variable change wheel of N teeth. A double worm on the change wheel spindle gears into an 80-tooth worm wheel; an eight-tooth pinion on this last spindle gearing into an 80-tooth wheel on the $\frac{1}{10}$-unit spindle.

The gearing constant is then (N 8) × (80/2) × (80/8) = 50 N = K, and this is the number of revolutions of the rotor per unit for correct registration.

From the above equation—

amp. × secs /revs. = 3,600,000/K × V
= 3,600,000 50 × N × V,

giving the relation between the constant and the number of teeth in the variable change wheel for any voltage. If, for instance, V = 230 and N = 72, the constant is found to be 1,000/V, or 4·35.

In the above case it is clear that for any constant the product N × V is constant, and that to adjust the meter to read correctly on a voltage different from that for which it is rated, a new wheel must be fitted according to the condition N′ = N V/V′, an increase in voltage requiring a smaller wheel. This, of course, only applies when the variable wheel is a driven wheel; had it been a driving wheel, N would have been proportional to the voltage—a single worm, for instance, being required in the above train for 115 volts, since the worm is a driving element.

As a further example, the train of a Ferranti d.c. meter may be worked out. In a meter of this type a single worm on the rotor spindle engages with a 50-tooth worm wheel; on the worm wheel spindle is a variable pinion of N_1 teeth engaging with a variable change wheel of N_2 teeth; on the last spindle is a 10-tooth pinion engaging with a 100-tooth wheel on the $\frac{1}{10}$-unit spindle.

$$K = (50/1) \times (N_2/N_1) \times (100/10) = 500\ N_2\ N_1,$$

and amp. × secs./revs. = $3{,}600{,}000 \times N_1/V \times 500 \times N_2$; taking $V = 230$, the variable pinion with 50 teeth, and the change wheel with 72 teeth, then the

$$\text{constant} = 3{,}600{,}000 \times 50\ 230 \times 500 \times 72 = 21{\cdot}8.$$

The calculation of constants of other forms is easily carried out by a preliminary determination of the gearing constant K. Thus—

$$\text{watt-hours/revs.} = 1{,}000 \times \text{units/revs.} = 1{,}000/K.$$

Again, $K = 3{,}600{,}000 \times \text{revs./(watts} \times \text{secs.)} = (\text{revs.} \times 60/\text{secs.}) \times (600{,}000/\text{watts})$

$$= \text{r.p.m. at full load} \times 600{,}000\ \text{full-load watts.}$$

$$\therefore \text{r.p.m. at full load} = K \times \text{full-load watts}/600{,}000.$$

Calculations regarding trains for prepayment meters are not very difficult, and may perhaps be touched upon. In such a mechanism, a definite fraction, say, $1/n$ of a revolution of the wheel of the epicylic gear actuated by the meter negatives the forward motion given by the epicylic wheel by one coin. If the ratio of the gearing between the last wheel in the prepayment train and the $\frac{1}{10}$-unit spindle be M, then

1 unit gives M revs. of the last wheel.
1 unit requires $M \times n$ coins.
If each coin is a pence, and p is the price per unit,
1 unit requires $M \times n \times a = p$,

this being equivalent to the self-evident fact that the revolutions of the $\frac{1}{10}$-unit spindle required to negative the action of one coin is equal to the ratio, units per coin.

To illustrate the above, the example of the prepayment train of a Vulcan meter may be considered. The value of the train between the escapement and the epicycles was—

$$(15/90) \times (N/80) \times (30/90) \times (45/90) = N/36 \times 80,$$

N being the number of teeth in the pence change wheel.

The wheel of the counter train actuating the escapement made 90 revolutions per unit, and this wheel made one revolution for each revolution of the "scape wheel of the prepayment train."

The total value of the train was therefore—

$$M = 90\,N/36 \times 80.$$

The meter was constructed for pennies, and the last wheel of the train made $\frac{1}{8}$ revolution per coin.

$$p = M\,a\,n = (90\,N/36 \times 80) \times 1 \times 8$$
$$p = N/4$$
$$4\,p = N,$$

the number of teeth in the variable pinion being equal to the price per unit in farthings.

THE PRODUCTION OF CONTINUOUS OSCILLATIONS IN CIRCUITS WHICH CONTAIN CAPACITIES OF HIGH VALUE.

By JOHN SCOTT-TAGGART.

It is frequently desirable to produce a source of oscillating current which may be adjusted between wide ranges of frequency by the simple continuous action of a variable condenser. The most usual circuit for the production of continuous oscillations with a three-electrode vacuum valve involves the use of a retroactor coil which operates only over a certain range of wave-lengths. This range may be considerably increased by winding the retroactor coil with resistance wire, but even so it is not possible to cover the wide ranges to be achieved with the circuits about to be described. Apart from the question of the retroactor, if we tuned our oscillatory circuit with a condenser we would find that, when the capacity of the condenser was above a certain value, the vacuum valve would cease to oscillate.

The circuits shown in fig. 1 and fig. 2 may be used for the production of oscillations of practically all frequencies. For example, with a variable condenser having ebonite dielectric and a fixed inductance of small value, a range of from 100 metres to 30,000 metres was obtained solely by adjusting the capacity of the circuit. Both circuits involve amplification of the timing potentials on the grid, which liberate energy in the anode circuit of the valve acting as a generator. When the capacity of the shunt condenser is large, the potentials across the oscillatory circuit are small, and if communicated in correct phase to the grid would be too weak to produce self-oscillation. These potentials are, therefore, first amplified by one or more three-electrode valves until they are strong enough to maintain the oscillations.

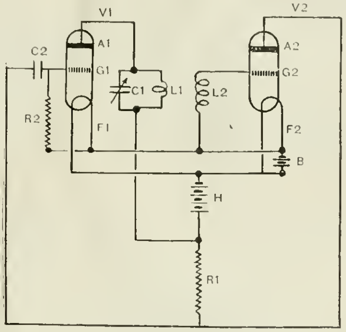


Fig. 1.

In fig. 1 the oscillatory circuit is shown as $L_1\ C_1$ included in the anode circuit of V_1, the battery H supplying the anode current. Any momentary oscillation in $L_1\ C_1$ is induced into L_2, a coil of high resistance. The potentials across L_2 are communicated to the grid G_2 of V_2 and amplified in the anode circuit $A_2\ R_1\ H\ F_2$ of the second valve V_2. This anode circuit contains a resistance R_1 having a value of about 70,000 ohms (which will be of the same order as the resistance of the filament-to-anode path of V_2). Magnified high-frequency potentials will be produced across R_1. The valve V_2 consequently acts practically as an aperiodic amplifier of all frequencies. The potentials across R_1 are now passed to the grid G_1 of V_1, and, if the coil L_2 be connected the right way round, will maintain the oscillations in the circuit $L_1\ C_1$. The condenser C_2 is merely used to prevent the high potential of the anode battery H from influencing the grid G_1. The leak R_2 (of about 2 megohms resistance) keeps the grid G_1 at a suitable normal potential.

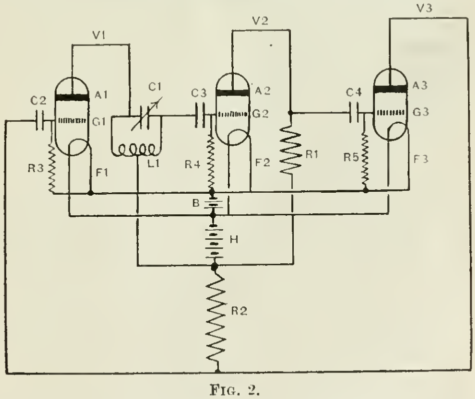


Fig. 2.

The second arrangement (fig. 2) works on exactly the same principle. There is, however, now only one main oscillatory circuit $L_1\ C_1$, no coupling coil being used. The middle tapping of L_1 is connected through H to the filament of the first valve V_1. The potentials across the right-hand half of L_1 are communicated to the grid G_2 of the second valve V_2 which acts as an aperiodic amplifier, the high-frequency potentials across R_1 being communicated to a third amplifying tube V_3. The potentials across R_2 are brought back to the grid G_1 of the first valve V_1, and are sufficiently strong to produce steady continuous oscillations in the circuit L_1 C_1, even when the value of the capacity of the condenser C_1 is very high. This circuit is also very useful for producing alternations in circuits using iron-core inductances. In these circuits radio-frequency transformers might be used between valves, instead of ohmic resistances.

These arrangements have many applications. The general principle of amplifying the "maintaining potentials" may be used to produce oscillations in an aerial circuit containing an inductance of low value. The chief application, however, is in heterodyne reception. The circuits may be used as external heterodyne oscillators, or as auto-dynes, in which case the aerial and earth might be connected across the condenser and telephones inserted in one of the anode circuits.

CONDENSERS FOR SMALL INSTALLATION WORK.

By L. C. GRANT.

The expense of house installation work has intimidated many a potential consumer. On the other hand, the cost of a small service is liable to produce equally undesirable effects upon the supply authorities. The expense attached to metering, both in initial cost and subsequent inspection and office expenses, is probably by far the greatest bugbear, and when these items are considered in relation to the actual power consumed, it is generally agreed that it is disproportionately heavy both for the consumer and the supply authority, which, of course, keeps up the price of the "juice."

The motor, mercury and induction types of meter are generally used and represent quite a considerable outlay; the electrolytic meter is cheaper, but is not looked upon with a great deal of favour on account of past sins. With a modern meter, however, a large part of the obstacle is prejudice.

The fixed-charge system is cheap for the supply authorities, and results automatically in a lowering of the price of the energy, but is unsatisfactory and unscientific, and is apt to lead to extravagance owing to there being no limit to the current consumption.

Current-limiting devices of a sort have been put into operation with mixed results. Some of them require too much resetting, while others require too much *a fortiori* reasoning in addition to a possible gift of clairvoyancy. A reliable current-limiting device, which must be inexpensive, would eliminate the cost of the meter and also a deal of administration expense. The ideal apparatus for this purpose would probably fulfil the following conditions:—(1) It must be cheap; (2) it must be reliable; (3) it must automatically prevent the current consumption exceeding a fixed value and, upon the excess load being removed, it must come into the reset position quite automatically; (4) and lastly, it must cause no appreciable loss.

To fulfil these conditions, the use of condensers has been suggested, and upon comparing a current-limiting condenser with the conditions outlined above, it will be found to slip most comfortably into position.

A condenser used for this purpose can be coupled into circuit in two ways; either in series with the whole system, or alternatively, each condenser and light run as a separate unit. Parallel operation of the lighting, which necessitates a separate condenser for each light, is not so suitable for the purpose, taking all into consideration, but the series system of coupling up presents many advantages for such small loads as are likely to be met with under the heading of domestic load.

With the parallel system each lamp is supplied from the distribution board in the usual manner except that it is connected in series with a condenser. The condenser used must be chosen with due regard to the consumption of the lamp, and the voltage across the mains will be split up across the condenser and the lamp; in other words, making up a circuit containing capacity and resistance to which the law: $C = E/R$ applies. The drop across the condenser is considerable, but the two components of the circuit are 90° apart, the condenser current leading by the maximum angle so that no appreciable loss takes place.

With one size of condenser, a variety of different candle-power lamps can be used, but the current consumption must be the same in every case, so that to get the correct wattage, and consequently candle-power, the lamp resistance must be increased as more light is wanted; in other words, a higher-voltage lamp must be used. Thus, assuming a condenser designed normally to pass $\frac{1}{2}$ A to get 30 c.p. a 60-V lamp must be used. A 15-c.p. lamp would have to be rated to operate at 30 V; for 10 c.p. a 20-V lamp would be required, and so on right down to the lowest voltage. It is even feasible to use a 4-V 2-c.p. lamp in this way.

There is, however, no very great advantage to be obtained with the parallel system, except that as lower voltage lamps are used the lamp costs are less. Further, the candle-power required can be very accurately supplied so that there is no need to use a lamp of higher candle-power than is necessary, as is very often the case with high-voltage lamps.

The series system is that which would prove most useful. In this case all the lamps are connected in series and in series with a condenser, the capacity of the latter being such that on a short circuit on its own terminals it will pass the maximum allowable load for any particular consumer. Each lamp or point is controlled by a switch connected *across* the terminals, so that the apparatus can be short-circuited. If any particular light is required, the switch is moved to the open circuit position; to put the light out again it is short-circuited.

Any number of lamps of any desired candle-power can be used, provided that they are all of the same current consumption, and that the sum of their voltages does not exceed more than about 40 per cent. of the supply voltage. For instance, assuming a 240-volt supply, a 1-A circuit could be adopted, and the lighting could be made up on the following lines:—Four lights could be used as 8 c.p., 8 volts; 12 c.p., 12 volts; 16 c.p., 16 volts; 32 c.p., 32 volts.

Further lamps could be connected up to a total of 100 c.p., but the current consumption must in each case be the same; any number of lights can be alight at one time, or all can be out together. If the 40 per cent. value is exceeded, the voltage variation across the lamps will vary to an undesirable extent from a minimum when all lamps are alight to a maximum when only one is alight. An arrangement of lamps like this would impose a limit of 1 A consumption upon any consumer, and any attempt at taking more by interfering with the wiring would only result in the diminution of the total candle power. The substitution of a lamp of greater current consumption in any particular holder would upset the balance of the group, and would only result in a decreased light.

The cost of the condenser is very little, and decreases with an increase in frequency. The circuit conditions are such that a leading current is always taken from the mains, which will usually be looked upon as an advantage, as it will counteract the lagging current due to induction motors, transformers, &c., and result in a tendency to level up the power factor towards unity.

Assuming all lamps to be alight, the circuit consists of a capacity and resistance in series, when the power factor will probably be in the neighbourhood of 0·5 per cent. leading. As lamps are switched out by short-circuiting them, the angle of lead will increase until, when all lamps are out, 90° is reached.

The calculations involved are quite straightforward. The voltages across the condenser, resistance (lamps), and across the two together are connected together as follows:—When the supply voltage $= E_s$; condenser voltage $= E_k$; lamp voltage $= E_r$; then $E_s^2 = E_k^2 + E_r^2$. The lamp voltage and supply voltage being known, the voltage across the condenser will then be $E_k = \sqrt{E_s^2 - E_r^2}$. The capacity of the condenser will be $K = 1/2 \pi f E_k$, when I is the normal current consumption, f = supply frequency, and E_k is the condenser voltage calculated from the previous equation. The current variation between the limits of one and all lamps alight can be obtained from the equation $I = E_s/\sqrt{E_r^2 + [1/2 \pi f K]^2}$, where E_r is the total rated voltage of the lamp or lamps connected in series.

HIGHLAND HYDRO-ELECTRIC SCHEMES.

In an article contributed to a recent issue of the *Glasgow Herald*, Mr. A. Newlands, engineer-in-chief, Highland Railway Co., dealt very fully with the work to be undertaken in connection with the two large hydro-electric schemes in which the highland lochs are to be employed.

The first of these schemes is that formulated by the British Aluminium Co. in its Lochaber Water Order. The plans of this company provide for the conversion of Lochs Laggan and Trigg into storage reservoirs. Loch Laggan is about seven miles long by an average width of half a mile. It has a superficial area of about 1,900 acres or three square miles, and its height above sea level is 819 feet. Loch Treig is approximately five miles long by half a mile wide, has a surface area of 1,500 acres, and stands 784 feet above sea level.

The scheme provides for an extension of Loch Laggan at its western end by the construction of a dam 26 ft. high across the Spean about half a mile from its outlet from the loch. The level of the loch is not to be raised. Loch Treig is to be raised 35 ft., *i.e.*, to the level of Loch Laggan, and the two lochs are to be connected together by a tunnel three and three-quarter miles long, so that they will together form one great reservoir. Powers are asked to run down Loch Treig 124 ft., and Loch Laggan may be run down about 20 ft.

The drainage area of Loch Laggan is to be supplemented by diverting into it the flood waters of the Spey, the Markie, and the Mashie, which at present flow to the river Spey. This involves the building of a dam 29 ft. high below the junction of the Markie with the Spey. All the waters of the Treig are to be utilised, as are also the waters of the Spean, with the exception of those flowing into it from the north, between its junction with the river Treig and the sea. From Loch Treig a tunnel 15 miles in length on an easy gradient of about 1 in 2,000 under the north shoulder of Ben Nevis will convey the waters of the combined lochs to a point overlooking Loch Linnhe, where they will be delivered to a generating station one and a quarter miles distant, to be built in the "Black Park" on the shore at Loch Linnhe near Ben Nevis Distillery. This tunnel will pass under the streams flowing off the north face of Ben Nevis, and the waters of these streams will enter the tunnel by way of vertical shafts.

A diversion one and a quarter miles in length of the West Highland Railway at Loch Treig is involved, and also powers to supply and sell electricity to outside authorities and persons are asked for.

The other scheme is contained in the Grampian Electricity Supply Order, which is to be presented to Parliament during the forthcoming session. In this scheme it is proposed to utilise Lochs Ericht and Garry in Perthshire, and Lochs Pattack, Cuaich, and Seilich in Inverness-shire as storage reservoirs. The most important of these lochs is Loch Ericht. It is 14½ miles long by an average of half a mile wide. Its surface area is approximately seven and a quarter square miles, and its height on ordnance datum is 1,153 ft. Loch Garry is two and a half miles long by quarter of a mile wide, and stands at an elevation of 1,359 ft. The others are smaller, but some of them stand at greater elevation, the levels of Loch Seilich being 1,390, Cuaich 1,302, and Pattack 1,386. Loch an Duin on the county boundary between Inverness and Perth is a small loch about 100 acres in extent at an elevation of 1,590 ft.

It is proposed to raise Loch Ericht 57 ft., *i.e.*, to 1,210 on ordnance datum, by damming it at each end, and the new water level will be such as would permit any overflow water to cross the water shed at Dalwhinnie and flow to the Truim and thence to the Spey, and there is physiographical evidence to show that in ancient times Loch Ericht actually did discharge into the Spey. In the present scheme, however, overflow waters will be made to flow into the Ericht as at present. Loch Pattack is to be raised 29 ft. by damming its existing outlet, and, by means of a tunnel, made to discharge the waters of its gathering area—and others led into it—into Loch Ericht; Loch Seilich is to be raised 55 ft. by a dam 110 ft. high some distance from its outlet, but Loch Cuaich is not to be raised.

Loch Garry is to be raised 71 ft. by a dam 79 ft. high, and the impounded waters are to be led in a tunnel along the southern slope of the Grampian range of mountains which extends eastward from Dalnaspidal to a point in Glen Bruar between Struan and Blair Atholl, where a reservoir is to be constructed by building a dam 107 ft. high across the river, from which reservoir the water will be delivered to a generating station to be built on the banks of the River Garry near the west lodge to Blair Castle at an elevation of approximately 450 ft. The waters of all the streams discharging into the river Garry from the east will be intercepted and stored in reservoirs built on each of them and delivered into the tunnel referred to through vertical shafts in the same way as is proposed for the Lochaber scheme. The surface levels of all these reservoirs, from Loch Garry to and including Bruar reservoir, are to be at the same level as Loch Garry, viz., 1,430 ft. on ordnance survey datum. A high-level reservoir having a surface level of 1,750 ft. is also to be constructed by an enlargement of Loch Mhuire on the river Tarf, a tributary of the Tilt. The construction of this reservoir involves the building of three dams 66, 89, and 130 ft. high respectively. Various streams rising on the Grampian watershed will be led into this reservoir, the combined waters of which will be led to a generating station on the Bruar reservoir, into which the tail race will discharge.

The total length of tunnelling involved is approximately 30 miles.

Provision is made for five generating stations:—

(*a*) On the shores of Loch Rannoch at the mouth of the river Ericht. This will deal with the water impounded in Loch Ericht.

(*b*) On the shore of Loch Ericht where the waters from Pattack enter the loch.

(*c*) On Loch Cuaich where the waters collected in and near to Loch Seilich are delivered into Loch Cuaich. This water after passing through the turbines is to be conveyed into Loch Ericht.

(*d*) On the Bruar reservoir already referred to.

(*e*) Near West Lodge, Blair Castle, already referred to.

An interesting engineering feature of these schemes is the adoption of pressure tunnels as aqueducts in place of open flumes. The construction of these tunnels will involve the sinking of shafts into them in order that work may be engaged in simultaneously at many points. The route is so arranged that these shafts can be sunk from the beds of streams crossing over the tunnel, and the gradient of the tunnels is such that the open mouths of the shafts will be at a higher level than that of the reservoir from which the tunnel starts.

In this way the full head of water between the reservoir and the turbines can be maintained without loss—beyond frictional loss—and flood water as well as the ordinary run-off of the streams can be taken into the tunnel as desired, thus conserving the stored water in the reservoirs against dry spells.

It will be noted that there is some overlapping in the claims of the promoters. The Lochaber scheme is confined to the county of Inverness, but contemplates diverting part of the waters of the Spey Basin into the Spean. The promoters of the Grampians scheme, which is a public utility project, seek constructional powers in the counties of Inverness and Perth, and powers to distribute and sell energy in an area of supply which includes part of the county of Inverness, viz., the parishes of Kingussie and Inch and Laggan, the whole of the counties of Perth, Kinross, and Forfar, the parishes of Lismore and Appin in Argyllshire, and certain parishes in Stirlingshire as far south as Kirkintilloch. Their proposals also involve the diversion of the waters in and around Loch Pattack from the Spean—Lochaber's scheme—to the Tay Basin, and they also wish to divert part of the waters of the Truim and the Tromie, tributaries of the Spey, into Loch Ericht and thence to the Tay.

There will very probably be opposition to these proposals to divert water from its natural gathering area into another area, and the County Council of Inverness has already decided to lodge objection to the schemes on these grounds. At this stage such opposition is more or less formal, and is for the purpose of securing a locus in order that protective clauses may be got when the hearing before committee takes place. It is very probable that similar objections may be lodged by other bodies for the same reason.

The power derived from the Lochaber scheme will, of course, be devoted principally to the purposes of the British Aluminium Co. The aims of the promoters of the Grampian scheme are indicated in their application. They are to be a public utility company, and their area of supply is defined in their application. It is popularly believed that Dundee, Perth, and other towns will provide an already existing market for the power, but, as in the case of the Lochaber scheme, local interests within the "area of origin" will doubtless see to it that reservation of such a block of power as is necessary for the development of their territory is secured.

Spanish Electrical Developments.—According to recent statistics, the total power yielded by existing installations in Spain is as follows:—Installations of 800 h.p. and above, 577,192; installations of 300 to 800 h.p., 28,162; installations of less than 300 h.p., 13,402—or a gross total of 618,756. Installations in course of construction, not reckoning those below 5,000 h.p., stand for 259,000 h.p., and applications for fresh concessions are always numerous. The total before the war was only 150,000 h.p.

JOINT ELECTRICITY AUTHORITIES.

We recently abstracted the leading particulars of the first scheme that has been formulated for the formation of a Joint Electricity Authority for the purposes of the Electricity (Supply) Act, 1919, namely, that referring to the West of England District.[*] A number of other schemes have now been prepared, but as they had not, at the date at which they had to be submitted to the Electricity Commissioners, been considered by some of the local authorities concerned, we are not at liberty to publish details thereof. Two schemes, however, are excepted, and they are abstracted hereunder. It will be seen that in the main they are somewhat similar to what may be termed the Bristol scheme, although they differ in one important respect; that is to say, in addition to the administrative and financial organisations to be adopted, technical proposals are also outlined. In what follows we shall only deal with those portions of the schemes which differ from the provisions of that proposed for the Bristol area.

Mersey and West Lancashire Scheme.

The scheme referring to this area (see our issue of July 23rd, p. 106) provides that members of the Joint Authority who shall be appointed or elected by local authorities shall be entitled when attending the meetings of the Joint Authority or the committees thereof to be accompanied by one official of the local authority by whom such member shall be appointed, or in the case of members elected by more than one local authority, by one official of one of the local authorities taking part in the election, such official to be selected by the member and shall not be entitled to vote, but in other respects may take part in the proceedings as if he were a member of the Joint Authority.

The Joint Authority may provide, let for hire, manufacture, sell, or otherwise deal in electric lines, fittings, apparatus and appliances for lighting, heating and motive power, and for all other purposes for which electricity can or may be used, and may connect, repair, maintain, and remove the same, and with respect thereto may demand or take such remuneration or rents and charges and make such terms and conditions as may be agreed upon between the Joint Authority and the person, company, or firm to or for whom the same are sold, supplied, let, connected, repaired, maintained, or removed.

The Joint Authority shall provide for the supply of areas not forming part of the area of supply of any authorised undertakers, either by including such areas in the district of adjoining distributors or supplying such areas direct, or in such other manner as they may with the approval of the Commissioners determine.

The Joint Authority, when formed, will proceed in stages, the first stage will be to interlink the generating stations of the authorised undertakers for the following county boroughs, viz.: Bootle, Birkenhead, Liverpool, St. Helens, Wallasey, Warrington. From this combination, extensions will be carried out when necessity arises. At a later stage it is proposed to link up the Joint Authority's undertaking with the United Alkali Co., the Mersey Power Co., and through the area now supplied by the Mersey Power Co., with Ellesmere Port, and thence through Birkenhead to a junction with the mains running from Liverpool to the Cheshire side of the river Mersey.

The system of supply to be adopted will be 3-phase, a.c., 50 periods. The main transmission pressure suggested is 33,000 volts stepped up from the generated pressure, which at the present time is in the majority of the stations 6,600 volts. An immediate pressure may be required on certain routes, but the necessity for it has not yet arisen. A list of the proposed transmission mains is given.

Ultimately a connection will be made between Prescot and the Mersey Power Co. when development of the load warrants it. It will also be necessary to provide for transformers, and a list of them, together with the necessary switchgear is set out. The Joint Authority will link up the main generating stations in the area referred to above with 33,000-volt mains, and as the load develops in other areas extensions to those areas will be made.

The following extensions of plant in connection with the main generating stations referred to are in course of construction: St. Helens, one 5,000-kW; Warrington, two 6,000-kW; Liverpool, two 12,500-kW; Wallasey, one 5,000-kW sets.

Until the new proposed capital station is running, all the existing stations will be required, but eventually certain of the stations will be shut down. The Joint Authority proposes that a new capital generating station should be installed in Liverpool on the riverside. Electrical energy will be generated at 6,600 V, 3-phase, 50 periods, with step-up transformation to 33,000 V for main transmission.

The maximum load estimated for the year 1925 for the main generating stations included above is 155,000 kW and the maximum load that can be provided for in 1925 by the individual undertakings with the extensions at present sanctioned will be 87,000 kW, a difference of 68,000 kW, which will have to be provided for the winter of 1925 The Joint Authority proposes to instal in the new capital generating station four 25,000-kW turbo alternator sets, which will provide one 25,000-kW set as spare. In the existing generating stations, when the proposed extensions are completed, it is estimated there will be 29,000-kW of spare generating plant installed, a total of spare generating plant available of 54,000 kW.

It is proposed to apply to the Ministry of Transport to proceed forthwith with the erection and equipment of the first section of the new capital generating station. The scheme will be capable of providing for railway and tramway requirements as and when the demand arises.

The Wirral Scheme.

This scheme is to be submitted in opposition to the abovementioned one, and it is proposed to include in it only the south-western portion of the area already delimited by the Commissioners, comprising the county boroughs of Birkenhead and Wallasey, the urban districts of Bromborough, Higher Bebington, Hoylake and West Kirby, Lower Bebington, Neston and Parkgate, and the rural district of Wirral.

In this case it is provided that the Joint Authority shall consist of only 18 members of whom 11 are to be appointed by the local authorities specified above; one each by Caldy Manor Estate, Ltd., Mersey Docks and Harbour Board, Cammel, Laird & Co., Ltd., Lever Bros., Ltd., railway companies using electricity, and two by other large consumers than those specified above.

This scheme assumes a large consumer to be a person, firm, or company whose consumption exceeded 100,000 units during the year preceding the date of the election.

As in the case of the Mersey scheme, certain of the provisions made in the Wirral scheme differ from those proposed for the Bristol district, but conform to those made in the Mersey scheme, especially with regard to the technical provisions. At the Wallasey generating station an extension of one 5,000-kW set is in course of construction. The maximum loads estimated for the year 1925 for the stations included in the area are: Birkenhead, 11,000; Wallasey, 12,000; Hoylake and West Kirby, 750; a total of 23,750 kW. The maximum load that can be provided for in 1925 by the individual undertakings with the extensions at present sanctioned will be 10,000 kW, a deficiency of 13,750 kW. It is, therefore, proposed to install in the Wallasey station three more 10,000-kW sets with boilers, condensing plant, and switchgear complete.

The saving that it is estimated will be effected by the proposed scheme is that if the 6,300,000 units sold by the Birkenhead Corporation in 1919 were generated at the proposed Wallasey station there would be a saving of £11,450 per annum in generating costs. The cost of cables would be approximately £30,000 or, say, an annual cost of £3,000, showing a saving of £8,450 per annum. The district of Hoylake and West Kirby is about six miles from the Wallasey generating station. If the 600,000 units sold by the Hoylake and West Kirby District Council, in 1919, were generated at the proposed Wallasey station there would be a saving of £2,500 per anum in generating costs. The cost of cables would be approximately £12,000 or, say, an annual cost of £1,200, showing a saving of £1,300, which, added to the aforesaid sum of £8,450, shows a total saving of £9,750 per annum.

WIRELESS RECEPTION BY TASTE PERCEPTION.

Practically all reception of wireless telegraph signals of a practical nature which has been done up to the present time has been accomplished by means of the sense of hearing of the operator. Attempts have been made to use the sense of sight for the purpose, but it has not been found sufficiently satisfactory to warrant its use in practice. The object of a paper recently presented to the Institute of Radio Engineers, New York, by Messrs. A. N. Goldsmith and E. T. Dickey was to describe the tests made to determine the feasibility of Mr. A. A. Isbell's suggestion that under certain operating conditions, *i.e.*, great interference due to external noise, it might be advantageous to employ the operator's sense of taste for receiving wireless telegraph signals. For the following abstract of the results obtained we are indebted to the *T. & T. Age*.

That a stinging sensation is produced when the two wires of a low potential electric circuit are placed on the tongue is a well-known fact. The first problem, then, was to design a pair of electrodes which could be kept in the operator's mouth for a considerable time, and which would not form injurious metal salts. Tests were made to determine the best position, pressure, and size of contact for the electrodes, and it was found that when using either d.c. or 60-cycle a.c. it was better to have the electrodes slipped over the upper front teeth, rather than to place the tongue between them. In this position one contact touched the inner part of the upper lip, while the other could be conveniently touched by the tip of the tongue.

When using signals from a buzzer source, and antenna, the arrangement just described was apt to cause painful sensations in the operator's front teeth. In an effort to prevent this, a disposition having the ends of both contacts touching the tip of the tongue gave very good results. The electrodes should be small and close together so as to confine the taste sensation to a small area of the tongue. Two pieces of number 16 silver wire 0.5 in. (1.27 cm.) long, separated about 0.125 in. (0.31 cm.) and partially embedded in some insulating material make very satisfactory electrodes for actual signal reception.

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[*] Elec. Rev., December 24th, 1920, p. 809.

The highest speed which the operator found it possible to receive by taste reception was five words per minute, and in order to do this it was necessary to become accustomed to this method of receiving, for it is quite dissimilar to audio-reception. It is possible that with sufficient practice an operator might be able to receive at a rate of ten words per minute by taste reception. It is doubtful, however, if the speed could be increased much above that. The reason for this is what might be called the "lag" of the taste nerves.

In the tests using d.c. and 60-cycle a.c. it was found that about 2 volts potential was necessary for workable taste signals. The measurements made with d.c. indicated that this potential produced a current of about 0.25 milliampere in the mouth electrode circuit. In other words, the energy necessary for readable taste signals was about 500 microwatts.

For receiving outside signals, an ordinary inductively coupled vacuum tube receiver was employed. The antenna used was a single wire, 150 ft. high and 180 ft. long.

With four stages of amplification it was possible to get taste sensations from all signals, the audibility of which in the detector circuit was 500 or more. The higher the audibility of the signal, the stronger was the taste sensation produced. The strongest signal received had an audibility of 5,000 in the detector circuit. The taste sensations resulting from this signal were not strong enough to cause discomfort for the operator. Whether or not a signal might be obtained of sufficient intensity to cause discomfort to the operator, would depend on the amount of energy which the last stage of the amplifier could handle.

As the signals received were commercial messages, their speed prevented them from being read by taste reception, but the intensity was sufficient to permit of their having been read had the sending been slower. It would be impossible to read through interference with the taste receiver unless one signal was quite strong and the other almost unnoticeable. Strong strays would probably cause signals to become unreadable.

From the point of view of electrical operation, taste reception is possible. It is possible to amplify sufficiently a signal having an audibility of 500 in the detector circuit to cause it to produce taste sensations. It is possible to read signals by the sense of taste if they are sent at a low speed (about five to ten words per minute).

CORRESPONDENCE.

Letters received by us after* 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

German Competition in the Electrical Trades.

I certainly have not overlooked any of the facts affecting the isoperimetrical problem which Messrs. E. P. Allam & Co. have evidently not studied seriously, as yet; and it is conceivable that their determination to refuse German offers—"not touch them with the end of a barge pole"—may have something to do with "the daily processions of the unemployed."

Let us try to get at the *truth*, and avoid all personal remarks. Will Messrs. E. P. Allam & Co. kindly say :—

1. How can Germany pay her war-debts to this country except by sending us goods?
2. Is it not a fact that the cheaper the goods the greater the quantity that must be sent?
3. Do "Rings" "enable the home buyer to have cheap goods, and, at the same time, enable the manufacturer to compete successfully in the world's markets"?
4. If "dumping" ruins this country, why do we not dump in self-defence?

W. H. M.

January 1st, 1921.

We should also like to tender our thanks to you for your leading article on this subject, and to endorse all that Messrs. E. P. Allam & Co. say in their letter in your issue of December 31st.

We wonder if "W. H. M." is a merchant or manufacturer—if the latter, we should be very interested to hear his views as to how he would meet the German competition, assuming that he is producing his goods with modern high-speed machinery and a thoroughly conscientious and hard working set of employés, and that after he has done all possible to reduce costs, he still finds these dumped German goods are being sold in this country at very much less than the cost of production here.

It would seem, according to "W. H. M.'s" letter, that we must thank Heaven that our trade is being destroyed and our country flooded with cheap German goods, that millions of pounds' worth of valuable new machinery is absolutely idle, and that hundreds of thousands of our workers are walking the streets starving and out of work, whilst the Hun dumps his finished goods into our free market, adds to our unemployed in this country and contributes nothing towards relieving our taxation.

All British.

A Generator Problem.

I am indebted to Mr. Robertson and Mr. Besley for their letters on the above in this week's Review. I have not tried the voltage across the shunt field as Mr. Robertson suggests, but will do so at the earliest opportunity. The fields of the motor and of the generator are connected N to N and S to S; if these connections are reversed, it is only possible to get 25 per cent. of the full rating.

The compound is not connected to the series winding as is usual with self-exciting machines, but is practically only a lead from the armature to the terminal box, with the usual windings around the field; the same results in every way can be obtained by disconnecting the compound and having a lead direct from the armature to the terminal box, hence my question: What is the reason for the compound winding? I quite agree with Mr. Robertson that "the compound winding is for the purpose of regulating the voltage under varying loads" if this machine was self-exciting. It being connected for separate excitation, it is impossible to cut out or short-circuit the series winding as Mr. Robertson suggests.

Several days were spent in testing by myself, another firm of electrical engineers, and also the engineer called in by our customer, so I am satisfied that the connections are correct. I am of the same opinion as Mr. Besley, that this machine is designed for separate excitation; why it will run as a motor and not as a generator is beyond me.

Wireman.

January 1st, 1921.

A Curious Phenomenon.

You will be interested to know, I feel sure, that shortly after the publication of my letter under the above heading, the Sectional (Leicester) Engineer of the Post Office telephone system sent one of his men to examine the earth wire of the Post Office telephone instrument fixed in my house, although the phenomenon in question occurs elsewhere.

I only give you this information to show how eagerly your paper is scanned through immediately it is published.

I also think that it is a feather in the cap of the sectional engineer, with whom personally I am unacquainted, and tends to show that Government officials are sometimes on the *qui-vive*, although sometimes we may assume the contrary to be the case.

I have not yet had time to carry out further experiments in this connection, but will do so at the first opportunity, and afterwards report the results to you.

J. Knowles Hassall.

Rotherwood.
January 1st, 1921.

The Cost of Living on the Gold Coast.

Will you kindly insert in your next issue (if possible) a few particulars regarding the Gold Coast? :—

Climate conditions throughout the year.

Cost of living, food, clothing, &c., and any other particulars available.

'Phone Engineer.

[We regret that we have no up-to-date information on this subject. We shall be glad to receive communications from any of our readers who possess a knowledge of the conditions obtaining on the Gold Coast.—Eds. Elec. Rev.]

To Correct an Impression.

Will you kindly permit us to make use of your columns for the purpose of correcting an impression which has gained ground to the effect that J. B. Saunders & Co., Ltd., have amalgamated with Twiss Electric Transmission, Ltd.? The incorporation covers the *transmission-line business only* of the former company. Otherwise J. B. Saunders & Co., Ltd., retain their individuality, and carry on their railway telegraph and telephone maintenance and construction business, as has been the case without interruption since 1857.

Sydney G. Leech.

London.
January 3rd, 1921.

Switches for Gasfilled Lamps.

We should be glad if any of your readers could give us information with regard to switches suitable for use with gas-filled lamps. Ordinary tumbler switches we have found unsatisfactory due to burning of the contacts. Rotary snap switches are difficult to get at the moment, and are also difficult to fix in a neat arrangement when mounted in groups of six or more together. We do not think there is any satisfactory box for groups of such switches when recessed for sunk work, or when mounted in iron boxes and covered with surface plates for factory work. We ourselves have not had sufficient experience with clock make-and-break tumbler switches to say whether these are satisfactory or not. A few inquiries have led us to the conclusion that the same state of ignorance and doubt exists amongst other contractors, and we think personal reports, from anyone who has had experience, would be of general interest.

Tyler & Freeman.

London.
January 3rd, 1921.

Home Lighting Economies.

I think a warning should be given to any of your readers who may be tempted to adopt "Voltman's" suggestion, on page 827 of your current issue, for the economical illumination of inaccessible places and dark recesses. The flexible and the miniature switches and lamp holders usually associated with 4- or 6-volt lamps are quite unsuitable for connection to a 230-volt circuit, and it should be remembered that although the shunted circuit is only occasionally in actual use, it will always be alive to the full pressure. The recesses referred to are among the last places in which such unsatisfactory fittings should be permitted, and I would advise "Voltman" to remove every part of his economy extensions that is not strictly in accordance with the I.E.E. wiring rules, and to make a beginning with that dark cupboard under the wooden staircase which leads to his bedrooms.

There is a further fire risk due to the accumulator cells "boiling" nearly dry—for instance, when they are not regularly "topped up" or when the house has been closed for a week-end and the main charging lamp left alight. There are several recorded instances of fires due to the prolonged charging and overcharging of small celluloid cells.

It is feared that economies of the kind suggested are those that are often paid for a thousand-fold by other persons—in this case the fire insurance companies.

E. R.

January 3rd, 1921.

Re Home Lighting Economies in this week's Review, I should like to point out to "Voltman" that when tantalum lamps first came in I tested several large installations in order to prove to the owners the saving that could be effected by using these new lamps, and the average watts per candle with the carbon lamps in use were well over six.

If, as it would appear, "Voltman" is not particular about initial expense, why not fix a few 230-V m.f. lamps in series and use intermediate switches in each room? He could then light all his rooms at the cost of one lamp.

C. A. Copinger.

Bentham.
January 2nd, 1921.

Mr. Luckiesh and the Sheringham Daylight.

I shall be greatly obliged if (in the interests of fair comment) you will allow me to publish a few words on the extract you published in your last number from Mr. Luckiesh's letter (about my invention) to the *Electrical News* of Toronto.

In this letter Mr. Luckiesh has adopted a course, somewhat unusual among scientists, that is of passing judgment on my invention before he has had an opportunity of seeing and testing it. He refers in his letter to some unsuccessful experiments he made with reflectors seven years ago; his deductions about "the Sheringham Daylight" invention must be influenced by his own lack of success in the application of reflectors, as he has had no first-hand experience of my invention.

Of course, we all know and appreciate at its full value his development of the British transmission lamp, which was invented by Mr. Dufton and Prof. Gardiner at Bradford, about 1895, and which Mr. Luckiesh describes, no doubt scientifically, as "straightforward."

The "millions" of colour-matching units, which Mr. Luckiesh refers to, are, of course, lamps that do not attempt to reproduce north sky light, and he himself describes them as only "fairly efficient"—see *The Illuminating Engineer*, February, 1920.

George Sheringham.

London.
January 3rd, 1921.

The Salaries of Works Engineers.

Apropos of the remarks of your correspondent "Testbed, A.M.I.E.E.," in your December 24th issue, may I be allowed to inform him that the E.P.E.A. does already possess a section for works engineers?

If "Testbed" or any other engineer interested cares to communicate with me through you, Sirs (in the first instance), I shall be glad to give any information or assistance.

Industrial.

Norbury.
December 28th, 1920.

LEGAL.

Unemployment Insurance.

At Padiham, Messrs. Simpson Bros., electricians, Hapton, were proceeded against under the Unemployment Insurance Act. There were 16 cases. An inspector called at Messrs. Simpson's works and found 135 workpeople's unemployment insurance books in arrears. In eight instances the books were impounded.

Mr. Waddington explained that it was a matter of neglect on the part of a girl clerk. The stamps were purchased, but the clerk had neglected to put them in the books. That constituted the whole offence. Although Mr. Simpson offered to put the stamps on, the inspector declined to agree. Mr. Waddington complained that from September 8th till now the Ministry had detained the eight impounded books, thereby preventing the firm from stamping them.

Defendants were fined 25s. in the first case, and ordered to pay two guineas advocate's fee, and costs in the remainder. They were also ordered to make good the arrears of stamps.

WATER POWER ON THE CONTINENT'

France.

As a result of the possibility of the world coal shortage hindering the re-establishment and development of the national industries, the French Government, shortly after the signing of the peace treaty, decided that it would be necessary to utilise on a greater scale than hitherto the water power resources of the country.

The problem being an extensive one, needing consideration from the technical and financial points of view, as well as the administrative one, a Commission was appointed in August 1919, to study the whole question and report to the Superior Council of Public Works. The report has now been presented, and although it is not possible to give it in full, the following points of detail taken from it, for which we are indebted to the *Moniteur des Intérêts Matériels*, may be of interest.

Naturally the question of finance comes in for early reference. Pre-war estimates put the cost of hydro-electric plant at from 500 to 800 fr. per h.p.; to-day the cost would be from 1,000 to 1,600 fr. per h.p. Therefore, to establish plant equal to 3,000,000 h.p., such as, it is considered, would be necessary to attain the desired object, would entail an expenditure of from 3,000,000,000 to 4,800,000,000 fr. The absence of a sufficient supply of materials is not so much feared as that the cost of plant at present prices would be prohibitive.

It is estimated that before the war over 1,000,000,000 fr. had been invested in hydro-electric plant in France—525 millions in light and power installations, 100 millions in electrochemistry and electrometallurgy, 75 millions in traction, and 300 millions in connection with small industries. During the war and since the armistice, considerable progress has been made, plant to the extent of 500,000 h.p. having been put down between 1914 and 1918, so that at the present time at least 2,000,000,000 fr. must be invested in hydro-electric plant in France.

The Commission recommends that the formation of *concessionnaire* companies should be facilitated by the granting of subsidies, and that these should be a direct charge on the Government Budget, instead of the so-called subsidies on which the *concessionnaires* have to pay interest and make repayment over a term of years. The Commission considers that in this way the *concessionnaires* would be encouraged, as they would not have to bear a heavy financial load which could only result in an increased cost of production. The Commission also recommends that companies which undertake the establishment of hydro-electric plant should be exempted from taxation for a period of five years, and that the Government should arrange with the Crédit Foncier to advance loans in respect of the utilisation of all State and private waterfalls, and finally that the Government itself should participate in the formation of undertakings, sharing in the advantages, risks, and difficulties.

The report does not deal at any great length with the technical problems. It recommends, however, that steps should be taken to extend the teaching of electrical work in the Grenoble, Toulouse, and Nancy districts by subsidies from the State and the electrical industry. It also points out that one of the hindrances to the development of water power for electricity generation is the considerable variation in the supply of water, and suggests that if the Government cannot see its way to undertake the construction of large reservoirs itself, it should grant subsidies to the *concessionnaires* for this purpose.

The Commission takes the view that the public interests must be considered before those of private enterprise, and that legislation will be necessary to deal with existing concessions and any rights which may have been granted previously, while as regards the future, it recommends that no concessions be granted for hydro-electric installations which do not contribute to the useful extension of electricity supply.

Holland and Norway.

There are two countries which are working in the direction of becoming independent of foreign supplies of coal at the end of ten years from the present time, these being Holland and Norway. In the case of the former, it is expected that apart from the great electrical generation and distribution schemes which are proposed to be undertaken by a semi-State or public authority, the national deposits of coal will have been so far developed that no deliveries of coal will be required from other countries at the expiration of a decade. On the other hand, Norway, which under normal circumstances is compelled to import about 2,500,000 tons of coal per annum, hopes to be able to substitute electric power for most of this quantity, leaving only 800,000 tons of coal needed for shipping, for the production of carbide, and for domestic consumption, after the lapse of ten years. It is, moreover, reckoned that the latter quantity will be obtained from Spitzbergen, which is now vested in Norway, so that in 1930 the latter country will be independent of British and other coal.

The State Water Power and Electricity Administration has under consideration draft regulations and a scheme for the electrification of the country, and is also dealing with the question of the exportation of energy—and that, too, at a time when the existing hydro-electric and steam generating works are unable to meet the home demand. It is, therefore, contended that before thinking of exporting energy the inland requirements should first be satisfied, the needs of industry and agriculture be met, and the railways converted to electric traction, so as to be able to escape the enormous expenditure on imports of coal. It is suggested that practical men should be empowered to proceed to solve the problems of (1) utilising the existing hydro-electric works to the fullest extent and erecting new transmission lines; (2) the regulation of water courses and the installation of more machinery where falls are already in use; (3) the completion of extensions which have been in progress for a long time; and (4) the transformation to electrical working of the railways having the heaviest traffic to transport.

The A.S. Tyssefaldene two years ago offered to supply Christiania with 100,000 H.P. on certain terms, and by request the company has just made a fresh proposal, but the price per KW. delivered is now more than twice that offered in 1918, owing to the high cost of machinery which would have to be installed for the purpose. The Akerhaas County Council has approved an agreement with the Christiania Savings Bank approved an agreement with the Christiania Savings Bank under which the latter will advance to the former a loan of 20,000,000 kr. for the hydro-electric works at the Raanaas waterfalls in Glommen, which is involving a total expenditure of 45,000,000 kr., and is expected to be completed in the winter of 1921-22.

BUSINESS NOTES.

Company Liquidations. — Electrical Engineering Society, Ltd. (late Electrical and Mechanical Co-operative Trading Society, Ltd.), South Castle Street, Liverpool.—At a meeting of creditors held recently in Liverpool, the statement of affairs presented by Mr. A. J. Glass, liquidator, showed liabilities of £1,903, of which £1,522 was due to trade creditors, while the bank was interested for £159, and there were cash claims of £223. The assets were estimated to realise £897, from which had to be deducted £78 for preferential claims, leaving net assets of £819, or a deficiency as regarded the unsecured creditors of £1,085. The assets consisted of:—Cash in hand, £10; stock-in-trade, £162; work in progress, £50; fixtures and fittings, £20; book-debts, £681, expected to produce £624; and unpaid calls, £31. The liquidator further stated that the business carried on was commenced by a number of members of the Electrical Trades Union about the beginning of 1919. In June of the same year the Society was registered under the Industrial and Provident Societies Act. The deficiency shown in the statement of affairs was accounted for by losses up to January, 1920, £566; depreciation written off the assets, £106; preliminary expenses, £9; and loss since last January, £1,281. It appeared that difficulties had been encountered in raising capital from time to time, and loans had been received from members. Last August the Society tendered for, and obtained, a large contract with a local co-operative society. With the exception of that contract, the other work carried out during recent months had been small. The sales had recently fallen off owing to the shortage of stock. After discussing the position the creditors passed a resolution in favour of Mr. P. S. Booth, Liverpool, being appointed to act as a joint liquidator, while a committee of inspection of three of the principal creditors was also nominated.

Detinning Processes, Ltd. — A meeting of creditors is called for February 3rd, at 41, Finsbury Square, E.C., to hear an account of the winding-up from the liquidator, Mr. H. C. Merrett.

Electrical Industries, Ltd.—A petition for the winding up has been presented to the High Court by Messrs. R. Johnston and Co., Ltd., of 92-3, Fore Street, E.C., and will be heard in London on January 18th.

Pritchett & Gold and Electric Power Storage Co., Ltd.—(Voluntary liquidation for the purpose of the sale of the undertaking to Pritchett & Gold and Electric Power Storage Co., Ltd). Meeting of creditors January 19th, at 50, Grosvenor Gardens, S.W. 1. Liquidator, Mr. A. W. Woodward.

Trade Announcements.—Messrs. Beckett & Parker, electrical instrument manufacturers, of 157-9, Summer Lane, Birmingham, have appointed Messrs. Baxter & Caunter, Ltd., their agents for London, Eastern and Southern Counties. Full stocks of their specialities will be held at 219, Tottenham Court Road, W. 1, and rapid deliveries are assured of switchboard type instruments.

The Chloride Electrical Storage Co., Ltd., have removed their London offices to 57, Victoria Street, S.W. 1. The telephone numbers, Victoria 442 and 445, remain unaltered.

The Dawson Electrical Installations, Ltd., have commenced business at 7a, Henshaw Street, Oldham.

The Imperial Electric Works will in future (as from January 1st) be known as Browning's Electric Co., Imperial Works, St. Martin's Avenue, East Ham, London, E. 6. Telephone, East Ham 801.

Catalogues and Lists.—The Macfarlane Engineering Co., Ltd., Netherlee Road, Cathcart. — Detailed price-lists of motors—d.c. and a.c squirrel-cage and slip-ring types—for 25 and 50 cycles. Also a list of principal users of Macfarlane motors and dynamos.

Sir W. G. Armstrong, Whitworth & Co., Ltd., 8, Great George Street Westminster, S.W. 1.—Leaflets Nos. 51 52, 53, and 54 illustrating and describing water turbines. Leaflet 51 bears a number of useful notes on turbine and site selection, which we reproduce in our "Notes" columns.

Higgs Bros., Sand Pits, Birmingham.—"Monthly Magazine," Vol. II, No. 10, containing the usual stock list and other features, including notes on the care of windings.

The Electric Heating Co., George Street, Croydon.—An illustrated price-list of "Elect" irons.

R. B. Hano & Co., Ltd., 63, High Holborn, W.C. 1.—A price-list (4 pp.) of electrical fittings and accessories, including cables, conduits, switches, cut-outs, adapters, &c.

Charles Churchill & Co., Ltd., 9-15, Leonard Street, Finsbury, E.C. 2.—An illustrated and priced booklet (72 pp.) dealing with numerous types of "Comet" brand high-speed steel cutters.

Ozonair, Ltd., 96, Victoria Street, S.W. 1.—Pamphlet No. 3—Ventilation. An illustrated note on ozone and its properties, ventilation, and the "Ozonair" system of pure-air ventilation.

The British Rawhide Belting Co., Ltd., Hythe Road, Willesden, N.W. 10.—List "A," giving prices and particulars of various beltings, belt laces, rawhide hydraulic packing, mallets, hammers, pinions, &c.

Scientific Appliances, 11 and 29, Sicilian Avenue, Southampton Row, W.C. 1.—An illustrated catalogue (48 pp.) of scientific apparatus, including Wimshurst machines of a wide range of sizes, electromagnets and parts, telephone apparatus, induction coils and X-ray tubes. Also optical apparatus, comprising spectacles, telescopes, lenses and prisms. Suitable for the use of students or teachers. Price 6d. post free.

T. Bath & Co., Ltd., 18, Savoy Street Strand, W.C. 2.—A sale catalogue of wooden buildings, Army huts, &c.

N. Taylor & Son, 17, Goree-Piazzas, Liverpool, manufacturers of hydro-carbonate bone-black for case-hardening. A booklet (18 pp.) entitled "Case Hardening—What to Use. How to Do It."

The B.E. Co. (of London and Birmingham), Ltd., Hendon House, 57, Upper Thames Street, E.C. 4. — A fully-illustrated catalogue (18 pp.) of electrical accessories, including switches, ceiling roses, adapters, cut-outs, fuseboards, "flex," &c. Code numbers are given in each case, and a key accompanies the catalogue.

X-Rays, Ltd, 11, Torrington Place, Gower Street, W.C. 1.—A priced descriptive catalogue (16 pp.) of Phillips's X-ray tubes of various types—water-cooled, heavy anode, platinum and tungsten targets, &c.

Sterling Telephone and Electric Co., Ltd., Telephone House, 210-212, Tottenham Court Road, W. 1. Publication No. 285.—A profusely illustrated price list (32 pp.) of telephone and signalling apparatus for mines, including telephone instruments, junction boxes, indicators, bells, storage cells, &c.

The Delta Electrical Co., Temple Courts, Temple Row, Birmingham. Publication No. 100a.—An illustrated and priced leaflet dealing with watertight tumbler switches.

Calendars, &c.—Messrs. A. Hawkins & Son, of London Road, Southwark, have again issued one of their wall calendars, with monthly date slips below a picture showing a skein of thread which a lady is winding, with the wording "Held by a thread."

From Mr. P. D. Morris, electrical engineer and contractor, 28, High Street, Islington, N., we have received a polished wood hand blotter and a piece of rubber.

Messrs. J. McMaster & Son, Belfast, have produced an artistic wall calendar, with monthly slips for 1921 below a rustic picture of a mill, entitled "The White Mill."

Messrs. Wood & Cairns, Ltd., 5, 7 and 9, Meuse Lane, Edinburgh, have sent us one of their large wall calendars, with monthly date slips with bold figures on a black ground, each slip showing views of the firm's head office and Glasgow and Dundee branches.

The Westinghouse Electric International Co., of New York, have prepared a large wall calendar, with monthly date slips on a white ground below a reproduction of a painting of the head and shoulders of a lady named "Joan."

The Keighley Gas and Oil Engine Co, Ltd, have sent us one of their wall calendars for 1921, with daily slips with figuring in black mounted on a stout card-base model of one of their "Imperial" engines.

The Holland Insulated Wire and Cable Works, Amsterdam, have sent us a four-sheet calendar bearing rather fantastic black and gold studies of Grecian mythological characters symbolising light, sound, power and heat.

E. Brook, Ltd., of Empress Works, Huddersfield, have issued an attractive hanging calendar, with monthly date slips below a coloured view of their works at night.

C. Isler & Co., artesian well engineers, Bear Lane, Southwark Street, have sent us a large wall calender, with illustrations showing their deep-well boring plant and other specialities.

The British Thomson-Houston Co., Ltd., of Rugby, have again provided one of their large wall calendars for 1921, showing three months on each page, with a view of the works and illustrations of some of their special electrical plant.

Macintosh Cables, Ltd., have issued a neat hanging oval calendar for 1921, with monthly slips below a picture entitled "Peace at Eventide."

From the Modern Business and Equipment Co., of 31, Staines Road, Hounslow, a small hanging calendar, with monthly slips below a coloured illustration of "A Bit of Surrey."

Annual Dinner.—On Tuesday, December 28th, the employés of the Musselburgh and District Electric Light and Traction Co., Ltd., held their annual dinner at the Port Seton Tea Rooms. Mr. H. C. Babb, the engineer and manager, was in the chair. During the evening a presentation was made to Mr. H. Payn, the chief assistant engineer, who is shortly leaving to take up another appointment as engineer and manager. This was followed by a musical programme and dancing.

Book Notices.—"A souvenir of the 25th anniversary of *The Autocar*, 1895-1920" (8 pp. + 4 plates).—The remarkable progress that has taken place in the world of motoring during the past quarter of a century is brought vividly to mind by the appearance of this handsome souvenir booklet. The part played by *The Autocar* in the development of automobilism is briefly outlined in the booklet, which contains also a number of historical motoring illustrations reprinted from early issues of the journal. One of these depicts the first motor drive of the late King Edward VII (then Prince of Wales), which took place in 1898. Other illustrations show the famous Gordon-Bennett Motor Race in Ireland in 1903, and the first of the Tourist Trophy Races, which was run in the Isle of Man in 1905. A number of the pages in the booklet are devoted to a reprint of congratulatory messages received on the occasion of the 25th birthday of *The Autocar*. These bear names that are famous in the annals of motoring, including such well-known pioneers of motoring as Sir David Salomons, Bt., Lord Montagu of Beaulieu, Earl Russell, Sir Arthur Stanley, &c. Not the least attractive feature of the souvenir is a pair of illustrations in colour reproduced from original paintings and depicting 20 years' progress in automobilism.

"The M. & C. Apprentices' Magazine," Vol. 4, No. 16 (76 pp.).—This is the Christmas number of this excellent little publication. Mr. Sam Mavor contributes a long article on "Efficiency in Production"; other articles are notes on railway engineering in the United Provinces, India, "Electrical Engineering in the East," and a number of biographical sketches, &c.

"Hydro-Electric Survey of India, Vol. II. Second Report on the Water Power Resources of India. Ascertained during the season 1919-20." By F. E. Bull and J. W. Meares, M.Inst.C.E., &c. (123 pp.). Calcutta: Superintendent Government Printing, India. Price R. 1·6.

"The Industrial League and Council *Journal*," Vol. II, No. 11. December, 1920, 40 pp. Price 6d.—This issue contains a foreword by Dr. Russell Wakefield, Bishop of Birmingham, reports of meetings, conferences, debates, &c., as well as a number of interesting articles.

"Science Abstracts A & B." Vol. XXIII, part 12, December 30th, 1920. London: E. & F. N. Spon, Ltd. Price 2s. 6d. each.

"Oscillographs and their Tests." (45 pp.) By A. E. Kennelly, R. N. Hunter, and A. A. Prior. Massachusetts: Institute of Technology (Serial No. 22).—A technical description of a method of testing and calibrating oscillographs, using an auxiliary vibrator or "oscillographmeter," whereby the resonant frequency of the tested oscillograph may be readily ascertained. From this and another test the bluntness of resonance is determined. The results of a number of tests are given in the paper.

"Willing's Press Guide"—issued from 125, Strand, at 2s.—is a most convenient alphabetical and classified guide to the Press. That it meets a real want is evidenced by the fact that it has now reached its forty-eighth annual appearance.

"Dental Radiography" (38 pp.) Stratford: Wilson & Whitworth, Ltd. Price 3s. 6d. net.—A handbook for the dental surgeon, including a full description of X-ray apparatus and a simple guide to its use, with diagrams and many illustrations.

"The *Journal* of the South African Institution of Engineers." Vol. XIX. No. 5. December, 1920. 20 pp. Price 2s. net. Includes paper on "Economical Design of Engineering Structures," and discussion.

British Ignition Apparatus Association.—The annual dinner will be held at the Trocadero Restaurant, Piccadilly Circus, on Wednesday, January 12th, at 7.30 p.m.

The People's Union for Economy.—This society has now established its headquarters at 1, King's Buildings, Millbank, Westminster, S.W. 1. It will aim at keeping a watchful eye upon all Government expenditure, with a view to directing attention to overlapping and waste in the Administrative sphere. For this purpose it invites all those who agree with its views to give it their support by joining the Union, and by supplying reliable information of any instances of public waste and extravagance. Forms of membership may be obtained on application to the hon. secretary at the above address.

The Effect of the Eight-Hour Day.—An official report on the effects of the introduction of the eight-hour day in Sweden, states that only one-ninth of the workmen have maintained their full monthly production by increased intensity of labour; about one-half show a reduced production corresponding to the diminished number of working hours; the average decrease in production amounts to at least 6 per cent. According to the Foerening's calculations, Swedish industry as a whole has lost Kr. 150,000,000 since, and owing to, the introduction of the eight-hour day.—*Reuter's Trade Service* (Stockholm).

Tramway Workers' Wages.—The Industrial Court, held on December 7th, to arbitrate upon the claim of the skilled workmen employed in the tramway, electricity, and highways department of the Sunderland Corporation, for an annual holiday of 12 days, with pay, has decided that the claim is not established. The award states:—"According to the evidence, the men concerned are not permanent employés of the Corporation, although they appear to have something like continuous employment. Their conditions of service are not settled by the Corporation, and this appears to establish a distinction between the skilled workers and other municipal employés of classes confined to service in public utility undertakings. The Court gather that it is a feature of employment in the service of the Corporation that skilled men and others similarly placed shall be paid the agreed district rate, and be subject to the general conditions of employment in force in the district. This is, no doubt, well understood by the men on engagement, and they must be assumed to accept service on those terms, although it is, of course, open to the Corporation to introduce, or to agree to, such improvements in the conditions as may be deemed advisable."

Lead Report.—Messrs. G. Cawson & Co. write under date January 1st, 1921:—Our last report was dated December 18th, 1920. Since that date the market has been irregular with some wide fluctuations, with business done down to £21 10s. for prompt and January, and up to £24 15s. for April. The closing is firm with a good demand for prompt and January lead. Final prices are:—

Prompt and January	£23 10 to £23 15
February and March	£24 10 to £24 15
April	£24 10 to £25 0

There has been a large turnover of lead, and shorts have been covering freely. The supply of prompt lead has now become very limited. The heavy arrivals at the end of December seem to have disappeared.

Messrs. James Forster & Co. write:—Although there is talk of hidden stocks in Spain, the reports from that country, and also from Australia, are to the effect that none of the mines can produce at a profit at anything like present values. Values during the last fortnight have been considerably below those ruling in the early summer of 1914, and there is little risk in consumers covering their requirements for some time to come, at current prices.

Anglo-German Debts.—British Nationals, who have registered claims against German Nationals in respect of pre-war debts, will shortly receive a notification from the Clearing Office that the last day for making the necessary statutory declaration in support of their claims is March 31st, 1921. No claim in respect of pre-war debts will be admitted which is lodged after that date, unless the Controller of the Clearing Office is satisfied that the omission to lodge the declaration by the date mentioned arose from circumstances for which the creditor could not justly be held responsible.

German Export Duties.—A decree has been issued at Berlin abolishing the export duties on many engineering and metal products.

A New French Company.—A new company has lately been formed in Paris (25, Rue de Clichy), with a capital of 2,500,000 fr. and the title La Société Francaise pour l'Exploitation des Brevets Bates (Poteaux pour Suspension de Cables Electriques) to manufacture the Bates type of electric mast.

For Sale.—The Great Western Railway Co. have for disposal one 4-pole B.T.H. generator and three slate panels with various connections; Accrington Corporation Electrical Engineering Department invites offers for two 500-kW Belliss-Dick-Kerr compound-wound generating sets; Liverpool Corporation Electricity Supply Department has for sale two 2,000-kW Westinghouse-Parsons turbo-alternators, with condensers, air-pumps and Gwynne circulating pumps; Stoke Newington Borough Council Electricity Department has for disposal a battery of accumulators, with boosters and control board; Shipley Urban District Council Electricity Department has for disposal one Parsons turbine-driven d.c. dynamo direct-coupled with condenser, switchgear; Buxton Corporation Electricity Department invites offers for two Belliss & Morcom generating sets, and one engine only. For particulars, see our advertisement pages to-day.

Forthcoming Exhibitions.—The following exhibitions are being organised:—

Birmingham.—March 21st-May 21st.—National Trades and Industrial Exhibition.

Cardiff.—January 26th-February 5th.—Health and Home Exhibition. (See Electrical Review, October 22nd.)

London.—February 10th to 26th.—"Efficiency" Exhibition at Olympia. (Electrical Review, June 25th.)

London, Glasgow and Birmingham.—February 21st to March 4th.—British Industries Fair. (Electrical Review, August 13th, September 24th, October 8th, November 12th and 26th.)

London.—March and October.—Society of Motor Manufacturers and Traders at Olympia.

London.—April 1st to 30th.—Builders' Exhibition at Olympia.

London.—June 3rd to 17th.—Rubber Trades' Exhibition at Royal Agricultural Hall. (Electrical Review, April 9th.)

London.—July 4th to 15th.—London Fair and Market at Royal Agricultural Hall.

London.—September 7th to 28th.—Shipping, Engineering and Machinery Exhibition at Olympia. (Electrical Review, November 12th.)

London.—November 17th to 25th.—Public Works, Roads and Transport Exhibition.

London.—1923.—British Empire Exhibition. (Electrical Review, May 14th, June 11th, September 24th, and November 5th.)

South Africa.—March 9th to 16th.—Chemical, Metallurgical, and Mining Exhibition in Johannesburg.

British Dominions.—1921.—Dominions Touring Exhibition (South Africa, Australia, Canada, and New Zealand). (Electrical Review, March 26th and August 6th.)

Brussels.—April 4th to 20th.—International Commercial Fair. (Electrical Review, December 17th.)

Ghent.—April 16th to June 14th.—International Exhibition of Architecture, Building, and Kindred Industries. (Electrical Review, September 24th.)

Iceland.—June.—World's Fair.

Lima.—June 1st to October 31st.—International Industrial Exhibition. (Electrical Review, November 12th and December 31st.)

Peking.—March, 1921.—International Exhibition. (Electrical Review, September 10th.)

Lyons.—March 1st to 15th.—Metallurgy, Engineering, Building, &c., Fair.

Mexico.—September.—Commercial and Industrial Fair.

Milan.—April.—International General Manufacturers' Fair.

Utrecht.—September 6th to 16th.—International Fair. (Electrical Review, December 24th.)

Buenos Aires.—1922.—International Exhibition.

Rio de Janeiro.—1922.—International Centenary Exhibition.

The Metal-Filament Lamp and Fittings Industry.—At the meeting of the Illuminating Engineering Society on December 14th, the report of the Committee on Progress in Electric Lamps and Lighting Appliances was presented. It stated that the demand for vacuum-type lamps could now be met for all standard types, and in most cases adequate stocks were available to meet the increased demand due to the cessation of summer time. There was evidence of real development in the exportation of electric lamps abroad, particularly to the British Colonies. The difficulties which previously handicapped the manufacturers, such as the shortage of bulbs and tubing and also the poor quality of these, had been very largely overcome by the increased production of such material in this country. The production of gasfilled lamps had increased five or six times during the last twelve months, and the demand for most of the standard sizes could now be met. Most of the leading manufacturers were rapidly extending their production still further.

During the past twelve months the manufacturers had again been able to give attention to the production of metal-filament lamps for special purposes, such as standard candle lamps, double-ended tubular lamps for window and cornice lighting, and various patterns of reflector type lamps. Such special lamps could now be obtained in any of the standard voltages and wattages without undue delay. The principal manufacturers had introduced a range of suitable fittings for gasfilled lamps to suit all voltages for which such fittings were required, *i.e.*, street lighting, works lighting, the lighting of railway termini or other large areas, and shop-window lighting. They had also introduced a variety of small shades and bowls for use in connection with the lower wattages of gasfilled lamps, which met a very real need for shop-window lighting and the lighting of small areas. By this means the efficient gasfilled lamp was able to be used, the light distributed in the right direction, and all glare eliminated.

Christmas Tree.—In accordance with their usual custom, Messrs. Cunningham, Ltd., of 169-171, Edgware Road, W. 2, gave the children of Paddington Green Hospital an electrically-illuminated Christmas tree, and toys and crackers to each little patient.

Electricity Works Dinner.—On December 18th the staff and employés of the Maidstone Corporation electricity works held a dinner at the Corn Exchange, when the borough electrical engineer (Mr. E. E. Hoadley) presided. After dinner an enjoyable smoking concert was given by a number of excellent artistes.

New C.A.V. Developments.—It is reported that Messrs. C. A. Vandervell & Co., Ltd., have acquired the patent rights of the Willard Storage Battery for the British Empire (except Canada), and will shortly commence manufacture, besides establishing a chain of service stations. The company is also bringing out a new coil ignition device, designed by Mr. A. H. Midgley.

Italian Workers' Threat.—The Chamber of Labour in Turin threatens the re-occupation of the factories unless the daily hours of work are reduced to six instead of eight. Owing to the lack of materials, the reduced production of the factories renders necessary the dismissal of workmen. The Chamber of Labour wishes to avoid the necessity of dismissals by reducing the hours of work.—*Morning Post.*

Socials.—Under the auspices of the Sports and Recreation Association of the Phœnix Dynamo Manufacturing Co., Bradford (a branch of the English Electric Co.), a series of Christmas parties have been held for the children of employés. Very enjoyable programmes were arranged, including a fairy play, written by Miss E. Matthias, the welfare superintendent.

The girls of the staff of the Edison Swan Electric Co., Ltd., gave a New Year's Eve supper, concert and dance on December 31st, in the Staff Café, at Ponders End. A merry company of about 80 sat down to an excellent repast, under the genial chairmanship of Mr. J. W. Elliott (joint sales manager). A concert followed, at which Miss Robinson, Mr. Moore and Mr. S. Barker supplied the vocal items, while Messrs. Will May, E. Lack, G. W. Tuffill and "Little Jack" supplied the humorous numbers. At the conclusion of the concert, a programme of 10 dances was gone through to the music of the Ediswan orchestra.

The German Glow-Lamp Combination.—A big capital transaction is contemplated by the Osram group, which will raise the total nominal capital to 240,000,000 marks. The Osram Co., which is composed of the glow lamp works of the A.E.G., the Siemens & Halske Co., and the Auer (German Incandescent Gas Light Co.) Co., reports that after defraying all expenses and taxes, the financial year ended on June 30th, 1920, shows divisible net profits of 27,000,000 marks, the method of disposal of which has not yet been disclosed. As a result of the large turnover, and the acquisition of most of the undertaking of the United Lausitz Glass Works, makers of tubes for bulbs, it is found necessary to strengthen the financial position, and for this purpose it is proposed to increase the share capital from 30,000,000 to 120,000,000 marks. The existing loan of 50,000,000 marks is also to be supplemented by a new 5 per cent. mortgage loan for 70,000,000 marks.

The E.P.E.A. Award.—We are informed that about twenty-five undertakings still refuse to adopt the recommendation of the National Joint Industrial Board regarding the salaries to be paid to members of the staffs of electricity undertakings. Negotiations between these undertakings and the Ministry of Labour are still proceeding. The Ilford Council agreed to adopt the schedule for six months, but this was unacceptable to the E.P.E.A. Strike notices in this case were suspended, however, and the question is to be brought up at the next ordinary meeting of the Ilford Council.

Trade Union Fusion.—On December 31st the National Warehouse and General Workers' Union and the Amalgamated Union of Co-operative and Commercial Employés ceased their separate existences and became merged into the National Union of Distributive and Allied Workers. The new Union covers a wide variety of workers, from the producers of household necessities through the wholesale factors to the retail shop workers, and is very powerful from a Trade Union standpoint. A large mansion has been purchased at Fallowfield, Manchester, to be the central offices of the new organisation. The membership of the amalgamation reaches nearly 200,000, with accumulated funds of £300,000, the membership of the approved society being 32,000.—*Daily Telegraph.*

British Property in Germany.—It is officially announced that an agreement was signed on December 31st, by the Secretary of State for Foreign Affairs and the German Ambassador, for safeguarding the restitution of British property in Germany under Article 297 of the Treaty of Peace, and meeting certain difficulties with regard to storage and other charges incurred on such property where it was not actually taken over by the German authorities. Certain clauses of the agreement can only be carried into effect by the passage of legislation in Germany, but in the meantime it is to be applied without delay, so far as can be done by administrative action; no actual release of German property will be made, however, until the necessary steps have been taken in Germany, and the agreement has been ratified.—*The Times.*

Rio Tinto Strike Settled.—The employés' strike at the Rio Tinto Copper Mines, Spain, has been settled following the intervention of the Minister of War. The miners accepted the English company's conditions, but reserved the right to discuss certain points at a later date.

Copper and Lead Prices.—Messrs. F. Smith & Co. report, January 4th:—Copper (electrolytic) bars, £83 10s., 10s. decrease; ditto sheets, no change; ditto wire rods, £99 10s., 10s. decrease; ditto H C wire, 1s. $\frac{13}{16}$d., $\frac{1}{16}$d. decrease.

Messrs. James & Shakespeare report, January 5th:—Copper bars (best selected), sheets, and rods, £130, £2 decrease. English pig lead, £25 5s., an increase of 15s. on last week's quotation.

District Joint Board.—At a meeting of the Home Counties (No. 9 Area) District Joint Board, held on December 22nd, 1920, it was reported that the following members had been nominated by the E.P.E.A. to sit on the employés' side.—Messrs. H. M. Bowman and A. T. Bullen (Bedford); F. Chignell (Colchester); H. A. Kell (Luton); and E. E. Pope and H. Wilson (Maidstone). Mr. Wilson was elected vice-chairman, and Mr. Bullen will act as secretary for the staff members' side.

Demand for Plant in S.A.—*The South African Engineer and Electrical Review*, in the course of a trade article, states that, as regards electrical plant and supplies, reports received from public bodies all tend to indicate that there is still a shortage, and that plant on order for very long periods has not yet been delivered. Most of the leading municipalities are not only unable to give extended supplies of electricity, but are still, with difficulty, coping with the existing demand with no reserve for emergencies. With regard to electrical goods, the market has been glutted with certain lines, such as lamps, which were over-imported in 1918 by speculators, but in most lines, such as heating and cooking apparatus, telephones, conduits, &c., supplies have been at times unprocurable at any price. One municipality reports finding it cheaper to use high-pressure steam pipe than ordinary electrical steel conduit. Apart from the difficulty of getting delivery of machinery against old contracts, it has been found almost impossible during the year to place orders in the United Kingdom. In spite of the adverse rate of exchange, America has taken practically every important order for large plant owing to the apparent inability of British manufacturers to quote firm either for delivery or price. At the present time public bodies are faced with the choice between paying what seem prohibitive prices and turning down all schemes for extended activities.

Trade Discounts in Canada.—The following extract from the *Electrical News* (Toronto) shows that a question which is agitating retailers in this country is equally acute in the Dominion:—"Sell electrical appliances as they do postage stamps." The manager of a large central station company has just written us regarding the retailing of electrical appliances through hardware and drug stores. It is typical of many such expressions of opinion which one hears on all sides. This manager writes:—"It is a crying shame the way wholesalers, distributors, &c., sell electrical goods to hardware shops, plumbing shops, tinsmiths and others not in the electrical business—even to consumers—at the same discounts given to *bonâ fide* electrical shops. These people then sell those goods as a side line at practically nothing above cost, as a drug store sells postage stamps, simply to attract the public. This results in the public getting the impression that the electrical shops are charging exorbitant prices. Furthermore, the hardware men and others frequently have below-standard goods foisted on them, whose poor quality eventually does an injury to the electrical business as a whole. What is needed is co-operation between representatives of all electrical men, from the manufacturers down to the retailers."

LIGHTING AND POWER NOTES.

Aberdeen.—Proposed Extensions.—At a meeting of the Electricity Committee on December 22nd, a scheme for the extension of the electricity works was examined. The proposals comprised the installation of a 10,000-kW turbo-alternator at a cost of £77,000; two boilers with economisers, forced and induced-draught apparatus, &c., £60,000; two motor converters of 1,000 and 1,500-kW capacity, £18,000; high and low-pressure switchgear, &c., £10,000; a 60-ton electrical crane, £6,400; and necessary alterations and extensions of buildings at an estimated cost of £20,000, making, with allowance for contingencies, a total of £210,540. The Committee was inclined to approve the suggestions, but decided to make further investigation before finally sanctioning them.

Accrington.—Extensions.—The following items are included in the scheme of extensions laid before the Electricity Committee, involving the expenditure of £150,000:—Engine house: 5,000-kW turbo-generator, condenser and auxiliaries, foundations and flooring, steam exhaust and water piping, switchgear and cables, two 1,000-kW rotary converters and switchgear. Boiler-house: Four 25,000-lb. water-tube boilers, superheaters, economisers, stokers, and coal-handling plant, boiler-house alterations, foundations and ash tunnel, steam feed and blow-off piping, valves, &c., two feed pumps and connections. The report has been adopted. The Electricity Commissioners are being asked to sanction the loan.

Australia.—Sydney Plant Overloaded.—The outspoken statement made by the city electrical engineer that the Council was responsible for the over-loading of the power-house because of its persistent refusals to get him the plant he asked for, was borne out by a report from the Electric Lighting Committee, presented to the City Council. The report stated that an accident occurred on October 12th to one of the turbo-alternators at the power-house, which resulted in the stripping of the high-pressure blading of the turbine. The temporary loss of this machine placed the department in a serious predicament. The defective blading had been cut out, and work was being carried on day and night to get the machine into service again. It was hoped to replace the blading from spare blading in stock. The machine was one of the older sets, and was getting into very bad condition. "The condition of this set," the report concluded, "and the accident which has occurred emphasises the urgency of installing new plant to relieve this plant as quickly as possible."—*Daily Telegraph* (Sydney).

Coal Shortage.—The city electrical engineer has informed the Council that it is impossible to generate electricity economically until a coal mine is purchased. The Council is, therefore, inviting offers of coal-bearing properties capable of supplying at least 6,000,000 tons, and also of controlling interests in other mines.

The fall in metal prices and the extension of the shipping strike are affecting all the dove-tailed industries and seriously reducing employment. Victoria and other States are unable to obtain supplies of coal from Newcastle, and are on the verge of a coal famine. The Federal Government has prohibited the use of gas and electric light and power except within severely restricted hours, while the Railway Administration is preparing a 35 to 50 per cent. reduction of the train services. Melbourne is threatened with the suspension of all tramway traffic after sunset and on Sundays.—*The Times.*

Barnes.—Loan.—The Urban District Council is applying for sanction to a loan of £10,000—the estimated cost of mains and services for the ensuing three years.

Birkenhead.—Water Power.—A scheme to utilise water from the town's reservoir in North Wales to generate electricity is being considered by the Town Council, says *The Times.* Ten million gallons of water are released daily at the reservoir, and it is proposed to use the water power to generate electricity, which will be conveyed a distance of 40 miles to Birkenhead and Wirral by means of an overhead transmission line.

Bentley (York).—Housing Scheme.—At a meeting of the Bentley-with-Arksey District Council recently, minutes approved included the prospective lighting by electricity of houses at Arksey. Inquiries had been made of the Doncaster Corporation, and quotations were considered. It was decided to ask the Corporation to undertake the wiring from the sub-station to the houses, and that if it declined, the Housing Commissioner should be asked to allow the cost of wiring to go for subsidy as part of the housing scheme. In default of any concession from the Corporation, Messrs. Barber, Walker & Co. were to be asked to estimate for supply of electricity. It has since transpired that Doncaster Corporation is reconsidering the matter.

Bingley.—Loan.—The District Council is applying for power to borrow £1,500 for the provision of further new electricity mains and services.

Birmingham.—Necessity for Extensions.—Owing to financial stringency, the Finance Committee, in a special report to the City Council, stated that it could not at present authorise further expenditure on housing schemes or upon the recently-sanctioned extension scheme of the Electric Supply Committee. The Electric Supply Committee urged the imperative necessity of putting the extension scheme in hand. It pointed out that the erection of the first portion of the Nechells works, with a net plant capacity of 30,000 kW, was authorised by the Council on July 31st, 1918. Although efforts had been made to press forward with the works, the plant would not be ready for service until the autumn or winter of 1921. The department had had to impose certain restrictions on consumers, and it had upon its books 3,500 applications for supply, including large and small works, business premises and private houses, but it could not, with its present limited plant capacity, deal with new business. Various measures had been taken by the Committee to alleviate the difficulty by temporarily supplementing the sources of supply, but it had proved impossible to provide adequate facilities to meet the requirements of present and prospective consumers. The report further pointed out that the existing plant was working to its full capacity, and that when any breakdown occurred the remaining plant had to be overloaded, or the supply curtailed. This state of things could not continue indefinitely, and the Committee recommended that it be authorised to proceed with the scheme at once.

U.S.A. Loan.—The possibility of the Corporation having to consider the raising of a loan in the United States of America is foreshadowed in the report of the Finance Committee which was presented to the City Council on Tuesday last. "If further contracts are to be entered into, such as those for the new electric power station and the housing scheme, the treasurer advises that such a step may be necessary," says the report.

Brazil.—Water Power.—A concession was granted in 1907 to an American firm for a hydro-electric plant on the Paraguassu River, says the United States Consul at Bahia in his latest report. The concession was later transferred to the Companhia Brazileira de Energia Electrica, a subsidiary of the American firm. A natural fall on the Paraguassu River has been used to generate 5,000 h.p., and it was hoped at the time of writing that the plant would be inaugurated during the latter part of 1920. The company will supply the city of Bahia with light, as well as power for the tramway system. It also expects to supply power to a number of the local manufacturing firms and sugar refineries, thus reducing the demand for coal and fuel.

A hydro-electric plant was recently inaugurated by the Companhia Valenca Industrial. It is built on the falls of the Una River, and besides supplying power for the textile factory of the above-mentioned company, it will supply the city of Valenca with electric light.

Canada.—Export of Energy.—The Hydro-Electric Power Commission of Ontario desired to prohibit the export of electric energy to the United States, but this did not receive the Government's approval. As an alternative, a reduction has been effected in the export licences from 110,000 kW. to 80,000 kW.

Continental.—Spain.—A new company has lately been formed in Barcelona, with a capital of 15,000,000 pesetas, and the title La Sociedad Termo-Energia, to exploit certain lignite mines and to generate and distribute electrical energy.

Dorchester.—Purchase of Undertaking.—The Corporation is applying to the Electricity Commissioners for a special order to authorise the Dorset Electric Supply Co., Ltd., to sell to the Corporation the electric supply undertaking and to authorise the Corporation to generate and supply electricity.

Downton (Wilts).—Inquiry.—An inquiry was held recently by the County Council into an application of the Parish Council for a loan of £650 for public lighting by electricity. The supply was offered by the Southern Tanning Co., Ltd., subject to the provision of mains by the Council. It was stated that the supply would not be available for private use. Objection was made on the ground of increased rates, and also because the entire parish would not be lighted.

Dundalk.—Report upon Extensions.—Mr. P. A. Spalding, engineer and manager of the electricity works, has presented to the Urban Council a report on proposed works extensions, which, he states, are urgently required. New plant is estimated to cost from £15,000 to £20,000.

Dundee.—Position of Undertaking.—Mr. Richardson, the Corporation electrical engineer, reports that he hopes to have new plant installed by the end of April at Carolina Port which will meet next winter's demand. For the winter of 1922-23 further steam plant, estimated to cost half a million pounds, would be needed to meet the requirements of consumers. The machinery would have to be ordered at once. The Corporation Electricity Committee discussed the possibility of a hydro-electric scheme being developed to meet the city's requirements, and the engineer stated that under the most favourable circumstances such a scheme could not be ready before the lapse of four or five years. The Committee instructed Mr. Richardson to submit a report on steam plant, and also agreed that Prof. A. H. Gibson and Mr. Richardson be invited to report as to the best methods for future extension of the city's generating resources and also on the hydro-electric proposals.

Electricity Districts.—West Riding (Aire and Calder).—The Electricity Commissioners have extended the time for the submission of objections or representations to February 28th, 1921.

North-East Midlands.—The time for the submission of objections or representations has been extended to March 31st, 1921.

Enniskillen.—Electric Lighting Investigation.—In view of the proposed increases in the charges for gas, the Urban District Council has retained the services of an expert to advise it as to the feasibility of establishing a municipal electric lighting scheme.

Falkirk.—House Lighting.—On the recommendation of the Corporation electrical engineer, the houses being erected by the Town Council are to be supplied with electricity, a loop-system of cabling being adopted.

Heston and Isleworth.—Increased Lighting.—The Lighting Committee reports that in view of the very small saving it finds to be effected by the non-lighting of one-third of the electric street lamps in the district, it has given instructions for the whole of these lamps to be lighted.

Leeds.—Loan.—Application is being made to the Electricity Commissioners for sanction to borrow £40,000 for house services.

Leyton.—Insurance.—At a meeting of the Lighting Committee, the electrical engineer reported that when the turbine was installed, the Committee considered it preferable to set aside £50 a year as a Self-Insurance Fund instead of insuring with an insurance company, and suggested the same course should be adopted with regard to the two motor converters to the extent of £25 per annum each; the Committee recommended that this suggestion be adopted.

Glasgow.—Loan.—The Corporation is applying to the Electricity Commissioners for authority to borrow an additional £1,800,000 for the Electricity Department.

New Turbo-Generator.—The Clyde Valley Electrical Power Co. is erecting at its Clydemill power station a 15,000-kW turbo-generator. A 33,000-V inter-connecting cable between the Clydemill and the Yoker generating stations is being laid.

Halifax.—Extensions Recommended.—The Electricity Committee recommends the expenditure of nearly £40,000. Of this £28,000 is for two new boilers at the generating station.

Kingussie.—Electricity Scheme.—Mr. Mitchell, Edinburgh, has reported to the Town Council in connection with the proposed electricity scheme for the town. There are three schemes put forward:—Power from the Guynack Burn and Loch Guynack; power from the River Tromie; and the installation of oil or gas engines. The cost of the schemes is estimated by Mr. Mitchell at £8,820, £11,521, and £6,570 respectively.

Leyton.—Parliamentary Bill.—The Urban District Council proposes to promote a Bill during the ensuing session of Parliament, one of the sections of which seeks to extend the Council's powers with respect to the electricity undertaking.

Machynlleth.—Public Lighting.—It is reported that the Kinema Co. has intimated that it is prepared to provide electricity for lighting the whole of the town.

Malta.—Inadequacy of Plant.—It is stated that the Government electricity plant is unable to meet the demands made upon it, and orders for new plant are being placed immediately in an endeavour to be able to cope with the next winter's load.

Newmill (Yorks.).—Joint Electric Lighting Scheme.—A meeting of representatives of the Newmill, Farnley, Shepley, and Thurstonland Councils has been held to consider the question of a joint electric lighting scheme. The local representatives reported that it had been decided to obtain electric power in bulk from the Yorkshire Electric Power Co.

Oldham.—Overloaded Plant.—When complaints were made regarding the electricity supply, Mr F. L. Ogden, electrical engineer, told the Committee that the cause was the overloading of the direct-current plant, and he advised that there should be no more connections made this winter. The department had no spare plant, and they were running at a risk.

New Zealand.—Hydro-Electric Requirements.—An elaborate statement regarding the development of hydro-electricity was given by the Minister for Public Works in an address to the New Zealand House of Representatives. The appropriations for the current financial year are set out in the Estimates as follows:—Arapuni scheme, £100,000; Mangahao scheme, £250,000; Horahora scheme extension: New works, £80,000; material for stock, £10,000; working expenses, £10,000; Lake Coleridge scheme: New works, £150,000; material for stock, £10,000; working expenses, £32,500; Survey and investigation of other schemes: North Island, £15,000; South Island, £15,000; total, £662,500; less estimated credits on capital account, £7,500, leaving a net total of £655,000. The expenditure during 1919-20 on the various schemes amounted to £58,970.—*Reuter's Trade Service* (Wellington).

Perth.—Interview with Commissioners.—The city's £25,000 scheme for the introduction of additional plant at the Corporation's electricity works is still in abeyance, pending the decision of the Electricity Commission. Reporting on an interview he had had with a member of the Commission, Mr. John Lambert, the electrical engineer, stated that amongst the questions discussed was that of introducing three-phase into the city, in which connection it had been pointed out to him that Perth being particularly a residential town, scope for producing a large industrial load was very limited. The electricity works, it had been further contended, having been designed as they unfortunately were, such an extension would be a most expensive venture, and one that could not give an adequate return for the outlay it would entail. The installation of coal elevators was also discussed. The Corporation Electricity Committee has deferred consideration pending the receipt of the Commission's finding.

South Africa.—Port Elizabeth.—The City Council is to borrow £550,000 for public works, one of the items being £200,000 for extension of the electricity undertaking, mains, &c. (including amount already spent).

Southend.—House Services.—It was stated by the electrical engineer, at a recent Council meeting, that the cost of connecting consumers to the mains had risen from £3 10s. in 1914 to £8 4s. The Council has decided not to pay the cost of these services out of revenue, as hitherto, but is seeking permission to borrow £24,000 to cover the cost for a period of years.

Cause of Failure.—The chairman of the Electricity Committee informed the Council, at a meeting, that the cause of a recent failure of power, resulting in a stoppage of the tramway services, was the extremely bad coal delivered to the works. He stated that this had actually extinguished two of the boiler fires. A deputation was appointed to meet the Chief Coal Controller.

Engineer's Vindication.—Owing to the criticism of the Electricity Committee regarding the present inadequacy of the electricity undertaking, the borough electrical engineer (Mr. Robert Birkett) has been forced to vindicate his position in the matter through the columns of the local Press. He states that he has done everything in his power and promises that the position will soon be improved.

Stalybridge.—Joint Scheme Abandoned.—The Stalybridge, Hyde, Mossley, and Dukinfield Joint Tramways and Electricity Board has been endeavouring to arrange with the Ashton-under-Lyne Corporation to form a joint electricity undertaking, but the Corporation has made other arrangements, and the Board will have to work on its own. The Board has authorised the engineer to get another water-tube boiler, as the increased load makes the provision of further steam-power imperative. The calls now being made are quite abnormal and unexpected, but the new boiler will be the limit of capacity at the Tame Valley station, and the capital outlay upon the proposed new generating station at Hartshead is greater than can be undertaken at present.

Stafford.—Report on Undertaking.—The Corporation has approved a recommendation of the Electricity Committee to retain the services of Mr. Arthur Ellis, of Cardiff, to prepare a comprehensive report upon the electricity undertaking at a fee of 200 guineas.

Stockport.—Breakdown.—An accident at the electricity works on December 30th, caused by a "short" on a 5,000-kW turbo-generator, resulted in a stoppage of the tramway services, and works using electricity. No electricity was supplied to any works until Monday. Thousands of workpeople were affected by the stoppage.

Stoke-on-Trent.—Price Reduction.—The *Staffordshire Sentinel* states that the Electricity Supply Committee has recommended that from the meter readings at the end of the September quarter, 1920, and until further notice, the charges for motive power supply, heating, cooking, and apparatus used in conjunction therewith, be reduced by 25 per cent., making 150 per cent. in all over tariff rates, except in cases where the supply is three-phase alternating, transformed on the consumer's premises; and that the charges for private lighting, upon which the present advance is 125 per cent., be reduced by 35 per cent., making in all 90 per cent. upon tariff rates. These reductions have been made possible by the profit made during the past year, and it is stated that the accounts will still show a substantial profit when the reductions are put into force.

Stourbridge. — Electricity Districts. — The Town Council has decided to lodge objections to the proposed inclusion of the borough in either the North-West or South-West Midlands Electricity Districts.

United States. — Ford Hydro-electric Scheme.—Messrs. Henry Ford & Son, Inc., have applied for a licence to authorise the construction, operation and maintenance of a hydro-electric power plant on the site of the Government dam at Green Island for the purpose of utilising the surplus water at that point for a motor manufacturing plant.—*Reuter's Trade Service* (Troy, N.Y.).

Wigton.—Workhouse Plant.—The Board of Guardians has decided to lay down a steam plant capable of providing electricity for lighting the workhouse, and also for heating the institution at an estimated cost of £1,600.

Wrexham.—House Lighting.—The Town Council is applying for permission to borrow £14,700 for the provision of an electricity supply to the 800 houses being built by the Council.

TRAMWAY AND RAILWAY NOTES.

Continental.—France.—A concession granted to M. Coignet some time ago for the setting up of a tramway network in the Departement de l'Yonne, has now been transferred to the Omnium Française d'Electricité Co., which, with its ample means, will soon carry the scheme to a conclusion. This company has also received the authorisation to submit plans for the utilisation of the water resources of this region, estimated to be equal to about 20,000 h.p., and for the distribution of electric energy.

Spain.—The Norte Compania has submitted a scheme for the electrification of the Barcelona to Tarragona line. The works were to be commenced at the beginning of the present year and ended, if no interruption occurred, in 1923. Other schemes are being examined, among which is the electrification of the Barcelona to Saragossa Railway. Another large undertaking, work on which was retarded during the war, owing to inability to secure material, is about to be taken in hand. This is the electrification of the highland section of the Pagarès. The first portion to be converted is 42 km. in extent, and the highest part of the track is 1,270 metres above sea-level. This line is very often covered with snow, and difficult to operate with steam traction.

Guernsey.—Electric Vehicles.—We understand that Mr. A. G. Bird, A.M.I.E.E., engineer and manager of the Guernsey Railway Co., Ltd., is considering the feasibility of adopting electric road vehicles suitable for carrying loads of from 4 to 5 tons each.

Halifax.—Through-Running of Cars.—The Tramways Committee have authorised the engineer to enter into arrangements with Bradford Corporation for the running of the Bradford railless electric battery cars through from the Bradford tramway system to Halifax, in connection with the carriage of parcels between the two towns.

The engineer and a deputation are to negotiate with the Brighouse authorities with regard to the establishment of a system of electric signals on the Halifax tramway route in Brighouse area.

Holland (Lincs.). — Light Railway Scheme. — Having received the unofficial approval of the Ministries of Transport and Agriculture and Fisheries, the plans for the proposed light railways have been completed. The estimated cost of the entire scheme is given as £548,000, which is to be apportioned as follows among the authorities concerned:—Holland County Council, £423,000; Lindsey County Council, £45,000; Cambridgeshire, £48,000; and the Soke of Peterborough, £32,000.

London.—Tube Breakdown.—Some delay was caused on the City and South London Railway line on Tuesday morning last by the breakdown of a train at Kennington.

Newcastle-under-Lyme.—Proposed Curtailment of Scheme.—A notification having been received from the Parliamentary agents of the North Staffs. Railway Co. stating that it was intended to apply for powers to abandon the construction in part of the light railways authorised by the North Staffs. Railway (Trentham, Newcastle, and Silverdale Light Railways) Order, 1914, the Rural District Council has decided, in view of the advantages which the railway would confer in the conveyance of passengers and goods, to disapprove of the abandonment of the schemes.

South Shields.—Light Railway Order.—Under the South Shields Corporation Light Railway Order, 1920, authority is given for the construction of a light railway within the areas of the county borough and the rural district of South Shields.

Salford.—Year's Working.—The gross income of the Corporation tramways for the year ended March 31st, 1920, was £495,025, as compared with £425,384 in the previous period. The gross profit amounted to £119,528, as against £130,883. After payment of capital charges, a net profit of £37,610 (£42,672) remained, of which amount £20,000 was allocated to rate relief. The depreciation and renewals fund shows a balance of £22,171.

Southport.—Tramway Feeders.—The insulation of the feeders of the Corporation tramways has perished, and the borough electrical engineer reports that it is necessary either to re-insulate them and re-lay them at an estimated cost of £14,950, or to place overhead feeders on the tramway poles at a cost of £5,200, less an estimated credit of £2,600 for the sale of the old material, the existing tramway poles being utilised after being strengthened by means of reinforced concrete. The Electricity Committee has instructed the engineer to proceed with the latter arrangement.

Warrington.—Proposed Fare Increase.—To put the tramway undertaking on a sound economic basis, the Tramways Committee has recommended a 2d. fare on all routes, with 1d. stages.

Wrexham.—Light Railway.—At a recent meeting of the Town Council a letter was read from the Clerk of the County Council stating that an interview had been held between the Light Railway Committee and the Railway Commissioner for Wales with reference to proposed light railway schemes from Wrexham to Ruthin, Denbigh to Llanrwst, Abergele to Llangefni, and Corwen to Bettwsycoed. The Commissioner desired certain information respecting the schemes, such as the approximate cost, whether the owners of the land would be prepared to give sufficient for the light railway, and whether they would support the schemes financially. It was decided to call a conference of local authorities concerned in the Wrexham-to-Ruthin scheme.—*Manchester Guardian.*

TELEGRAPH AND TELEPHONE NOTES.

Austria.—Financial Position.—A *Reuter's Trade Service* telegram from Vienna states that Austria's State finances are in the most precarious condition, and the Government is experiencing the utmost difficulty in finding the money to meet current expenditure. The telephone and telegraph employés and other State officials are clamouring for increased pay. Both telegraph and telephone charges were to be raised some 250 per cent. on January 1st.

Canada.—State Telegraphs.—With New Year's Day the Canadian Government will complete the biggest telegraph merger in the history of the Dominion, which will include the extinction of several companies organised largely with English capital. The new merger will make one of the largest single telegraph systems in existence, comprising the Great North-Western, Grand Trunk, Grand Trunk Pacific, Canadian Northern, Inter-Colonial Railway, and Commercial systems, with a number of smaller companies, and the name in future will be the Canadian National Telegraphs. The new system will be conducted on similar lines to the national railway system, under an organisation as free from political influence as is possible to any Government-owned concern, while with the merger a number of changes of methods are announced which will tend to promote economy and co-ordination of services.—*Daily Telegraph.*

Continental Telegraphists' Strike.—The "keep-to-the-rules" strike of French telegraphists, which we referred to in our last issue, is, says the *Daily Express*, spreading rapidly on the Continent. Italian, Spanish, and Belgian officials are falling into line with their French colleagues. The chaotic condition of the Paris telegraph offices has become worse. There has been only one hour of telegraphic communication with Italy. All other telegrams, charged for at the usual rates, have been sent by post. Hundreds of telegrams from Italy for England arrived in Paris by post. Twelve hundred and fifty telegrams were posted there for London on December 23rd, and the post baskets for Berlin, Hamburg, and Mayence were full of official telegrams. It now takes 24 hours for a telegram to be delivered in the French provinces.

France.—Guiding Aeroplanes by Wireless. — A French engineer, M. Henri Detable, claims to be the inventor of an aeroplane which can be flown without a pilot, being guided by wireless telegraphy, says the *Evening News*. A claim for the invention has already been made by an American. Detable says he completed his machine during the war, and several trials were made. The aeroplane was guided in the air with nothing in it but a bag of ballast, and it was able to rise from the ground and land again with perfect safety. He adds that he was unable to exploit the idea through lack of capital.

A number of French Deputies have tabled a Bill to institute a separate budget for the postal, telegraph and telephone services, which would thereby cease to be a Government department, and could be administered separately on business lines.

Germany.—Berlin-Brussels Telephone Communication.—The Ministry of Posts states that the restrictions on telephone communication between Germany and Belgium were removed on January 1st, from which date pre-war conditions of communication were re-established. The fee for a three-minutes' conversation between Berlin and Brussels is six marks ninety pfennigs, and for urgent calls three times this amount.—*Reuter's Trade Service* (Berlin).

Greece.—Telegraph Rates.—The telegraph authorities announce that from the 1st inst. the rates for telegrams to Greece and Greek islands were increased by ½d. on those shown in the Post Office Guide.

Poland. — Swedish Telephone Co. — The Telefon Aktiebolaget Cedergren, whose concession to handle the telephone system of Warsaw expired on November 1st, 1919, has obtained a renewal covering a period of 20 years, together with important new concessions for several other Polish towns, including Lodz and Lemberg. It is stated that a Polish company will be formed to deal with these concessions, all the shares of which will be held by the Government and Telefon Aktiebolaget Cedergren. The share capital of Telefon Aktiebolaget Cedergren is Kr. 4,500,000, and is entirely in the hands of the Swedish-Danish-Russian Telephone Co., whose share capital amounts to nearly Kr. 22,000,000.—*Reuter's Trade Service* (Stockholm).

Spain.—Fire.—It is reported that a serious fire at Segovia, 43 miles N.-W. by N. of Madrid, did extensive damage, and ruined 15 large buildings, including postal, telegraph, and telephone offices.

Wireless Telephony.—A proposal is under the consideration of the Mersey Docks and Harbour Board to establish communication between the Bar lightship and the Dock Board's offices by means of wireless telephony.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Sydney.—January 31st. Municipal Council. H.T. and L.T. cable (specification No. 628). Electric Lighting Department, Town Hall, Sydney.

South Australia.—P.M.G.'s Department. March 2nd. Telephone parts, Schedules 558 and 559; telegraph and telephone material, Schedule 560. (See this issue.)

Belgium.—Commune of Ixelles at Brussels. 5,000-kW, 5,000-V, 3-phase alternator, exciter and condenser. A copy of the specification (in French) may be seen on application to the Department of Overseas Trade (Room 48), 35, Old Queen Street, S.W.1.

January 19th. The Belgian Post and Telegraph authorities at La Salle Madeleine, Brussels. Supply of telephone commutators and other telephonic apparatus. The specification (No. 545) may be obtained for 1.75 francs from above address.

Antwerp.—February 1st, Municipal authorities. Transformer set with switchboard for a transformer cabin at the docks. Copies of the specification may be obtained for 3 francs from the Hotel de Ville, Antwerp.

Edinburgh.—January 24th. Electricity Supply Department. Circulating water pipes and valves for the Portobello generating station, Specification No. 30. (See this issue.)

Halifax. — February 3rd. Electricity Department. Twelve months' supply of stores, including electric lighting fittings and accessories, cables, V.I.R., and phosphor bronze, telephone wire, e.h.p. and l.p. cables, meters, &c. (See this issue.)

India.—Meerut. — January 17th, 1921. Government of United Provinces hydro-electrical installation. Generating station equipment, including workshop equipment, H.T. transmission and distribution (overhead equipment, including poles), sub-station equipment, pumping station equipment and piping, &c. Mr. G. McHoey, sanitary engineer to the Government, United Provinces, Allahabad.—*Reuter's Trade Service* (Bombay).

London.—Hammersmith. — January 21st. Electricity Department. Three or more water-tube boilers capable of supplying 150,000 lb. of steam per hour. (See this issue.)

Manchester.—January 24th. Electricity Committee. Six motor-driven circulating-water pumps; three motor-driven boiler feed pumps and one motor-driven pump for weight-tank sump. (December 24th.)

January 11th. Tramway Committee. Electric welding equipment for the welding of tramway rail joints. J. McElroy, Manager, 55, Piccadilly.

Natal.—Durban.—January 26th. Corporation. Supply of telephone cable, paper sleeves, concrete pipes, and various telephone and miscellaneous accessories and materials.

February 16th. One 1,000-kW rotary converter with transformers and switchgear. Specifications of the above may be consulted on application to the Department of Overseas Trade, 35, Old Queen Street, E.C.

New Zealand. — Napier. — January 17th. Borough Council. One 500-kW electric generating set. Copies of the specifications and blue prints may be seen at the Department of Overseas Trade, 35, Old Queen Street, S.W.

Rhodesia. — Salisbury. — January 13th. Municipal Council. Electric generating plant, switchgear, cable and converters. Specification (£3 3s.) from the Council's Consulting Engineer, Royal Chambers, Johannesburg. A copy of the specification may be consulted at the Department of Overseas Trade (Room 48), 35, Old Queen Street, S.W.1.

South Africa.—Johannesburg.—January 31st, 1921. Rand Water Board. Supply and erection of steam boiler, superheater, stoker, economisers, &c., steam turbo-driven centrifugal pumps, condenser, &c., for the Swart Kopjes pumping station. Copies of the specifications, &c., and forms of tender can be seen on application to the Machinery Section, Department of Overseas Trade, 35, Old Queen Street, S.W.

CLOSED.

Blackpool.—Electricity Committee. Park Royal Engineering Co., for switches in connection with the h.p. switchgear for transformer chambers, and the Metropolitan-Vickers for h.p. switch.

Halifax.—The Tramways and Electricity Committee. Recommended:—

Babcock & Wilcox, Ltd.—Two cross-type marine boilers superheaters stokers, chimneys, and fans, at electricity works; £28,340.

E. Green & Son, Ltd.—Two economisers, each consisting of 240 tubes, for above boilers; £4,498.

Invergordon (Ross-shire).—Electric light installation, the Academy; E. Spell, £194.

London.—Stepney.—Electricity Committee. Accepted:—

Coal supplies—

3,000 tons Ibstock D/S nuts, at 24s. 1d. per ton; 3,000 tons Hawkins Cannock nutty slack, at 23s. 9d. ton; 2,000 tons West Cannock nutty slack, at 44s. 3d. ton; 5,200 tons Walsall Wood washed beans, 45s. ton.—E. Foster & Co. One barge ½ in. Peasley slack, 24s. 1d. per ton.—Bradbury, Son & Co., Ltd. 190 tons Cowdenbeath rough slack, at 53s. 7d. per ton; 240 tons rough small, 45s. 6d.—E. Foster & Co.

Cable—

¼ mile ·007 sq. in. lead-covered cable, £74 10s.; ½ mile each twin and 3-core armoured cable and ¼ mile ·04 sq. in. 3-core armoured cable, £829.—W. T. Henley's Telegraph Works Co., Ltd.

Morecambe.—Electricity Committee. Tudor Accumulator Co.—Repairing battery at the East Street battery station, £291.

Manchester.—Electricity Committee.

High and low-pressure valves.—Dewrance & Co., Ltd., J. Blakeborough and Sons, Ltd.

High and low-pressure piping.—Aiton & Co., Ltd.

Overhead distribution work on the Gorton Mount and Mount Road Housing Estates.—British Insulated and Helsby Cables, Ltd.

Cable.—G. N. Haden & Sons, and Pirelli-General Cable Co., Ltd.

Electric tipping truck.—Electromobile (Leeds), Ltd.

Transformers at Barton Power Station.—Metropolitan-Vickers Electrical Co., Ltd.

Sub-contractors: Oil-coolers and oil pumps, Power Gas Corporation, Ltd., and Pulsometer Co.

Two transforming plants at Stuart Street and High Street sub-stations.—Metropolitan-Vickers Electrical Co., Ltd.

Sub-contractors: Fans, Davidson & Co., Ltd.

Transformers at Oldham Road "B" sub-station.—Ferranti, Ltd.

Sub-contractors: Fans, Davidson & Co., Ltd.; motors and switchgear, British Thomson-Houston Co., Ltd.

Water screening plant at Barton Power Station.—F. W. Bracket & Co., Ltd.

Sub-contractors: Driving chains, Brampton & Co., Ltd.; reducing gear, Northern Manufacturing Co.; motors and switchgear, Metropolitan-Vickers Electrical Co., Ltd.; lifting tackle, Young & Co.

Motor generator plant, &c., at Barton Power Station.—Bruce Peebles and Co., Ltd.

Sub-contractors: Rotor starter and switchgear for motor, G. Ellison and Co.; shunt-field regulator and generator, Bray, Markham & Reiss.

One battery "milking" motor-generator and switchgear, &c.—General Electric Co., Ltd.

One pressure-testing motor-generator and switchgear.—Electric Construction Co., Ltd.

Salford.—Electricity Committee.

One 100 kVA transformer, £300; one 600 kVA ditto, £1,182; one 6,600 V switch cubicle, £266; spare and rotor parts for No. 2 turbo-alternator, £4,400.—Metropolitan-Vickers Electrical Co., Ltd.

Stirling.—Town Council. Electrical work for 12 months; W. and T. Marshall.

Turbine Furnace Contracts.—The Turbine Furnace Co., Ltd., of 5, Budge Row, London, E.C 4, have received an order for two sets of turbine furnaces for Babcock type boilers from the Hexham Electricity Supply Co., of Hexham.

Wellingborough.—Board of Guardians. Cable and electric light wiring, laundry; Wellingborough Electric Supply Co., £170.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, January 7th. At the Caxton Hall, Westminster. At 8 p m. Lecturette on "The Indicator: Its Use and Application," by Mr. H. G. Pusey.

Friday, January 14th. At Caxton Hall, Westminster, S W. At 8 p.m. Chairman's address, "The Tides: Their Cause, Effect and Use," by Mr. B. E. Dunbar Kilburn.

Birmingham and District Electric Club.—Saturday, January 8th. At the Grand Hotel, Colmore Row. At 7 p.m. Presidential address, by Mr. A. C. Wynne.

Royal Institution of Great Britain.—At Albemarle Street, W. At 8 p m. Christmas Lectures—"The Haunts of Life"—by Prof. J. Arthur Thomson:—Saturday, January 8th. "The Conquest of the Land." —Tuesday, January 11th. "The Mastery of the Air."

Institution of Post Office Electrical Engineers (London Centre).—Monday, January 10th. At the Royal Society of Arts, John Street, Adelphi. At 5.30 p.m. Paper on "Four-wire Telephonic Repeater Systems," by Mr. C. Robinson.

Electricity Commissioners.—Tuesday, January 11th. At the Town Hall, Bristol. Inquiry with regard to the West of England Electricity District.

Institute of Marine Engineers.—Tuesday, January 11th. At the Institute, the Minories, E. At 6.30 p.m. Paper on "Electronomy," by Mr. W. B. Sayers.

Association of Engineers-in-Charge.—Wednesday, January 12th. At St. Bride's Institute, Bride Lane, E.C. At 7.30 p.m. Paper on "Pulverised Fuel," by Capt. F. S. Shaw.

British Ignition Apparatus Association.—Wednesday, January 12th. At the Trocadero Restaurant, Piccadilly Circus, W.1. At 7.30 p.m. Annual dinner.

Manchester Wireless Society.—Wednesday, January 12th. At the Albion Hotel. At 7.30 p.m. Discussion on "High Frequency Currents." To be opened by Mr. J. McKernan.

Paisley Association of Electrical Engineers.—Wednesday, January 12th. At the Technical College, George Street. At 7.30 p.m. Paper on "The Progress of Lighting," by Mr. C. J. Gregg.

Royal Society of Arts.—Wednesday, January 12th. At John Street, Adelphi, W C. At 8 p.m. Lecture on "Industrial Fatigue," by Dr. C. S. Myers, F.R.S.

Chelmsford Engineering Society.—Thursday, January 13th. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Polyphase Induction Motors," by Mr. P. Huggins.

Belfast Association of Engineers.—Thursday, January 13th. At the Municipal Technical Institute. At 6 45 p.m. Paper on "Railway Construction in France during the War," by Major R. M. McCreary.

Institution of Electrical Engineers.—Thursday, January 13th. At the Institution of Civil Engineers, Great George Street, S W. At 6 p.m. Twelfth Kelvin Lecture, "Electrons," by Sir Wm. Bragg, F.R.S.

North - Midland Centre.—Tuesday, January 11th. At the Hotel Metropole, Leeds. At 7 p.m. Visit of the President, Mr. Ll. B. Atkinson.

Scottish Centre.—Tuesday, January 11th. At the North British Station Hotel, Edinburgh. At 7 p.m. Paper on "Range of Wireless Stations," by Capt. R. C. Trench.

Dundee Sub-Centre.—Monday, January 10th. At the University College Engineering Department. At 7.30 p.m. Lecture on "Electric Driving of Jute Factories," by Mr. W. Sutcliffe

South-Midland Centre.—Wednesday, January 12th. At the University, Birmingham. At 7 p.m. Ordinary Meeting.

Scottish Centre (Students' Section).—Friday, January 14th. At the Royal Technical College, Glasgow. At 7.30 p.m. Paper on "Alternating Current compared to Direct Current for Distribution and Supply," by Mr. R. R Birch.

Edinburgh Electrical Society.—Friday, January 14th. At the Philosophical Institute. At 8 p.m. Paper on "Some Notes on Cables," by Mr. W. F. Mitchell.

National Association of Supervising Electricians.—Saturday, January 15th. At the Holborn Restaurant. At 6.30 p.m. Annual dinner.

The Electrical Contractors' Association.—Wednesday, January 19th. At the Connaught Rooms, Great Queen Street, W.C.2. Annual dinner.

NOTES.

The "Electrical Review" Index.—The Index to Vol. LXXXVII of the ELECTRICAL REVIEW, which will shortly be printed, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 6d., post free. Any reader or advertiser, at home or abroad, who requires a copy for binding or for other purposes, is asked to make early application therefor to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

British Oil.—At the recent meeting of Messrs. Oilfields of England, Ltd., it was stated that drilling for oil had begun at Kelham, Notts.

An isolated "pocket" of oil has been struck at Heath, near Chesterfield, in the same district as Hardstoft, where oil has been flowing slowly since May, 1919.

A British company is reported to have obtained oil concessions in Thrace from the Greek Government.

Correction.—In our leaderette on "Electric Supply Agreements with Local Authorities," on p 834 of our last issue, the ninth line from the end was accidentally dropped. The sentence should read: "It was apparently supposed by the local authority in making the agreement that it had authority to indicate to the Supply Company what it should charge private consumers."

Fire.—A fire occurred at Messrs. Crompton & Co.'s works at Chelmsford on Tuesday night, an isolated building, used as an oil and paint stores, and its contents, being partially burnt out. The manufacturing shops were not affected and no delay will be occasioned to the orders in hand.

Service Notes.—It is officially intimated that Naval electricians who are within three years of completing their service for pension, or within three years of completing their first engagement, and do not wish to re-engage, will not be required to requalify at the Torpedo School. Should they decide to re-engage they will have to re-qualify. The following warrant telegraphists have been appointed to the ships named:—Mr. G. Cadman, to the destroyer *Stuart*, flotilla leader; Mr. C. E. Robson, to the *Victory*, Nelson's old flagship at Portsmouth; and Mr. R. P. MacDonald, to the destroyer *Spencer*—all from New Year's Day.

Educational.—VEHICLE DRIVERS' EXAMINATIONS.—The fifteenth annual examinations, organised by the Commercial Motor Users' Association, with the object of encouraging drivers to take a personal interest in the driving and condition of their vehicles, will be held during the last week of April next, says *The Times*. Hitherto confined to London and the Home Counties, these examinations will now be open to any driver in Great Britain, and will be held in various provincial centres. They will be divided into three classes, each with sub-classes for steam, petrol, and electric vehicles. Full particulars may be obtained from the General Secretary of the Association, 50, Pall Mall, S.W. 1.

Six Chinese naval officers are taking a two years' course in practical wireless telegraphy at the Marconi works at Chelmsford.

Fatalities.—On December 24th, an employé of Messrs. Jonas & Colver, Ltd., of Sheffield, named Booth, was cleaning a part of a high-pressure switchboard, when he fell, and came into contact with the "live" portion of the board, with fatal results. The firm was subsequently charged at Sheffield City Police Court with negligence, in that the power was allowed to be on the board while work was being carried out. The firm pleaded "Not guilty," and stated that the deceased man should have spoken to his superior before attempting to go inside the switchboard "cage." A fine of £30 was imposed.

While Alexander William Burnside (24), an electrician, residing in Leith, was engaged measuring a wall at the sub-station of the Atlas Steel Foundry, Rathgate, his head came in contact with a charged wire, which caused instantaneous death.

The Housing Problem and Smoke Abatement.—The Ministry of Health has issued an interim report of the Committee on Smoke and Noxious Vapours Abatement (Cmd. 755, price 2d. net), which has been submitted with a view to securing the adoption of improved methods of heating in connection with the great housing schemes which are now in progress. This Committee was originally appointed in 1914, but its operations were interrupted by the war; it was reappointed in January last.

The report points out that at least 50 per cent. of the total smoke nuisance is due to domestic chimneys—even in industrial areas—and that domestic soot is more deleterious than factory soot, because it contains more tar. Evidence is quoted showing that smoke has a serious effect on the health of the community, on the growth of plants, on live stock, and on buildings. The extra cost of household washing in Manchester, compared with Harrogate, allowing for the difference in population, is stated to be no less than £290,000 a year for fuel and materials alone, disregarding labour. Various methods of heating are considered, and electricity is commended for cooking and heating, but "the high price at present charged for electricity in many localities" is regarded as an objection to its adoption; no mention, however, is made of the high price of coal and gas, or of the fact that the *relative* cost, and not the absolute cost, should be considered. Central heating by steam or water is commended; it has been carried out in some important housing schemes. Where the heating installation is concentrated, the cost is said to be almost the same as the cost of a separate installation in each house, and the upkeep and running expenses can be covered by a rent charge of 1s. per house per week, which in the case of tenement houses or blocks can be reduced to 6d. It is recommended that not more than one coal grate should be installed in any house built with the aid of the Government subsidy, and that the Central Housing Authority should decline to sanction any scheme in which specific provision is not made for the adoption of smokeless methods of supplying heat; the practice followed by some municipal authorities of overcharging for gas and electricity in order to secure profits for the relief of the rates is condemned.

We may remark that the use of electricity in connection with many of the new housing schemes is hindered by the low prices quoted by the gas suppliers for equipment, doubtless with the intention of recouping themselves by way of the charges for gas, whilst on the other hand, electricity supply authorities are not making efforts to meet this form of competition by offering a low tariff for heating and cooking. We commend to the notice of the latter the admirable example of the North-East Coast companies, whose electric houses at Billingham were described in our issue of October 29th, 1920. Material economies can be effected in the cost of the buildings by the omission of fireplaces and flues, and the provision of electrical apparatus for heating and cooking, as well as, of course, for lighting, should add very considerably to the attractions of the new houses.

Russian Scientists.—We have received from the British Committee for Aiding Men of Letters and Science in Russia, a letter inviting subscriptions to a fund for providing literary and scientific men in Russia with the works they need; they have seen no European publications since the revolution. Cheques made out to the Treasurer, Mr. C. Hagberg Wright, should be addressed to the above Committee at the British Science Guild Offices, 6, John Street, Adelphi, W.C. 2.

The Federated American Engineering Societies.—At the first meeting of the Council on November 19th; Mr. Herbert Hoover, former Food Administrator and president of the American Institute of Mining and Metallurgical Engineers, was elected president of the governing body, the American Engineering Council. The meeting was attended by delegates from all but one of the 21 charter-member societies and by some representatives of bodies that expect to become charter members.

One of the first activities of the new body will be a survey under Mr. Hoover's direction to determine quantitatively the amount of waste motion in industry. Included in this survey will be the threefold waste in production occasioned by (1) intermittent employment, (2) non-employment arising in shifting industrial currents, and (3) strikes and lockouts.

It was decided to elect only 20 members of the executive board of the Council, leaving four vacancies to be filled by other societies which might later become charter members. On the basis of membership the national societies were entitled to 14 members on the board and the local regional and State organisations to the remaining six places by districts. Washington, D.C., was chosen as the place to establish headquarters. It was decided to extend until July 1st, 1921, the time within which societies may become charter members.

A report by the committee on plan and scope indicated a number of activities, many of which were inherited from the Engineering Council, in which the new organisation could well engage. The executive board appointed Mr. L. P. Alford as its temporary secretary.

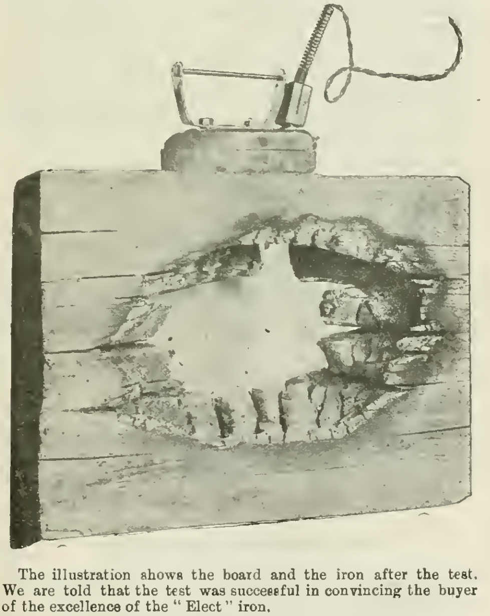
It is reported that the American Society of Civil Engineers, which voted not to become a charter member of the Federated American Engineering Societies, has taken steps to hinder the functioning of the new American Engineering Council of the Federation by trying to perpetuate the old Engineering Council.

British and American Generating Practice.—One of the main objects of the recent tour of the U.S.A. which was made by Alderman Dagnall, chairman of the Manchester Electricity Committee, and Mr. S. L. Pearce, the city's electrical engineer, was, says the *Manchester Guardian*, to ascertain if any desirable points in American practice could be incorporated in the design of the new Barton generating station. In an interview which Mr. Pearce gave to a representative of the above-mentioned newspaper, he is reported to have said that whilst he came across many features that could be embodied in the Barton scheme, he saw nothing to induce him to fundamentally alter the lay-out. The station with its 150,000 kw. total capacity compares with the Duquesne station, at Pittsburg, U.S.A., of 360,000 kw. ultimate capacity supplied by six 60,000-kw. sets. Large American generating sets have not been a complete success, and there is a tendency to proceed more slowly and generate with sets of a more moderate capacity. The explanation given was inability to obtain proper materials during the war period. No faults in design are admitted, but Mr. Pearce is not prepared to accept that statement. He, however, states that the Americans are much keener on extracting the utmost power from their boiler houses. There is much likelihood, Mr. Pearce thinks, that pulverised coal will become the boiler fuel of the future. Americans are awaiting the results of the trials in the Milwaukee stations; in Manchester they may wait, or investigate on their own at Stuart Street later on. "It is certainly a thing we shall have to consider."

"Another matter that interested me," said Mr. Pearce, "was the public steam-heating systems in many American cities, particularly in New York and Detroit. We have done a little bit of warehouse and office block heating from Dickinson Street with exhaust steam, and have tried to make it a by-product supply from the power station. They started in exactly the same way in the States, but they found out, as we found out, that it is next to impossible to run the supplies of electricity and steam together, because the loads are not coincident with the times of demand. In America they have now independent steam-heating stations, owned and controlled in some cases by the electrical companies." Mr. Pearce sees no reason why something of the sort should not be done in Manchester, though the great difficulty would be to find room under the streets for the steam pipes; however, the boilers at the Dickinson Street station could well be used for the purpose when that station ceased to be required for generating purposes. It would be difficult to dogmatise from American experience as the conditions there were so different. The electrical undertakings in the States were operated by companies—it was an exception for the municipality to own and control the public utility services—and in all interconnecting schemes the companies acted in a spirit of voluntary co-operation. A striking example was in Ohio where something like 500,000 kw. of power was interconnected. The outstanding scheme, however, was the interconnecting of the whole of the electrical undertakings on the Atlantic seaboard from Maine to Washington—an area 400 miles long and 150 to 200 miles wide. "The thing that struck me," said Mr. Pearce, "was that it apparently paid certain undertakings to shut down their own plant and buy power from stations 80 or 90 miles away." In cable transmission, said Mr. Pearce, America was 10,000 volts behind this country in pressure—23,000 against 33,000—but overhead transmission there ranged from 33,000 volts to 165,000 volts, and contracts had been placed for overhead lines to operate at 220,000 volts. This country, however, was much restricted in the use of overhead transmission, and whilst not ruling out entirely the possibility of its use in South-east Lancashire, Mr. Pearce expressed the opinion that it would be found possible to use the cable system for higher pressures than 33,000 volts. He doubted whether the requirements of the particular area would ever call for a higher transmission voltage than 66,000. The transformer sub-station in the States, Mr. Pearce proceeded, was usually of the outdoor type, and the apparatus was built to withstand all atmospheric conditions. No buildings were required. Manchester would no doubt adopt the system to a limited extent. America's choice in converter sub-stations was between two types—the remote controlled and the entirely automatically operated—the object of both designs being to cut down operating expenses. It was almost uncanny to see in those converter stations machinery working with the same certainty of proper movement as if a skilled attendant were in charge. America, generally speaking, was very keen on automatic control, and the human agency in the working of telephones was being replaced as quickly as the newer system could be installed. Enormous contracts were in hand all over the United States.

An interim report by Ald. Dagnall and Mr. Pearce, very much on the same lines as the foregoing, was received and approved by the Electricity Committee on January 5th.

A Remarkable Test.—To convince an Australian buyer of the efficiency and durability of their "Elect" iron, the Electric Heating Co, George Street, Croydon, arranged the following test:—A 6-lb. iron was mounted on a wood plank 14 in. wide and 4½ in. thick, and the current was switched on. In 13 hours the iron, which had become a white-hot mass of metal, had burned its way through the board, and although the wooden handle was destroyed and the nickel plating removed, the element was as sound as before the test and the following day a pint of water was boiled on the iron.



The illustration shows the board and the iron after the test. We are told that the test was successful in convincing the buyer of the excellence of the "Elect" iron.

Water-Power Notes.—Some useful notes on the points to be taken into consideration when choosing sites for water turbines are given in a leaflet issued by Sir W. G. Armstrong, Whitworth & Co. The first is the determination of the head, *i.e.*, the vertical distance between headwater and tailwater level, also stating if possible the variations of the head and tail water levels; (2) what h.p. is required, and into how many units the total power is to be divided; (3) available water supply in cubic feet per second; (4) is there always sufficient water, or is the supply liable to run short? (5) is the water supply clean, or does it contain sand or other foreign matter? (6) what has the turbine to drive, and is there any particular desire for a special speed? (7) is a horizontal or vertical shaft turbine required (bevel gears must be avoided if possible)? (8) is the water led to the turbine through a pipe line or an open flume? (9) how long is the pipe line, and is the diameter decided upon? (10) what is the height from the turbine to low water level (the suction head for Francis turbines ought not to exceed 20 ft. vertical. The altitude at which the turbine is to be installed is a factor)? (11) if possible give a sketch showing the site, and also one showing the position of the power station in connection with the pipe line, flume, tail race and dam; (12) in the case of small units, is an oil pressure governor required, or will regulation by hand be resorted to?

Appointments Vacant.—Borough electrical engineer (£400), for the Limerick Corporation; charge engineer, for the Paisley Corporation Electricity Department; teacher of electrical engineering, for the East Ham Technical Institute Evening Classes; accounts clerk (£234), for the Wolverhampton Borough Council Electricity Department; relief charge engineer (80s. + war bonus, at present total remuneration about £8 5s.), for the L.C.C. Tramways Department; junior assistant, for the Borough of Bacup Electricity Department; gas engine attendant and electrician, for the Sheffield Water Works; temporary charge engineer (1s. 11¾d.), for the Aldershot Urban District Council Electricity Works; plumber-jointer, for the Stepney Borough Council Electricity Department; assistant engineer (£300), for King's College Hospital; 1 t. plumber-jointer, for the Wolverhampton Corporation Electricity Department. See our advertisement pages to-day.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Informal Meeting.—An additional informal meeting will be held on January 24th, for the purpose of discussing in what ways the Institution can be made more useful to its members. This will give an opportunity to members who made suggestions at the recent meetings in connection with the increase of subscriptions to put forward their views on the subject.

As it is expected that the attendance at this meeting will be larger than usual, arrangements have been made for it to be held at the Institution of Civil Engineers, at 6 p.m. (instead of at the Chartered Institute of Patent Agents, 7 p m.).

North Midland Centre.—At the first meeting of the 1920-21 session of the above Centre, which was held on December 14th, the chairman, Mr. C. J. Jewell, announced that Mr. Ll. B. Atkinson, president of the Institution, had promised to address the members of the Centre at Leeds on January 11th.

Association of Engineers and Managers of Electrical Undertakings in Australia.—The third annual Conference of this Association was held in Adelaide, from October 5th to 8th. Reports were received from Committees appointed to draw up standards or low-pressure line insulators and consumers' service fuses. Committees were appointed to draw up standards for line insulators or 6,000 V, also for standard line construction for Australian conditions. The next Conference is to be held at Hobart, in November, 1921.—*Australian Mining Standard.*

The Faraday Society.—At the annual general meeting, on December 13th, 1920, the following officers and Council were elected to serve for the coming year:—

President.—Prof. F. W. Porter, F.R S.

Vice-Presidents.—Mr. W. R. Cooper, Prof. C. H. Deach, Dr. J. A. Harker, O.B.E., F.R.S., Mr. Emil Hatschek, Prof. T. M. Lowry, C.B.E., F.R.S., Dr. E. H. Rayner, Dr. G. Senter.

Treasurer.—Mr. Robert L. Mond, F.R.S.E.

Council.—Dr. A. J. Allmand, Dr. H. Borns, Prof. W. C. McC. Lewis, Mr. Harold Moore, O.B.E., Prof. J. R. Partington, Mr. C. C. Paterson, O.B.E., Prof. A. O. Rankine, Sir Robert Robertson, F.R S., Sir T. Kirke Rose, Dr. W. Rosenhain, F.R.S.

Iron and Steel Institute.—The annual meeting of the Institute will take place on Thursday and Friday, May 5th and 6th, at the Institution of Civil Engineers.

The latest date for receiving applications from candidates for election is March 10th.

The annual dinner will be held on May 5th, at the Connaught Rooms, Great Queen Street, W.C. Particulars of the cost of the dinner and details of the arrangements will be circulated later.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

The New Year Honours.—Amongst the recipients of honours in the list published on January 1st we notice the following:—Sir W. Beardmore, Bart., to be a baron; Sir Joseph Hewitt to be a baronet, for notable services rendered in the Coal Controller's Department; Mr. P. R. Rylands, President, and Mr. E. F. Oldham, Deputy Chairman, of the Federation of British Industries, Mr. A. R. Duncan, Coal Controller, and Capt. L. de L. Wells, late Chief Officer of the Metropolitan Fire Brigade, to be knights; Col. J. W. Pringle, Chief Inspecting Officer of Railways, Ministry of Transport, to receive the C.B.; Mr. G. R. Clarke, O.B.E., Indian Civil Service, Director-General of Posts and Telegraphs, to receive the C.S.I.; Mr. W. H. Massey to receive the M.V.O. (Fourth Class). Practically every profession except engineering, as usual, is well represented in the list; in fact, Sir W. Beardmore and Mr. Massey appear to be the only members of the engineering fraternity whose names are in the list.

On December 31st Sir Thomas Williams retired from the post of general manager of the L. & N.W. Railway. He will become a member of the Board of Directors. Asked by a representative of *The Times* what he considered the most far-reaching change in the railway in his experience of nearly 50 years, he said that this was the electrification of the line to Watford. His successor is Mr. Arthur Watson, of the L. & Y. Railway.

Halifax Tramways Committee, in re-affirming a previous decision (referred back by the Town Council) to appoint Mr. J. W. Galloway, tramway engineer, as general manager, at a salary of £700 for one year—the matter then to be re-considered—has also recommended that £250 per annum, for three years, be paid to Mr. J. D. Caird, traffic manager, who is not, in consequence of illness, fit to resume his duties, and that at the expiration of such period the question be reviewed.

Bolton Town Council General Purposes Committee has decided not to grant applications made by Corporation officials in the electricity, tramway, and other departments for increases of salary, on the ground that the position was sufficiently met by the grant of the Civil Services war bonuses recommended by the National Whitley Council last May.

Mr. H. Carey-Thomas, A.M.I.E.E., has been appointed to a commission in the Regular Army, with the rank of Captain, for duty with the Royal Corps of Signals. Captain Carey-Thomas, who held a commission prior to the war in the London Army Troops, R.E. (T.F.), served in France continuously from October, 1914, to May, 1918, and was mentioned in Lord (then Sir John) French's dispatch of January, 1916. In May, 1918, he was appointed Assistant Director of Army Signals at G.H.Q. the Forces in Great Britain, with the rank of Lieut.-Colonel, and at a later date held the appointment of Chief Signal Officer, H.Q. Western Command, Chester.

Mr. R. H. Cridge, B.Sc.(Eng.), has left Messrs. Electro-Metals, Ltd., and joined the Harding Co. as a specialist in pulverised coal and industrial grinding.

Stepney Borough Council General Purposes, Staff and Education Committee recommends that in consideration of the extra work performed for the electricity undertaking by the borough treasurer, a sum of £100 per annum be paid to him as from April 1st last; and that in lieu of the salary and bonus now being paid to Mr. A. J. Squire, the deputy commercial manager in the electricity supply department, he be paid a consolidated salary of £700 per annum, as from June 1st, 1920, rising by annual increments of £25 to £750.

Obituary.—Mr. C. J. Gale.—The death occurred on December 29th, of Mr. C. J. Gale, secretary of the Topsham E.L. Co., Ltd. He was 55 years of age, was a member of the Topsham Parish Council, and a Past-Master of the Brent Lodge of Freemasons.

NEW COMPANIES REGISTERED.

G. W. Higgins & Sons, Ltd. (172,253).—Private company. Registered December 24th. Capital, £3,000 in £1 shares. To carry on the business of shop fitters, cabinet makers, upholsterers, builders, painters, decorators, sanitary and electrical engineers, &c The permanent directors are: G. W. Higgins (governing director and chairman), 22, Connaught Street, W. 2; S. G. Higgins (managing director), 33, Pope's Grove, Strawberry Hill; Mrs. F. Higgins, 22, Connaught Street, W. 2. Registered office: 34, Connaught Street, W. 2.

Controls, Ltd. (172,218).—Private company. Registered December 23rd. Capital £1,000 in £1 shares. To carry on the business of makers of and dealers in flexible wire and rod controls, throttle and ignition controls for internal combustion engines, gear and brake controls for automobiles, motor and other cycles, aircraft, ship telegraphs, and switchboards, mechanical, electrical, and consulting engineers, &c. The subscribers (each with one share) are: W. Mair Rolph, 66, Piccadilly, W., engineer; F. Hay, 9, Lincoln's Inn Fields, W.C., solicitor. W. M. Rolph (director of Hatchetts White Horse Cellars, Ltd., Simms Motor Units (1920), Ltd., Standard Insulator Co., Ltd., and Gerrett & Co., Ltd.) is permanent governing director, with £200 per annum as remuneration. Secretary: L. S. Thompson. Registered office: 66, Piccadilly, W.

Women Engineers.—Atalanta, Ltd., has been registered with a nominal capital of £10,000 in £1 shares. The objects are: To carry on the business of manufacturers of and dealers in automobiles, motor and other cycles, carriages, and electrical appliances, engineers, founders, smiths, machinists, &c. The formation of the company was suggested by members of the Women's Engineering Society, to utilise the available services of women skilled in different branches of the engineering profession. The first directors are: Hon. Lady Katherine Parsons, 6, Windsor Terrace, Newcastle-on-Tyne; Hon. Lady Eleanor G. Shelley-Rolls, 21, Eaton Square, S.W.; Miss Caroline H. Haslett, 46, Dover Sreet, W. (secretary of Women's Engineering Society); Miss Annette Ashberry, 139, Ashby Road, Loughborough; Miss Dora W. Turner, 139, Ashby Road, Loughborough; H. Scofield, M.B.E., &c., The Technical College, Loughborough; W. P. Johnson, A.R.C.Sc.(Lond.), &c., The Technical College, Loughborough. Minimum cash subscription, 60 per cent. of the shares offered to the public. Secretary: Miss Dora W. Turner. Solicitor: R. J. Evans, Midland Chambers, Princess Street, Wolverhampton. The office is at Atalanta Works, Selbourne Street, Loughborough.

George Nobbs, Ltd. (172,328).—Private company. Registered December 30th. Capital, £5,000 in £1 shares (3,000 8 per cent. cumulative preference). To carry on the business of manufacturers of and dealers in electrical appliances, &c. The subscribers are: C. G. Nobbs, 50 West Heath Drive, Hampstead, N.W. 11, electrical engineer (1,000 ordinary shares); Mrs. F. E. Nobbs, 50 West Heath Drive, Hampstead, N.W. 11 (5 ordinary shares). C. G Nobbs is permanent governing director. Registered office: 89, Cleveland Street, W. 1.

C. A. Besley, Bailey & Co., Ltd. (172,282).—Private company. Registered December 28th. Capital, £6,000 in £1 shares. To take over the business of C. A. Besley, Bailey & Co., of Hope Street Lane, Cardiff, and to carry on the business of electrical, telephone, heating, sanitary, hydraulic, motor, gas, ventilating, railway, constructional, and general engineers, &c. The first directors are: F. Morgan, Dowlais Arcade, Cardiff; A. Jones, Dowlais Arcade, Cardiff; C. D. Esnouf, 14, West Bute Street, Cardiff; V. A Bailey (managing director), Hope Street Lane, Cardiff. Solicitor: L. Francis, 12, Dumfries Place, Cardiff.

Globe Engineering Co., Ltd. (172,285).—Private company. Registered December 28th. Capital, £5,000 in £1 shares. To take over the business of electrical engineers carried on by Barraclough Bros., Ltd., at Perseverance Mills, Brighouse. The first directors are: R. M. Brooke, Elstree, Savile Road, Elland; A. Dean, 20, Elizabeth Street, Elland; A. M. Lawry, 28, Heath Crescent, Halifax. Registered office: Perseverance Works, Huddersfield Road, Brighouse.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Dale & Hardy, Ltd.—Charge on certain moneys due under a contract, dated December 9th, 1920, to secure all sums due or to become due from company to the charges for goods, sold and delivered by them. Holders: Samuel Cutler & Sons, Ltd., 39, Victoria Street, Westminster.

Rhondda Tramways Co., Ltd.—Satisfaction to the extent of £5,400 on December 9th, 1920, of charges dated March 24th, 1911, November 13th, 1912, and March 11th, 1915, securing £250,000.

Radio Communication Co., Ltd.—Satisfaction to the extent of £15,000 on November 23rd, of mortgage dated April 28th, 1920, securing £5,000, and further advances up to a maximum of £15,000.

Laminated Gears, Ltd.—Issue on December 16th, 1920, of £600 debentures, part of a series already registered.

Hale, Pearn & Co., Ltd.—Satisfaction in full on December 23rd, of mortgage dated January 27th, 1920, securing £3,600.

Electric Supply Co. of Victoria, Ltd. (66,059).—Capital £325,000 in 175,000 preference and 150,000 ordinary shares of £1 each. Return dated October 27th, 1920. 175,000 preference and 125,000 ordinary shares taken up. £50,007 paid. £249,993 considered as paid. Mortgages and charges, £118,358.

Salford Electrical Industries, Ltd. (112,599).—Capital £20,000 in 10,000 preference and 10,000 ordinary shares of £1 each. Return dated November 30th, 1920. All shares taken up. £10,000 paid on the preference. £10,000 considered as paid on the ordinary. Mortgages and charges, nil.

Anglo-Russian Engineering Co., Ltd.—Satisfaction to the extent of £500 on November 24th of debentures dated January 17th, 1917, securing £2,000.

CITY NOTES.

Edison Swan Electric Co., Ltd. The directors' report for the year ended June 30th, 1920, states that the profit for the year was £111,570, plus £61,710 brought forward, making £173,281, out of which the following payments have been made:—

Interest on both classes of the debenture stock	£17,690
Seven per cent. dividend on participating preference shares to January 31st, 1920	7,000
Excess profits duty to June 30th, 1918, less munitions levy refund ...	16,615

The balance of £131,976 is to be appropriated as follows:—

Special munitions plant depreciation	2,844
Expenses of issue of ordinary shares	10,000
Transfer to reserve	5,000
Dividend of 3 per cent. on participating preference shares (making 10 per cent. for the year)	3,000
Provision for debenture stock sinking fund	5,978
	26,822
To be carried forward, subject to excess profits duty from June 30th, 1918, and corporation profits tax	105,154
	131,976

During the year under review the sum of £127,550 has been expended upon capital account, of which £460 is in respect of additional building land, £78,268 on buildings, and £48,822 on plant and machinery. Extensive additions have been made to the lamp works, mainly to provide for the manufacture of gasfilled half-watt lamps; the expenditure upon these buildings and their equipment amounts to £91,169.

In the early part of this year the board entered into an arrangement with Messrs. Philips' Glow Lamp Works, Ltd., of Eindhoven, Holland, whereby it has been able to obtain the co-operation of that firm at the Edison-Swan works at Ponders End in the manufacture of all classes of electric lamps. The Philips' Glow Lamp Works, Ltd., possesses processes, plant, and machinery which have hitherto enabled it to manufacture lamps on the most economical basis, and of the very highest quality. Similar plant, machinery, and processes have now been installed for some months at the Ponders End works of the Edison-Swan Co., and although the benefits derived from this installation do not, at the date of the balance sheet, reflect in the profits, they are becoming apparent, and should very considerably increase the profits in the future. The directors are satisfied that the arrangement made with the Philips' Glow Lamp Works, Ltd., will prove beneficial to the company, and under the terms of the agreement a separate company will be formed for the entire manufacture of electric lamps for the Edison-Swan Co., the necessary capital being equally contributed by the Edison-Swan Co. and the Philips' Co.

Arrangements have been entered into with the Sangamo Electric Co. of the United States, manufacturers of high-class electric meters, which they are producing on an extremely economic basis, and which command a ready sale in all parts of the world. Under this arrangement a company is being formed in conjunction with the American firm, the capital being subscribed by that firm and the Edison-Swan Co., to manufacture similar meters at the Ponders End works of the Edison-Swan Co., buildings having been erected for the purpose at a cost of £25,000.

During the period of the war and for some considerable time after the cessation of hostilities, the stocks of raw materials and manufactured goods had fallen very low, and in order to efficiently carry on the company's operations it has been found necessary to very largely increase these. For this reason, coupled with the heavy expenditure on new buildings, plant, &c., the prospective employment of further large sums in lamps, electric meters, and other stocks, it is necessary that additional capital should be provided. The position of the money market, however, is not sufficiently favourable to allow of an immediate issue, but so soon as it is possible it will be made. In the meantime it is necessary that the cash resources of the company should be conserved, and under these circumstances the directors regret that they are not able to recommend the payment of a dividend upon the ordinary shares, and they, therefore, propose to carry forward the sum of £105,154, which will be subject to excess profits duty and corporation profits tax. Should the financial position become more liquid, the directors may be in a position to declare a compensating interim dividend before the termination of the financial year.

French Companies. *The Etablissements Maljournal et Bourron* report a gross profit on the working year of 6,139,140 fr., and a net profit of 1,345,789 fr., which, with the sum carried over from the previous year, yields an available balance of 1,360,907 fr. (against 775,707 fr. for the year 1918-1919). Out of this a dividend equal to that of the foregoing year is declared, namely, 12 fr. per share. All the items of the company's balance sheet show improvement, the aggregate for the year totalling 25,620,248 fr., against 17,943,365 fr. in 1918-1919.

The Syndicat des Mécaniciens, Chaudronniers et Fondeurs de France has published a resolution passed at a previous meeting that its manufacturing members, in dealing with their customers, were ready to return to all the usages of credit customary before the war, notably in the matter of accepted bills of exchange, presuming, of course, reciprocal equality of treatment on the part of their clients. To render this step effective the stamp duty (0.20 fr. per cent.) should, it says, be reduced, which would result in a larger return from this duty by reason of the greater volume of business which would result from the reduction. The Syndicat is an important body, numbering a thousand members scattered all over France, and employing over 250,000 workmen. The Lyons Chambre de Commerce and the chairmen of the Parisian Chambers have likewise drawn the Government's attention to the effect of this tax on restricting trade and the need for restoring complete freedom to commerce. Only measures of this kind, it is held, can stave off the oncoming general commercial breakdown.

German Companies. *The Brasilianische Elektrizitats Gesellschaft*, of Berlin, which has a share capital of 5,000,000 marks, and whose assets are represented by the telephone system in Rio de Janeiro, reports general expenses and taxes in Berlin amounting to 158,000 marks for 1919-20, which sum has been debited to the Rio de Janeiro Tramway, Light & Power Co. The accounts show no profits, and a dividend has not been paid since 1915-6, when the shares were disposed of to a Canadian company.

The report of the *Berlin Elektrizitats Werke A.G., of Berlin*, whose activity is now limited to that of acting as a trust for the A.E.G., states that the undertakings which the company is interested in yielded satisfactory results in 1919-20. These include the Leopold Colliery, the Bitterfeld Electrochemical Works, and certain supply companies. The accounts indicate net profits of 5,788,000 marks, as contrasted with 4,781,000 marks in 1918-19, and the dividend is at the rate of 10 per cent., as against 8 per cent. in the previous year.

The shareholders in the *Rheydt Cable Works Co.* have just sanctioned an increase in the share capital of 10,000,000 to 25,000,000 marks. At the recent general meeting it was stated that the augmentation was rendered necessary by the general development of affairs, and as an instance it was mentioned that while a stock of from 500 to 600 tons of copper cost 600,000 marks before the war, a sum of from 15 to 18 millions of marks was now required for the same quantity. It was also stated that business had become more active in the past few weeks, and orders were now on hand for several months forward.

Stock Exchange Notices.—Dealings in the following securities have been specially allowed by the Committee under Temporary Regulation 4 (3):—

General Electric Co.—78,641 ordinary shares of £1 each, fully-paid, Nos. 2,033,335 to 2,111,975; and 22,891 7½ per cent. "B" preference shares of £1 each, fully-paid, Nos. 1,600,001 to 1,622,891.

The Committee has ordered the following to be officially quoted:—

British Electric Transformer Co.—137,500 7 per cent. cumulative preference shares of £1 each, fully paid, Nos. 325,001 to 462,500.

Provincial Tramways, Ltd.—Final dividend of 10d. per share (making 7½ per cent.) on the ordinary shares for the year ended September 30th. £10,000 is placed to reserve and depreciation account, and £10,000 is provided for excess profits duty.

Victoria Falls & Transvaal Power Co., Ltd.—Dividend at the rate of 6 per cent. per annum, less tax, on preference shares for the six months.

British Electric Transformer Co., Ltd.—Profits for the half-year ended June 30th last were £36,344, as compared with the corresponding period in 1919 of £21,419.

STOCKS AND SHARES.

Tuesday Evening.

The New Year opened with strength in most of the Stock Exchange markets. There was a better tendency shown amongst the majority of stocks, due doubtless to the fact that money was being released from deposit and current accounts where it had lain, for window-dressing purposes, up to the end of 1920. There is talk in the air of a possible reduction in the Bank Rate, though in good quarters this revived expectation is treated cautiously. The present 7 per cent. Bank Rate has been in force since last April, and the argument in favour of a reduction in the rate is that such a step would fit in with the Government's programme for stimulating and encouraging trade in order to reduce unemployment.

Buoyancy in the War Loan and other gilt-edged securities constitutes a useful platform from which the general markets of the Stock Exchange can step off to better conditions in the New Year. There is certainly more willingness than was displayed last month on the part of the public to invest money in Stock Exchange securities. Forced liquidation has come to an end for the time being, nor is there much likelihood of its being renewed in the same measure at all events, as characterised the pressure of the last six months. These things make for better markets, and while several ugly niggers remain in the hedge, Stock Exchange opinion is inclined to be optimistic, though tempered by the consideration that too great uncertainty prevails for the House to look for any especial expansion of business in the near future.

The Edison Swan Co. has greatly disappointed its shareholders by passing the dividend for the final six months of the year. Moreover, there is talk of a probable new issue before long. The company's profits for last year came to £111,500 as against £137,400 for the previous twelve months, when 10 per cent. was paid. Once again it is the money position which renders distribution of profits inadvisable. The directors state that should the financial position become more liquid, they may be able to declare a compensating interim dividend before the termination of the current financial year. This latter statement is regarded as being in the nature of consolation, and for its fulfilment everything really depends upon the money position. The company did reasonably well last year, and in the ordinary way there would have been a dividend on the ordinary shares, but, as with the India-Rubber and various other companies which are issuing their reports just now, the necessity for keeping cash in hand over-rides the desirability of paying dividends to shareholders.

This is the kind of thing which it may be feared will make itself unpleasantly conspicuous in reports and statements of industrial companies during the next few months. It comes about as the direct result of the deflation which one can see now clearly enough was bound to be one principal feature of war's aftermath. In addition, however, there is the factor of the coal strike to be taken into account. This had the effect of holding up trade for several weeks, not only while the strike itself lasted but for some considerable period previously, when manufacturers and others declined to enter into contracts, or to take on any risks except those which were absolutely necessary, having regard to the struggle forced by the coal-miners.

Amongst the firmer markets which the New Year has brought must be included the market for Home Railway stocks, where numbers of rises have taken place during the past few days. So far, however, Undergrounds have not benefited, and there is not much doing in the stocks of the companies. Underground £10 shares are ⅛ lower at 35s.

English Electric 8 per cent. six-year Notes, which were issued at 98, can be bought at 92 or a little cheaper, offering a return on the money of 8¾ per cent., with a full interest payment due on July 1st. The Notes are redeemable in 1927 at 103, or after 1923 at the same price. A similar yield can be obtained from the 5 per cent. debenture stock of the Metropolitan Electric Tramways, which stands at 58, with interest due April 1st and October 1st. Westinghouse Brake 8 per cent. first mortgage debentures, which came out at 95, can be bought at one or two points discount, giving a yield of 8½ per cent. on the money, and being redeemable at par in 1944 or earlier. There is a sinking fund to be applied to purchases in the market, or to drawings at par. The 4½ per cent. second debenture stock of the Brush Electrical Co. is on offer at 56, affording 8 per cent. on the money, and this is a perpetual security. Calcutta Electric 5 per cent. convertible debentures, which came out at 95, are obtainable at 93½, giving 5⅜ per cent. free of tax, equivalent to 7¾ per cent. on the money, allowing for income tax at 6s. in the £. These carry conversion rights into the ordinary shares, between June, 1922, and June, 1925, inclusive, at the rate of £7 10s. debenture for £5 ordinary shares. In the preference list, General Electric 7½ per cent. "B" shares can be bought at 18s. 9d. ex dividend, paying 8 per cent. on the money; the company's 6½ per cent. "A" preference at 17s. 3d. offering just over 7½ per cent. County of London Electric 6 per cent. preference have come on offer at a little over £8, thus offering 7½ per cent. on the money, with dividends due in March and December. We mention these various issues as showing what is available in the markets for sound securities of the kind which may appeal to those who are putting away money for permanent investment at the beginning of the year.

Brompton ordinary are ⅛ down at 5⅞. South Metropolitan 7 per cent. preference weakened to 13s. 9d., and the 6 per cent. second preference to 12s. City of London ordinary shares are 1-16 easier at 21s. 3d., and these are the only changes in the electricity supply list. County of London remain at 7½. It is announced that the company is seeking Parliamentary authority to constitute its Barking supply into a separate undertaking. A meeting will be called to take the necessary powers. Amongst the manufacturing shares, Edisons fell to 8s. 9d., on the lack of the dividend, but rallied again to 10s.; the 5 per cent. debenture stock at 70 is ex dividend. Siemens are easier at 20s. 7½d. Babcock & Wilcox went up 3-16 to 2 5-16, and most of the iron, steel and armament shares are disposed to harden. Armstrongs improved to 19s., and Vickers, in which there is apparently a bear position, recovered to 16s. 3d. after dipping to 14s. 6d. the day after the recent meeting.

In the cable group, Great Northerns gave way to 20, but apart from this, the general tendency is decidedly firm. Eastern stocks are all in demand, and it is difficult to get the offer of any reasonable amount at the figures quoted in our lists. Marconis recovered to 2 5-16 ex the dividend. Better prices also have come into force for Radio Common at 9s. 6d., and preferred at 10s. 6d. Other Marconi shares are inclined to be a little better, though without any particular change in the prices.

Anglo-Argentine Tramways first preference are quoted 2¾ ex dividend, and the 5 per cent. debenture is easier at 53½. Mexicans are quiet on the whole. Mexican Light and Power preferred at 22½ is 3 points down, but the first mortgage bonds firmed up to 61½. Other foreigners are unchanged. Dollar stocks have been fluctuating a good deal, and are lower on balance. One of the Stock Exchange features at the moment is a sharp recovery in rubber shares, owing to the suggested Credit Export scheme. This, if established, might have the effect of bringing in the long anticipated buying of rubber from Germany and Austria, to the clearing off of the accumulated stocks of rubber and the re-establishment of the industry on a profitable basis. Many substantial price-improvements have occurred this week, although actual business continues to run on very retail lines.

SHARE LIST OF ELECTRICAL COMPANIES.

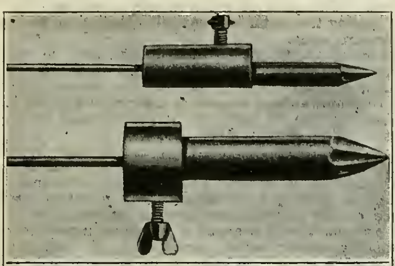
	Dividend 1918.	Dividend 1919.	Price Jan. 4, 1921.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	12	5⅞	⅛	£10 4 4
Charing Cross Ordinary	4	7	8⅜	—	10 7 4
do. do. do. 4½ Pref. ..	4½	4½	2¾	—	8 8 8
Chelsea..	3	4	3⅛	—	8 8 0
City of London	8	10	1 1/16	— 1/16	9 8 2
do. do. 6 per cent. Pref. ..	6	6	17/6	—	6 17 2
County of London	7	8	7½	—	10 13 4
do. do. 6 per cent. Pref.	6	6	8	—	7 10 0
Kensington Ordinary	6	7	8⅞	—	9 0 6
London Electric	Nil	2½	⅜	—	10 0 0
do. do. 6 per cent. Pref. ..	6	6	2¾	—	10 18 2
Metropolitan..	6	6	2⅝	—	11 8 8
do. 4½ per cent. Pref. ..	4½	4½	2 9/16 xd	—	8 15 8
St. James' and Pall Mall	10	12	6¼	—	9 12 0
South London	5	6	2½	—	9 12 0
South Metropolitan Pref.	7	7	13/9	— ⅛	10 3 8
Westminster Ordinary	8	10	4¾	—	10 10 6
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	75½	—	7 19 0
do. Def.	33/6	1½	15¾	+ ⅛	9 10 8
Chile Telephone	8	6	5½	—	*5 9 1
Cuba Sub. Ord.	7	7	7	—	*10 0 0
Eastern Extension	8	10	14¾	—	*6 15 7
Eastern Tel. Ord.	8	10	152½	—	*6 11 4
Globe Tel. and T. Ord.	8	10	14¾	—	*6 15 7
do. do. Pref.	6	6	8½	—	7 1 2
Great Northern Tel.	22	22	20	— ½	11 0 0
Indo-European	13	10	80	—	8 6 8
Marconi	25	25	2 5/16	+ ¼	—
Oriental Telephone Ord.	10	12	2 5/16	—	*6 4 0
United R. Plate Tel.	8	8	5⅞	—	*6 16 4
West India and Panama	1/3	Nil	1/16	—	Nil
Western Telegraph..	8	10	14¾	—	*6 15 7
HOME RAILS.					
Central London Ord. Assented ..	4	4	43½	—	9 4 0
Metropolitan	1	1¼	20	—	6 5 0
do. District	Nil	Nil	15½	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅝	— ⅛	Nil
do. do. "A" ..	Nil	Nil	5/-	—	Nil
do. do. Income ..	6	4	60½	—	—
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams, First Pref. ..	Nil	6½	2¾ xd	—	10 0 0
do. do. 2nd Pref. ..	Nil	Nil	8⅛ *	—	Nil
do. do. 5 % Deb. ..	5	5	53½	—1	9 8 6
Brazil Tractions	Nil	Nil	37	—	Nil
British Columbia Elec. Rly. Pfce.	6	5	56	—	8 18 4
do. do. Preferred	2½	5	55½	—	*6 8 2
do. do. Deferred	Nil	3	52½	—	*6 10 10
do. do. Deb. ..	4½	4½	53½	- 3	7 19 0
Mexico Trams 5 per cent. Bonds ..	Nil	Nil	37	—1	Nil
do. 6 per cent. Bonds ..	Nil	Nil	27½	—	Nil
Mexican Light Common	Nil	Nil	16	—	Nil
do. Pref.	Nil	Nil	22½	—3	Nil
do. 1st Bonds	Nil	Nil	61½	+1	Nil
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	2 5/16	+ 3/16	6 9 10
British Aluminium Ord.	10	10	⅞	—	11 8 6
British Insulated Ord.	12½	15	1¾	—	10 18 2
Callenders	25	15	1¾	—	10 18 2
,, 6½ Pref.	6½	6½	17/6xd	—	7 8 7
Castner-Kellner	20	17	2⅞xd	—	7 2 9
Crompton Ord.	10	10	16/6	—	12 2 6
Edison-Swan	10	10	10/-	—	—
do. do. 5 per cent. Deb. ..	5	5	70xd	—	7 2 10
Electric Construction	10	10	16/6	—	11 8 8
Gen. Elec. Pref.	6½	6½	17/8xd	—	7 10 9
do. Ord.	10	10	1 3/16	—	*8 8 5
Henley	25	15	1⅝	—	9 4 8
do. 4½ Pref..	4½	4½	8⅛	—	7 4 0
India-Rubber	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	1 11/16	—	9 9 4
Siemens Ord...	10	10	1 1/32	— 1/32	*9 14 2
Telegraph Con.	20	20	21	—	*6 14 8

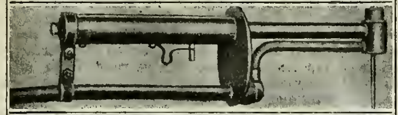
* Dividends paid free of Income Tax.

CARBON ELECTRODE ARC WELDING AND CUTTING.

An outline of welding and cutting by means of the carbon arc was given by Mr. O. H. Eschholz in a recent issue of the *American Machinist*, and the article enumerated several advantageous applications of this type of work.

Carbon or graphite welding is the oldest of the electric arc fusion processes now in use. The original process consisted in drawing an arc between the parent metal and a carbon electrode in such a manner that the thermal energy developed at the metal crater fused the edges of two members together.





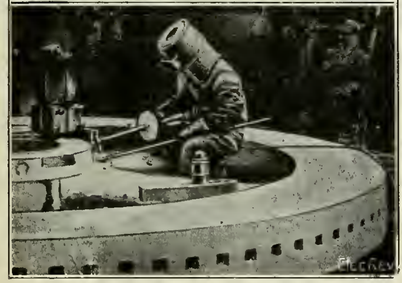


Fig. 1.—Adapters for Using Carbons in Metallic Electrode Holder.
Fig. 2.—Metallic Electrode Holder.
Fig. 3.—Correct Welding Position.

This process was early modified by adding fused filling metal to the molten surface of the parent metal.

The equipment now used consists of a direct-current arc-circuit possessing inherent means for stabilising the carbon arc, a welding hood for the operator, an electrode holder that does not become uncomfortably hot in service and suitable clothing such as bellows-tongued shoes, gauntlets, and apron of heavy material.

When arc currents of less than 200 amp. are used, or when a graphite arc process is employed intermittently with the metallic electrode process, the carbon-holding adapters shown in fig. 1 may be used with the metallic electrode holder, the shank of the adapter being substituted for the metal electrode. With very high arc currents, 750 amp. or more, special holders should be constructed to protect the operator from the intense heat of the arc. Fig. 2 shows a typical holder.

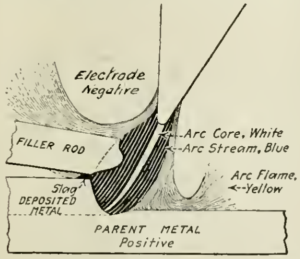


Fig. 4.—Position of Electrode and Characteristics of the Arc.

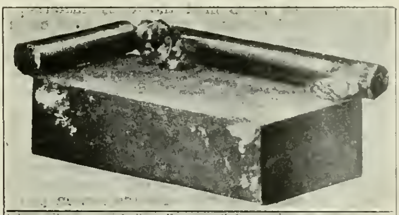
Electrodes.—Although hard carbon was originally employed for the electrode material, experience has shown that a lower rate of electrode consumption as well as a softer weld may be obtained by substituting graphite electrodes. While both electrodes have the same base and binder, the graphite electrode is baked at a sufficiently high temperature (2,000 deg. C.) to graphitise the binder, thereby improving the bond and the homogeneity of the electrode.

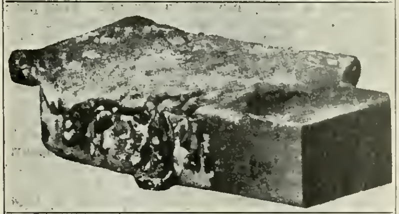
The diameter of the electrode is determined partly by the arc current. To fix the position of the carbon arc terminal, thereby increasing arc stability and arc control, all electrodes should be tapered. This precaution is particularly important when using a low value of arc current, or when maintaining an arc under conditions which cause distortion and instability. The following table gives electrode diameters in most common use with various arc currents:—

Amperes			Diameter
50 to 150	...	...	¼ in. tapered to ⅛ in.
150 to 300	...	...	⅜ in. tapered to ⅛ in.
300 to 500	...	...	1 in. tapered to ⅛ in.
500 to 750	...	...	1¼ in. tapered to ⅛ in.
750 to 1000	...	...	1½ in. tapered to ⅛ in.

Filler Material.—A strong, sound weld can be obtained only by using for filler metal low-carbon, commercially pure iron rods having a diameter of ⅜ in. or ½ in., depending on the welding current used. Cast iron or manganese steel filler rods produce hard welds in which the fusion between the parent and added metals may be incomplete. Short rods of scrap metal, steel turnings, &c., are frequently made use of for filler metal when the purpose of the welder is merely to fill a hole as rapidly as possible. It should be understood that welds made with such metal are weak, contain many blowholes, and are frequently too hard to machine.

For graphite arc welding employing a filler the correct posture of the operator is shown in fig. 3. The filler rod is grasped by the left hand with the thumb uppermost. When held in this position the rod may be used for brushing off slag from the surface of the metal.





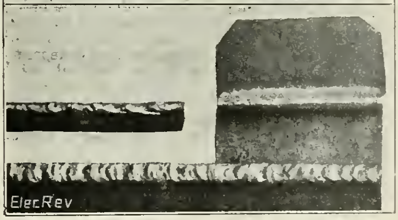


Fig. 5.—Building up Process—Commencement.
Fig. 6.—Building up Process Nearly Completed.
Fig. 7.—Flanged Edges Welded with Graphite Arc.

The surfaces to be welded should be chipped clean, and where they are scarfed the angle should be wide enough to enable the operator to draw an arc from any point without danger of short-circuiting the arc. The practice of removing sand and slag from the metal surfaces by fusing them with the arc and striking the mass with a hammer should be discouraged on account of the danger of flying fragments.

Arc Manipulation.—If the arc is formed from the surface of the deposited metal or from that of a molten area, slag particles may adhere to the end of the electrode, deflecting the arc, and rendering manipulation difficult. When the electrode is held vertically, irregularities in the direction and force of convection currents deflect the arc, causing movements in the metal arc terminal. By inclining the graphite electrode approximately 15 deg. to the vertical the deflecting force is constant in direction, keeping the arc stream and arc terminal approximately in line, as shown in fig. 4.

Polarity.—The positive terminal of a carbon arc is hotter and consumes more energy than the negative. Consequently, if the electrode is made the positive terminal, energy will be uselessly consumed, and the resulting higher temperature will increase the consumption of the carbon, and moreover a very unstable arc will be obtained. Therefore the electrode should always form the negative terminal, and any reversal of polarity will be detected by the excessive heat developed.

Arc Length.—If carbon is permitted to be absorbed by the fluid metal a hard weld will result, and therefore practically all the volatilised carbon should be oxidised. This may be accomplished by regulating the arc length so that atmospheric oxygen will have ample time to diffuse through the arc stream, and combine with the carbon present. The correct arc length is dependent on the welding current and the degree of confinement of the arc. Since the arc diameter varies as the square root of the current, the arc length should be increased in proportion to the square root of the current. It is also obvious that when an arc is drawn from a flat, open surface the vaporised carbon is more accessible to the atmospheric gases than when it is enclosed by the walls of a blowhole. This means that to secure the same amount of oxidised carbon under both conditions the confined arc should be the longer. Many welders are not familiar with this phenomenon, with the result that metal deposited in holes or corners appears to be inexplicably hard.

The lengths of 250-amp. and 500-amp arcs should not be less than ½ in. and ¾ in. respectively when the arcs are drawn from a flat surface. The maintenance of excessive arc lengths causes the diffusion, through convection currents, of the protecting envelope of carbon dioxide, with the result that the exposed hot metal is rapidly oxidised or "burned."

For most purposes a 250-amp. arc should not exceed a length of 1 in. and a 500-amp. arc should not be longer than 1½ in.

The energy developed at the metal terminal or arc crater is utilised to melt the parent metal, while that generated in the arc stream serves to melt the filling material. If the molten filler is not properly guided and, as a consequence, overruns the fused parent metal, a poor weld will result. This process necessitates, therefore, a constant observation of the distribution of the fused metals as well as a proper control of the direction of flow and speed of deposition of the filling metal.

There are two methods in use for adding the filler with a minimum overlap. One is called the "puddling" process. It consists in melting a small area of the parent metal, thrusting the end of the filler rod into the arc stream, where a small section is melted or cut off, withdrawing the rod and fusing the added material with the molten parent metal by imparting a rotary motion to the arc. This puddling of the metals serves also to float slag and oxidised material to the edge of the fused area, where they may be brushed or chipped off.

The rapid building up of a surface by this method is shown in fig. 5. The short sections of filler rod were welded to the sides of the casting in order to prevent the molten material from overflowing and to indicate the required height of the addition. The appearance of the nearly completed "fill" is shown in fig. 6. One side of the added metal is lower than the others to facilitate the floating off of the slag, some of which may be observed adhering to the edge of the plate.

In the second method the filler material is deposited in layers, the deposits being similar to those obtained with the metallic electrode process, but wider and higher. This method simply requires the operator to feed the filling rod continuously into the arc stream so that the molten filler is deposited on the area of parent metal fused by the arc terminal while the arc travels across the surface. If the end of the rod is moved forward while resting on the surface of the newly-deposited metal, most of the slag produced by the oxidation of the hot metal is floated to the sides of the deposit, where it may be brushed or chipped off.

To remove slag or improve the appearance of the deposits the surface of the added metal may be remelted by running the arc terminal over it, provided "burning" and hardening of the metal is avoided.

The expedient of hammering or swaging the hot deposited metal is frequently resorted to where a refinement in the structure of the crystal grains is desirable.

Flanged Seam Welding.—Fig. 7 illustrates a useful application of the original carbon-arc process wherein no filler metal is used, the metal arc terminal serving to melt together the flanged edges.

This process is easily performed. To obtain adequate fusion the arc current selected should have such a value that the metal-arc crater nearly spans the edges of the seam. To assure the maintenance of a stable arc a small, tapered electrode should be employed, the diameter of the electrode end remaining less than ⅛-in. during use.

The graphite arc process is used occasionally to form butt and lap welds by melting together the sides of the joint without the use of filler metal. Examination of sections through joints made in this manner reveals that the weld is very shallow, and therefore weak.

Welding of Non-ferrous Metals.—Copper and bronzes have been successfully welded with the graphite arc when employing a bronze filler rod low in tin and zinc and high in phosphorus, at least 0.25 per cent. The best filler material for the various analyses of parent metals has not been determined, but it is recognised that the presence of some deoxidising agent such as phosphorus is necessary in order to ensure sound welds free from oxide and blowholes. Since copper and its alloys have a high thermal capacity and conductivity, preheating of the structure facilitates the fusion of the joint surfaces. The grain of the completed weld may be refined by subjecting the metal to a suitable mechanical working and temperature cycle.

Low-melting-point metals such as lead may be welded by holding the graphite electrode in contact with the surfaces to be fused without drawing an arc, the current value used being sufficient to heat the end of the carbon to incandescence. The hot electrode tip may also be used to melt the filler rod into the molten parent metal.

Application.—The graphite arc processes may be used for the following purposes: Welding of cast steel and non-ferrous metals; cutting of cast-iron and cast-steel risers and fins and non-ferrous metals; rapid deposition of metal to build up a surface or fill in shrinkage cavities, cracks, blowholes, and sand pockets, where strength is of minor importance; fusion of standing seams; melting and cutting of scrap metal; remelting of a surface to improve its appearance or fit; preheating of a metal structure to facilitate the welding operation, to reduce locked-in stresses or to alter some dimension; deposition of hard metal or the hardening of a surface by the inclusion of vaporised carbon, such as rails, frogs, and wheel treads; and automatic cutting and welding of sheet metal.

Cutting.—The manipulation of the cutting arc is exceedingly simple, the operator merely advancing the arc terminal over the section to be cut at a rate equal to that at which the molten metal flows from the cut. The cutting speed increases with the value of arc current used. The width of the cut increases with the arc diameter, and therefore as the square root of the arc current. When cutting deeper than 4 in. the electrode should not come into contact with the walls of the cut and thereby short-circuit the arc. This process may be used for cutting both ferrous and non-ferrous metals. It is often used for the "burning" out of blast-furnace tap holes and the melting or cutting of iron frozen in these furnaces.

THE HEATING OF BURIED CABLES.

(*Abstract of Report discussed before the* Institution of Electrical Engineers.)

(*Concluded from page* 842.)

Section II.

Report, by Mr. E. Fawssett, May, 1920, on Work at Newcastle-upon-Tyne on e.h.p. Paper-insulated Cables laid direct in the Ground at Different Depths.

The depths were 1, 2, and 4 ft. from the ground surface to the top of the 2-in. concrete slab over the cable, corresponding to depths of 1½, 2½, and 4½ ft. approximately to the centre of the cable. The results show considerable variation between tests on the 1 ft. and 2 ft. depths, but a fairly constant difference between those on the 1 ft. and 4 ft. depths. The average increase in temperature-rise for the same current for the cable at 2 ft. over that at 1 ft. is 4 per cent., and for the cable at 4 ft. over that at 1 ft. 15.7 per cent. This amounts to rating the 2 ft. cable at 2 per cent., and the 4 ft. cable at 7.5 per cent. less current than the 1 ft. for the same temperature-rise on the core.

The tests were carried out in fairly still weather and under average winter conditions. The results obtained with D.C. did not show any perceptible difference from those obtained with A.C. The whole of the results obtained are plotted in fig. 7, in which actual temperature rises are shown as against depth, and at the top is plotted the percentage increase in temperature rise with depth, over the rise of the 1 ft. cable. This shows clearly how the ratio of the rise of the 1 ft. and 2 ft. cables varies with the different tests, and it should be emphasised that this variation is not due to inaccuracy in the measurements. The average curve probably represents very fairly the average results to be expected from an armoured cable laid direct in the ground under average conditions in winter weather in a soil of average moisture content.

Various samples of the soil were taken at different times while the tests were in progress, and the moisture content was determined. This was never far from 20 per cent.

Section III.

Report, by Prof. E. W. Marchant, on Work at Liverpool University on Vulcanised Bitumen Cables laid solid in Stoneware Troughing.

Four pairs of feeders were laid at a depth of 3 ft. below ground. The cable was insulated by two layers of fibre served on the conductor, then dielectric of vulcanised bitumen, then two layers of strong bitumen tape well compounded, and was supported on porcelain bridges in stoneware troughs, filled with bitumen, and covered with flat tiles, the arrangements being the same as those employed by the Corporation in ordinary street work. The ground in which the cables were laid was a soft sandstone rock in which the moisture was usually found to be about 10 per cent.

It was suggested that the temperature coefficient of the copper in the cables might be measured by observing the resistance of the cable at the ground temperature, for different ground temperatures. The results obtained, however, fig. 6 (see p. 842 of our last issue), did not give any definite relations between those quantities. The ground temperature, as read on a thermometer, varied. In other cases the ground temperatures were steady while the cable resistance varied. Again variation in ground temperature occurs daily, and when a test was being made this variation had apparently no effect upon the cable resistance.

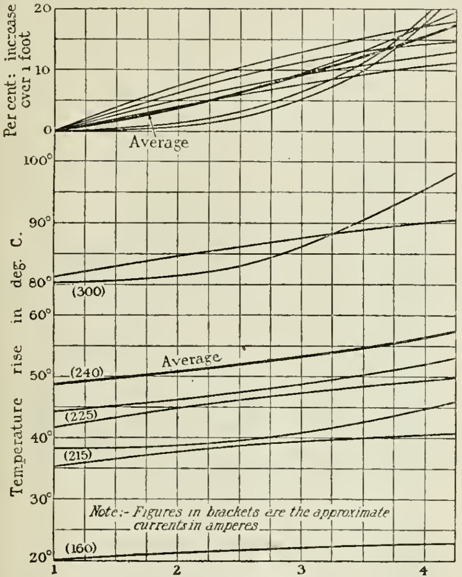


Fig. 7.—Temp.-rise with Varying Amounts of Cover.

The mean ground temperatures at the depth of the cable (3 ft.) have been taken continuously and seem nearly constant at about 5 deg. C. throughout the winter, until the middle of April. Then it rises steadily till at about the middle of June it assumes a nearly constant value of about 14 deg. C.

Measurements were made of the temperature coefficient of the copper, and the results show that the mean temperature coefficient was about 0.409 per cent. from 10 deg. C., which agrees with the value given by the British Engineering Standards Association for that temperature. The temperature rise of the cable was estimated from the increase in its resistance. The sandstone in the trench never contained less than 8 per cent. of moisture. During the time that these tests were run, *i.e.*, June, 1916, to March, 1917, the maximum amount of moisture was 13 per cent., the soil in this condition being non-friable.

The results of the first series of tests are shown in fig. 8; the temperature rise on any cable is almost exactly proportional to the power loss in it, and the difference in the moisture of the ground surrounding the trough appears to exercise little influence on the heating of the cable. The final rises in each case, namely, at 750, 1,000, and 1,250 amps. per sq. in., are substantially the same, *i.e.*, 10, 20, and 30 deg. C. The tests show that, within certain limits the temperature rise for any given size of cable can be estimated very closely from the rate of heat production in it, and also afford data enabling the effect of momentary overloads to be calculated.

For practical purposes correction for "end effect" may be neglected. The relation between the temperature rise of cables after a six-hours' run and the current passing through them is discussed, and it is shown that the temperature rise is nearly proportional to the square of the current, but it is relatively small with cables of smaller section with given current densities.

The most important factor in the cooling of cables laid directly in the ground is the moisture in the earth surrounding them. The extreme variations in moisture were from nearly 13 to 9 per cent. during a comparatively dry spell. The character of the troughing and its comparatively large heat capacity would lead one to anticipate that the effect of variations in moisture would not be very large except for long continued runs.

After the first series of tests, the 0.6 sq. in. cable was run for 58 hours at 600 amperes. The increase in temperature rise at the end of this period, as compared with that after six hours, is nearly 20 per cent. A further series of tests was undertaken with a view to finding the ultimate rise in temperature after several days' run.

The results have been worked out to show the ratio of the temperature rises after a total time of 12, 24, 48, 72, and 96 hours, to the temperature rise after a six hours' run, and the temperature rise is very nearly the same after 96 hours as it is after 48 hours, *i.e.*, the temperature of the cable reaches a nearly constant value after about 48 hours. The cable approaches its final temperature rise more quickly when it is of small section, than when it is of larger section. The increase in temperaure rise between six and 96 hours is, for the 0.6 sq. in. cable, about 25 per cent. of that obtained on the 6-hour rise, for the 0.4 sq. in. cable about 21 per cent., for the 0.25 sq. in. cable about 20 per cent., and for the 0.1 sq. in. cable about 19 per cent.

So long as the temperature rise did not exceed 30 deg. C. the final rise was very nearly proportional to the watt loss per foot run in the cable, but when the temperature rise exceeded 30 deg. C. there was a slightly greater rise.

Finally, the theory and determination of thermal constants for insulating material are discussed. Values of thermal resistivity for cables of 0.6 sq. in. section are recorded as 487, 540, and 488; and for cables of 0.1 sq. in. section as 507, 530, 536, and 531. The corresponding thermal resistances are given respectively as 43.3, 48, 43.5; and 73.9, 77.1, and 77. The thermal resistance in the same units for the trough filling and ground is given as 87 for the 0.6 sq. in., and 92 for the 0.1 sq. in. cables. The cable covering showed no serious sign of softening, except in the case where the final temperature was 67 deg. C., and the working limit of temperature was estimated to be about 50 deg. C., which is of the same order as the figure of 43 deg. C. usually employed in specifications for this type of cable.

Four factors affect the heating of cables, namely, the thermal conductivity of (*a*) the cable covering, (*b*) the bitumen in the trough, (*c*) the trough itself, and (*d*) the surrounding earth. The earth immediately above a trough carrying cables, in which the temperature rise was about 20 deg. C., was not more than 5 or 6 deg. C. above that of the normal earth temperature. The fact that there was little difference in cooling with varying degrees of moisture is, therefore, not surprising. An empirical relation is suggested for determining the heating of these cables. The equation connecting current and temperature rise at any given final cable temperature may be expressed as:—

$$I = K\sqrt{TA/R\,(1+a\,t)},$$

where I = current passing, R = specific resistance of copper at 0 deg. C. in ohms per sq. in., $a = 0.00427$, the temperature coefficient of increase of resistance at 0 deg. C., A = cross section of cable in sq. in., T = excess temperature of cable above surrounding earth, t = ground temperature plus T in deg. C., and K = constant depending on the cable covering and the trough and surrounding earth. The values of K are respectively 148, 142, 136, 124 microhms for the 0.6, 0.4, 0.25, and 0.1 sq. in. cables tested after a six-hours' run.

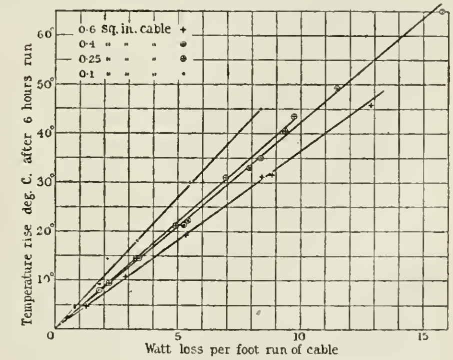


Fig. 8.—Temp. Rise of Cables Laid Solid in Bitumen in Stoneware Troughs.

Discussion in London.

Mr. E. B. Wedmore, director of research, introduced the report, briefly referring to the circumstances which led to the inauguration of the research, and pointing out that the report was only a preliminary one; much important work had been done since it was printed, and more remained to be done, the report, therefore, should not be assumed to be a complete one. Any suggestions put forward in connection with the work still to be carried out would be welcomed and carefully considered by the committee in charge of the research work.

Mr. S. W. Melsom and Miss V. Cockburn, of the N.P.L. at Teddington, Mr. E. Fawssett, of Newcastle, and Prof. E. W. Marchant, of Liverpool University, were present to reply to the various points raised in the course of the discussion. The meeting was scantily attended, and the discussion was on the whole disappointing.

Mr. C. P. Sparks opened the discussion by explaining that Mr. Melsom had taken the tables issued in the I.E.E. Wiring Rules as a basis, and the outcome was the present report. The huge standing charges involved in distribution systems were of the first importance, and it was only by knowing what the safety factor really was that they were working with, and the limiting temperature the material would stand, that they could hope to make the best use of the colossal investment contemplated in future schemes, which would grow. In the past they had little knowledge of the real safety factor, but now knew that they could work at higher temperatures. With regard to the comparison of the different ways of laying cable, further investigations with grouped cables would show a still greater discrepancy against the "solid" systems. Fig. 2 showed a difference of 7 deg. C. between solid and armoured cables, which did not agree with Mr. Melsom's statement that thermal resistivity was not so important as might appear at first sight. Concerning the rating of cables depending on the depth at which they were buried, a definite distance from the surface would appear to be necessary to avoid mechanical damage. The correct method of tackling the problem of temperature rise was that of the watt loss per ft. run of cable, especially where cables were grouped close together. The final permissible maximum temperature of a paper-insulated cable was fixed in the I.E.E. Wiring Rules as 150 deg. F.; the figure did not refer to large or buried cables, but was a safe one for ordinary conductors used in houses, and he hoped to see that figure increased before long.

Mr. C. J. Beaver thought that Mr. Melsom's remarks on the actual amount of moisture present in the soil seemed to have been written with some surprise. The reason for that surprise was, in the speaker's opinion, to be found in the incorrect information given in Table II. It was difficult to believe that the current-carrying capacity of cables laid "solid" and direct in the ground did not differ considerably. In his opinion it would be dangerous to increase the figure of 150 deg. F. referred to by Mr. Sparks, because although paper and other organic matter deteriorated up to a certain point slowly under the influence of heat, once that point was reached further deterioration was very rapid. Dielectric heating problems were of the first importance.

Mr. B. Welbourn explained that having been connected with the committee in charge of the research for some three years, he was not in a position to criticise its work, but he paid tribute to the investigators, and pointed out that as the work had been carried out during the war period difficulties had been experienced in obtaining samples and money. Referring to the superiority of armoured cable laid direct in the ground, he did not think much attention need be paid to the current-carrying capacity of the solid system, because, if it was not already dead, it was distinctly moribund. Armoured cable laid direct in the earth would carry probably 25 per cent. more current than a corresponding cable drawn into a duct, which fact was not commonly appreciated. Unfortunately it was not possible to take advantage of it in the case of many town networks, because high excavation costs necessitated the adoption of a duct system. The normal was that for equal current-carrying capacity more copper was needed in a duct system. The suggestion of varying the size of the conductor according to the nature of the ground through which it was laid deserved consideration, but would it be worth while doing so in practice? Mr. Melsom's table of cables corrected to two standard values of thermal resistivity would, he thought, profoundly influence cable manufacture both at home and abroad. Probably 2 ft. 6 in. would be the best depth at which cables should be laid. Bitumen cables were used in collieries in high temperatures, and Dr. Marchant's figures for the continuous working temperature of such cables were interesting as showing that the permissible safe rise to be allowed must inevitably reduce the current-carrying capacity of the cable.

Mr. P. Rosling was of the opinion that the thermal resistivity of the soil under various conditions was of even more importance than dielectric heating; it would have a larger reflex on the current-carrying capacity. The temperature of a cable was generally taken as that of the lead sheath, but it was the temperature of the conductor that mattered. It should be clearly defined which of the two temperatures was referred to, but the I.E.E. Rules omitted to do so.

Mr. R. O. Kapp remarked that the theoretical law for temperature rise plotted against time was generally assumed to be an exponential curve, and suggested that the research workers should try and ascertain why most of the heating curves given in the report approximated closely to such a curve while others varied by about 10 per cent. If the reason could be ascertained they would probably be able to formulate some law relating to the over-loading of cables. Concerning the heating of cables, the earth effect was equivalent to a larger cable, the earth took part in storing as well as in dissipating heat.

Mr. T. N. Riley wanted a summary of the work so far done, showing how it could be put to practical use; as given in the report the results only applied to cables laid in a particular manner. He asked for an indication of the relation, as regarded heating, between a cable laid along the ground and one coiled as usually tested in the works. Tests had been made in America which showed that filling the ducts with petroleum jelly reduced the temperature by 14 per cent. for the same current-carrying capacity.

Mr. J. R. Beard pointed out the danger of assuming that cables should be run up to the maximum limits indicated in the report. The impression that cables when laid deeper were cooler was wrong.

Mr. H. M. Sayers suggested that expansion effects upon loaded cables should be investigated, particularly with regard to plumbed joints; apparently repeated expansion and contraction caused cables to rack at such joints.

Mr. G. L. Addenbrooke referred to tests he had made 16 years ago of some cables in service in London, and suggested that as he still had the records and apparatus, and the cables also still existed, it might be worth while repeating the tests so as to provide actual data on deterioration.

From the reply to the discussion it appeared that the "reporters" had at the moment no more information to give than was contained in the report itself, and that suggestions made at the various discussions would prove useful to them. The heating curves did not follow an exponential law; if they had done so it would not have been necessary to carry out much of the work that had been done, and the suggestion of filling the ducts with vaseline was too costly to be entertained.

Prof. Marchant pointed out that the report had shown how the universities and technical colleges could be associated with the N.P.L. in technical research work with beneficial results to all concerned. In his opinion the equation which had been derived connecting the current and temperature rise at any given final cable temperature was the most important part of his section of the report.

Discussion at Newcastle-on-Tyne.

At Newcastle-on-Tyne the report was discussed before the North-Eastern Centre of the Institution on December 13th. Mr. J. R. Beard presided, and Mr. Vernier briefly outlined the origin of the committee. Mr. S. W. Melsom, of the National Physical Laboratory, and Mr. E. Fawssett, Newcastle, submitted the salient features of the report.

Dr. W. M. Thornton in opening the discussion, said that the resistivity measurements showed clearly a total variation of 4.7 per cent. (101.2 to 96.5). Was that considered satisfactory in the light of the British Standards requirements? The value of the temperature coefficient given by the N.P.L. was 0.00390 at 20 deg. C., but Dr. Marchant's value was 0.00393 at the same temperature, the difference being 7.7 in 1,000. These measurements were made with double bridges at Teddington, Liverpool, and Newcastle, and in view of the fact that an accuracy of 1 in 1,000 was readily obtainable by double-bridge working, he asked whether the bridges had been compared at the N.P.L.—as all instruments in a joint research of that kind should be. The work on the influence of the state of the surface of cables in air gave interesting results. Cables with aluminium painted surfaces ran 22 per cent. hotter than when the surface was dull. As might be expected, at low temperatures the colour made no difference so long as there was no bright metallic surface exposed. But if the heat were lost by low-temperature radiation alone, he would expect a much greater difference between bright and dull surfaces. His own observations on the heat lost by roofing confirming other N.P.L. results would lead one to think that there would be five or six times more lost when dull than when bright. That that was not so pointed to the fact that the greater part of the heat was lost by conduction and convection when the cables were in air, and a comparatively small amount by radiation. The relation between temperature and current, as given in the reports (figs. 6, 7, 8, and 11), was approximately a square law, but the index rose. In fig. 8 writing $\theta = a\,i^n$, $n = 2$ at 110 amperes, 2.16 at 140, and 2.25 at 165, and showed signs of still higher figures. Now, if the temperature rose faster than the heat generated it seemed that the rate at which heat was got rid of fell as the temperature rose; that the cooling was proportional to some law with an index less than unity. The temperature gradient in fig. 9 was uniform from the inner conductor to the outside of the sheath, and the triangular curve would fit even better if instead of being drawn to a point the curve's ends were set at the diameter of the inner conductor apart. The conclusion from the curve was that the copper or lead in the cable had no perceptible influence on the gradient, or that the drop of temperature in the metals was negligible. The curves of rates of rise of temperature, figs. 1 to 5, were approximately logarithmic, but appeared to be complicated by variations of the loss coefficient. They should be logarithmic, and any departure from that form could only be attributed to variation of the coefficient of dissipation to earth. For, considering the equation of heating and absorption, in heat units it was:—

$$r\, i^2/\mathrm{J} = \mathrm{W}/\mathrm{J} = m\, \sigma\, d\, \theta/d\, t + k\, s\, (\theta - \theta_0),$$

where m was the mass of unit length, s its outer surface, σ the specific heat, and k the coefficient of cooling to the ground. Where there was cooling to air there was radiation to be considered, perhaps to be included in the linear cooling law, and convection which followed the same law at low temperatures. The rate of transfer of heat was relatively rapid through the insulation, its thickness was small, and there was no need for the introduction of a term covering the thermal conductivity of the dielectric if the temperature θ were taken at the surface. The solution of the above equation was:—

$$\theta = \theta_0\, t\, \theta_1\, (l - \epsilon^{-k\, s/m\, \sigma\, t}),$$

the final running temperature being $\theta_0 + \theta_1$. If the curve of rise was not simply logarithmic it could then only be by variation of the ratio $m\, \sigma/k\, s$, that was of σ or k. It was unlikely that the specific heat would change, and the curves, therefore, provided a means of observing the changes in the value of k from time to time, that involving the conductivity of the surrounding earth as a factor in the rate of cooling, but all included in the numerical value of k. The thermal time-constant of such a rise was $m\, \sigma/ks$, which could be obtained in the usual way by drawing a tangent to the curve at zero and dropping a perpendicular to the time line from the point where it cut the steady value. Fig. 5 contained final steady values drawn to a base of copper area × outer diameter of sheath, but it might be simpler to plot θ_1, against diameter alone. It was always difficult to estimate with any degree of certainty when the steady state was reached, but by taking $\theta = .95\, \theta_1$, or any other suitable ratio approaching unity, they could find the corresponding time t^1 from the curves or by calculation to a much closer degree of approximation. Having chosen some such value to be used in all cases, the log term was constant; t^1, therefore, varied as $m\, \sigma/k\, s$. But for any one given type of cable it varied as the total sectional area, and s as its diameter, so that as a first approximation, t^1 varied as the diameter σ. The ordinates of fig. 5 might then plot to a straight line if the abscissæ were taken as overall diameter. If the time of reaching a steady state were approximately proportional to the diameter of the cable it would simplify matters, but there would always be the difference of soil or other conditions to be considered as varying k. The observed time constants of the given cables suggested that the cables might fit into a scheme of time constants in a fairly regular manner.

However interesting this preliminary report might be in the problems it dealt with, not the least interesting of which was the thermal resistivity of cable material so fully discussed later in the paper, and in the valuable results of the work at Liverpool, it all led up to *deterioration*. Was there enough evidence of the effect of continued temperature and electric stress, direct or alternating, on the life of insulating materials? They could make a paper cable last as long as they pleased by enclosing it in lead. V.I.R. cables, with a vegetable gum as a basis must deteriorate with time. Paper was more durable, and he saw no reason why paper cables should not last 5,000 years if lightly loaded in the same manner as the papyrus of ancient Egypt. The supply companies' problem was to find the most economical current to run a cable at, having regard to its earning power, life, and cost of renewal.

Mr. Bertram said one of the most interesting parts of the report was the conclusion arrived at by the committee concerning the end of armoured cables with regard to the rise of temperature. The figures given, showing a rise of more than 33½ per cent., would surprise many of their operating engineers.

Mr. Parker wanted more information with regard to the temperature at which it was safe to run a cable for an overload purpose, say, for one or two hours. Operating engineers would like some instrument which would assist them in this matter.

Mr. Allen suggested that the results obtained might be sent out to their members in, say, Australia and South Africa, with a view of obtaining detailed information about the conditions met with elsewhere, particularly in hotter climates so as to assist in making the records complete.

Mr. H. Bridges said the paper dealt largely with single cables, but they needed to go further than that, and they looked forward to the results of the committee's work with groups of cables. In the future they would have to pay more attention to the amount of ground they should give to cables at stations. Cable makers were turning out cables with thinner dielectrics than in years gone by; were they running any risks in reducing the thickness of the dielectrics? Cable depreciation was the real question.

Mr. E. B. Wedmore spoke of the need for research work, and the effort the committee was making to make the work of real utility.

REVIEWS.

Lectures on Industrial Administration, delivered at Cambridge, July, 1919. Edited by B. Muscio, M.A. Pp. viii+276+16. London: Sir Isaac Pitman & Sons, Ltd. Price 6s. net.

Industrial Administration; a series of Lectures. Pp. viii+203. Manchester: The University Press; and London, New York, Bombay, &c.: Longmans, Green & Co. Price 7s. 6d. net.

The first of these two books consists of twelve lectures, delivered at Cambridge in July, 1919, at which time there was held there, under the general direction of Dr. C. S. Myers, F.R.S., a school for the study of certain industrial management problems, chiefly from the psychological point of view. The volume contains a selection of the lectures delivered at the school, and for some reason, not immediately apparent, it is divided into five parts. The first part contains only one lecture, and it is entitled "Some Ethical Aspects of Industry," the lecturer being Prof. W. R. Sorley, Litt.D., LL.D., F.B.A.

Criticism is to some extent deprecated (we will not say disarmed, for criticism disarmed is criticism neglecting its plain duty) by the lecturer's opening remarks, in which he states that his contribution must have the appearance of a series of platitudes. Nevertheless, platitudes ought to be repeated now and then, if only to see that we remember them properly, and we are none the worse off for being reminded that there *is* an ethical side to industry, though it is in these days more often ignored, if remembered, by both sides, than acted upon. It would do everyone good to think a little more about duty. Labour is fond of saying it is the employer's duty to provide good conditions and a good wage for workers, and employers point out the duty of the workers to do as much as they are able. Both are right, but each should lay emphasis on its own, and not the other side's, duty.

The second part contains three lectures. They are: "The Need for a Science of Industrial Administration," by Mr. J. A. Bowie, M.A.; "Some Tendencies in Industry," by Mr. E. M. Wrong, M.A.; and "Taylor's Principles in Modern British Management," by Mr. A. R. Stelling. Of these three, Mr. Bowie is concerned with proving the necessity for something that everyone agrees to be necessary, so he is banging at an open door. It is probably because he feels this to be the case that he exaggerates the failings of the old-time director or proprietor of a business, who is said to stamp even his idiosyncrasies on the business he controls, to such an extent that British industry is a "riot of individuality," the while "many employers are not fit to be decent labourers." The quotation marks are Mr. Bowie's, but he is in agreement with the sentiments expressed. He also states it as his opinion that "it is certain that the usual commercial courses now being promoted in many of our universities aim at imparting the principles of pure industry, rather than applied or administrative." Now, industry is an applied science, or it is nothing, and how any distinction can be made between pure and applied industry we cannot understand. Mr. E. M. Wrong's contribution bears evidence of that careful thought we are accustomed to find in his writings, and he shrewdly hits one of two nails on the head, as when he remarks: "When in doubt Englishmen form a committee, whether they are in Parliament or in a factory"; and summarises the objections to Government interference as coming mainly under three heads: Complaints against the Liquor Control Board, objection to any limitation of profits, and fear of inefficiency. We may note their relative positions. He also points out a feature of time-registering systems to which those who use them have grown so accustomed that they think of them as a normal and inseparable adjunct to the systems, viz., that insistence on "clocking off" causes a queue to assemble in front of the clock in order to be in a position to begin clocking the moment the buzzer blows. The value of the time lost through this practice is seldom appreciated. The fourth lecture, by Mr. A. Robert Stelling, deals with Taylor's principles and some of the objections to their adoption. The workman does not want to be forced to carry out a manufacturing process in accordance with a specification detailing every motion and the time to be occupied in doing it. And he is not going to agree to anything of the kind if the inevitable result of the increased output brought about is a reduction in the piece rate, and while he realises that his earnings will be limited in some way or other. The Taylor system, as understood—or possibly misunderstood—in this country, is too impersonal, too inhuman, to be received with any enthusiasm. If they were properly understood and applied, as Mr. Stelling shows they could be and ought to be, Taylor's principles are not only practicable for British industry, but afford a complete solution of the problem of the increase of production.

The fifth lecture, with which the third part begins, is on "Vocational Diagnosis in Industry and at School," by Mr. Cyril Burt, and is largely a piece of special pleading on behalf of the science of psychology. We are not prepared to accept a number of his conclusions without something very much more adequate in the nature of proof than he has seen fit to give in the lecture. "A child who at six has a mental age of three, and therefore a mental ratio of only 50 per cent., will at the age of sixteen exhibit, as a rule, the same mental ratio, and therefore attain a mental age of only 8." Taking due account of the qualifying "as a rule," we wonder if this is a correct deduction. The six-year-old child with the mental age of three may be merely a late starter, and at sixteen he may very well have attained a mental age of thirteen. It does not necessarily follow that the law is of the same character as a geometrical progression; it may conceivably be arithmetical. His process of sifting children, so that only the "duds" are left for trade vocations, would not appear to us to be the best thing for industry. The value of competitive examinations as a means of selecting the best from among a number has, we think rightly, been much questioned of late years, and in spite of Mr. Burt's advocacy of it in the case of the children who are to be sorted, it must not be assumed that the man who only succeeds in matriculating in the second division will not go far.

The sixth lecture, by Mr. S. Wyatt, M.Sc., M.Ed., on "The Psychology of Advertising," contains little that is new. The seventh, on "Social Psychology and the Industrial System," is by Prof. T. H. Pear, M.A., who occupies the chair of psychology in the University of Manchester. This lecture is exceedingly interesting, but affords small scope for criticism.

Part IV opens with the eighth lecture, that on "Industrial Overstrain and Unrest," by Dr. Charles S. Myers, M.A., M.D., Sc.D., F.R.S., the director of the course. The damage done by fatigue is nearly always under-estimated, and although the cynic may be tempted to wonder how fatigue or overstrain is possible in these days of ca' canny, short hours, no overtime, and similar agitations, there is no doubt that it is wrong to work the system to the point of fatigue, no matter what the occupation. Dr. Winifred Cullis, D.Sc., follows with a lecture on "The Demands of Industry upon Women from the Physiological Standpoint." Our opinion is that she unduly minimises the effects of the differences in structure and in function between men and women upon their suitability—not their capacity—for industrial work, and there are other medical women who are of an entirely different opinion from Dr. Cullis on this important point. It was a fine thing to see, during the war, strong hefty girls pick up a chunk of lead and slog the chuck holding a big shell to tighten or loosen the screw, but in the interests of women themselves, and of the race, they should not be employed on heavy work while there is any doubt—and there is much—as to the effects produced on the organism. Another medical lecture follows, on "The Practice of Industrial Welfare and Health," by Dr. Edgar L. Collis, M.D., who has occupied the important position of Director of Welfare and Health under the Ministry of Munitions. We think he is wrong in crediting primitive man with a knowledge of the fact that the primary reason for the existence of industry is the service of the community, and in stating that this primitive purpose became more and more overlaid as time went on. It has been learned at long last after many trials and errors; the community was not considered of any importance in the earlier stages of human history. Individualism was rampant through feudal times, and through the earlier periods of the industrial era which, broadly speaking, began in the century before last. A mistake on p. 205 credits the Welfare Department with murderous intent alleging that it (the Welfare Department) should deal with reasons why the *lives* of the workers should be so long, instead of their *hours*. For the rest, while he advocates the establishment of a welfare and health department in all undertakings, he dabbles, tinkers half-heartedly, and talks down, and we are not at all inspired by his recommendations. Either welfare work is worth doing properly, or it is better left alone. No good at all can be done by going into it with any idea of tenderness towards prejudice and ignorant pig-headedness; the welfare administrator should be of sufficiently high standing to see his ideas carried out to their full extent.

The fifth part opens with the eleventh lecture, which is by Mr. A. P. M. Fleming, C.B.E., M.Sc.Tech., M.I.E.E., on "Industrial Research." His synopsis of American practice is both interesting and useful, and cannot be too widely known. We believe research to be entirely worth while, and it is well that it has been realised by the great ones of the industrial world that it must be undertaken wholeheartedly and earnestly, with determination and will to overcome discouragements. We do not agree that routine testing should be done by the research department. The last lecture is by Dr. P. Sargent Florence, M.A., Ph.D., on "The Statistical Measurement of the Human Factor in Industry." It is chiefly of interest as showing the extent to which absorption in a science can carry one into the realms of impracticability. Does Dr. Florence really expect to get truthful answers to personal questions about people's homes, recreations, use of earnings, tastes, and so forth? No doubt such statistics would have a certain value if they could all be tabulated and Hollerithed, but the fact is they cannot, and we must be content to accept that fact. Industrial management will have to stay in the works, and the improvement of homes and habits is a matter for the schools and for voluntary self-education.

The second book contains a set of eight lectures, delivered at Manchester, and they cover much the same ground. Prof. Pear, indeed, lectured both at Cambridge and at Manchester. The first lecture is by Mr. B. Seebohm Rowntree, on "Social Obligations of Industry to Labour." He analyses carefully the expense of running a working man's home, and emphasises the necessity for raising the pre-war standard of living. We think there is danger in the suggestion that employers should give workers a guarantee that no man shall suffer through the introduction of labour-saving machinery. The endeavour should be to increase output and demand, so that the introduction of improvements will actually lead to more employment and better amenities of life for everybody. And if each industry carries its own unemployment, as may very possibly be the case before long, one of the objections to the use of labour-saving devices will disappear from the mind of labour. Prof. Pear's lecture is the second, and deals with "The Applications of Psychology to Industry." He emphasises the value of observation, and shows that two types exist, the "spread" and the "concentrated." We suppose everyone who has read of Sherlock Holmes realises the usefulness of observation of both kinds, but its value is immensely enhanced if it can be made automatic. It is the chief value of the Pelman, and indeed, of any system of mental training that it conduces to the attainment of speed and expertness in this respect. Mr. A. E. Berriman, O.B.E., M.I.Mech.E., lectures on "Education as a Function of Management," and he deals in considerable detail with apprentice training. Dr. T. M. Legge, C.B.E., M.D., D.P.H., comes next with a lecture on "Occupational Diseases." Mr. Leonard Hill, F.R.S., lectures on "Atmospheric Conditions and Efficiency," and in spite of immense improvement in this matter of late, or at least during the last thirty years or so, he shows conclusively that there is still more to be done than has yet been accomplished. The expectation of life in a big city is sixteen years less than it is in the healthiest districts. The importance of smoke abatement and of the movement towards small garden cities could not be better illustrated than by that statement.

Mr. T. B. Johnston, J.P., lectures on "Industrial Councils and their Possibilities," and his contribution gives an account of valuable work that has been done in the pottery trade. Mr. St. George Heath lectures on "Training for Factory Administration," explaining the nature and objects of the education required. The eighth and last lecture is by Dr. A. F. Stanley Kent, M.A., D.Sc., on "Industrial Fatigue," and is ratehr elementary.

It is a good sign that such courses of lectures should have been provided, and that they should have been successful. They will be of use to a wider audience through being reprinted, and we hope other similar courses will be arranged. The success of industry, particularly in Great Britain, depends on the human factor more than on any other, and for this reason the science of psychology and its applications to the betterment of the industrial situation are worthy of close and constant study by all who are concerned in any way with the directing or administering of industry.

The Elements of Electrotechnics. By A. P. Young, M.I.E.E.
Pp. 348+viii; 179 figs. London: Sir I. Pitman & Sons, Ltd. Price 7s. 6d. net.

The essential object of this book is to explain to students, and others interested in the applications of electricity, the fundamental laws upon which the science is based, and to show how these laws are applied in practice.

This is excellently done; the language employed is simple and lucid, and numerical calculations are given where possible, so that the student shall gain definite ideas of the quantities with which he is dealing.

The novel feature of the book is the way in which the author has illustrated the divisions of his subject by examples from the most recent practice in electrical engineering. As instances, it may be mentioned that, in the chapter on the production of electricity from magnetism, reproductions are given which show sectional views of British magnetos which were developed for use on aircraft engines during the war, whilst in the chapter on electric motors, particulars and performance curves are included of the 1,500-volt series motors used on the Chicago, Milwaukee, and St. Paul Railway.

It might, of course, be argued that these examples are somewhat above the heads of the persons for whom the book is primarily intended, but the method is that of the lecturer who retains the interest of his class by showing them slides of actual machines which embody the principles that he wishes to instil, and, in fact, the work is the outcome of a series of lectures delivered by the author to evening students in a large works.

The notes on permanent magnets and magneto ignition are particularly interesting, and the information given on insulating materials is much more practical and complete than is usual in a book of this type, whilst in the chapter on systems of units this difficult but highly important part of the subject is dealt with in a very clear and convincing manner.

The general scheme is similar to that laid down by the City and Guilds Institute. Alternating currents are not dealt with except for a brief reference in connection with hysteresis and eddy current losses in iron.

The book is illustrated by a large number of diagrams and photographs which are reproduced in an excellent manner, and should prove of great assistance to the student and to the large and increasing number of engineers who, without being actually engaged in the electrical industry, find it necessary to understand something of a subject with which they are continually coming into contact. Furthermore, there is a considerable amount of information which should prove useful to electrical engineers with wider experience than those for whom the book is written.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Unit-type Distribution Pillars.

Standardisation is an essential feature of economic and satisfactory production and working. This especially applies to electrical gear where circumstances usually render it necessary to effect alterations or additions in a minimum of time. The unit-type distribution pillar made by W. T. Henley's Telegraph Works Co., Ltd., Blomfield Street, London Wall, E.C. 2, is an example of standardisation and simplicity in construction. The frame of the unit consists of two micanite-covered steel tubes coupled rigidly together at top and bottom. Upon this frame are clamped the copper fittings carrying the busbars and fuse clips. The front half of the sealing chamber is bolted on to the frame, and when jointing up it is therefore necessary only to bring up the cables to the bent copper connectors which pass through insulating bushes in the sealing chamber. This method of connecting up the cables to the bars eliminates the use of rubber tails and the consequent extra number of joints, reducing the risk of failures to a minimum. It occasionally happens, however, that existing cables are of insufficient length to bring up to the connectors, and in such cases a special sealing chamber can be employed, and rubber tails used to bridge the distance between cables and connectors; this does not affect the rest of the design of the unit. The units are easily interchangeable, and it is only necessary to cut off the supply for a few minutes while changes are being effected. The sealing chambers are supplied with the well-known "Henley" lead cone grips or brass wiping glands, which are designed to deal with all classes of cables with only slight alterations. The units may be bolted side by side on a frame to form a fuse panel, rubber tails being taken to each contact without the use of the sealing chamber.

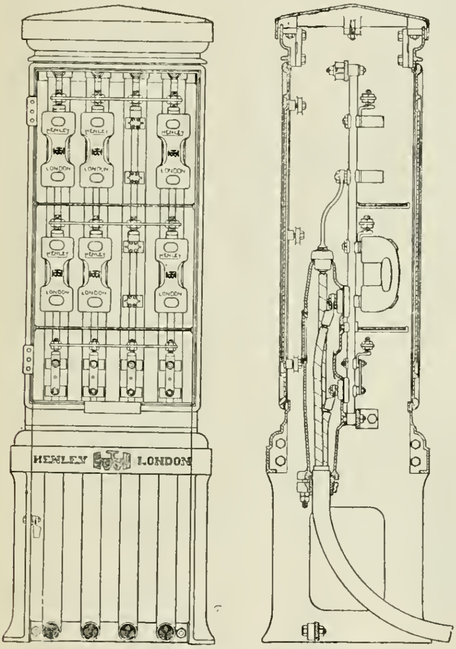


Fig. 1.—The "Henley" Unit Type Pillar.

Fig. 1 shows two views of a pillar containing four units arranged for 3-phase, 4-wire distributors. In this example three of the cores are directly connected to the fuses.

A Cold-starting Oil Engine.

Messrs. Ruston & Hornsby, Ltd., of Lincoln, send us particulars of tests carried out by Capt. H. Riall Sankey, C.B., &c., on one of their cold-starting oil engines. The subject of the tests was a 260 b.h.p. horizontal engine, diameter of cylinders (two) 18½ in., stroke 30 in. The load was applied by means of a Heenan & Froude hydraulic brake. The engine was started at 8 o'clock and ran at about half-load for 1½ hours, when full load was applied for three hours. The load was then quickly reduced to ¾, and maintained at this for an hour, after which it was reduced in succession to ½ and ¼ each for an hour. Then for half-an-hour the engine ran unloaded, and during the next half-an-hour was overloaded by 10 per cent. Lastly the ¼-load test was repeated for half-an-hour, and the test then ended. The lower calorific value of three samples of oil used was taken for purposes of calculation; this was 18,050 B.th.u. per lb., and the following results were obtained:—

Load.	Average revs. per min.	Average B.H.P.	Oil consumption. Lb. of oil per B.H.P. hour.
Overload	174.1	261.1	.403
Full load	175.57	235.9	.401
Three-quarter load	177.15	178.2	.405
Half load	179.33	119.9	.405
Quarter load ...	181.1	60.4	.508

A New Ceiling Rose.

We have received a sample of a new type of combined ceiling rose and block which is being placed on the market by the B.E. Co. (of London and Birmingham), Ltd., of 57, Upper Thames Street, E.C. 4, and which is illustrated in fig. 2. The primary idea was to avoid the use of pottery, on account of its shortage, but the article is now submitted as being suitable for general use in any modern electric light installation. The device is a labour saver, inasmuch as both the block and the connections for the wires are fixed by means of two screws only in place of four with the ordinary type of pattress and ceiling rose. The wood pattress is so cut away that it is ready for fixing without the necessity for further drilling in any way. The base containing the usual ceiling-rose plates is of specially hard non-hygroscopic insulating material; the brass cover matches the standard tumbler-switch cover in general use, and can be finished in any style to suit the switches. The inside of the cover is lined with an insulating paint. The new rose should be capable of being employed in general use, and appears to be a step in the right direction towards that desirable aim of cheaper, but at the same time efficient, lighting fittings and installations.

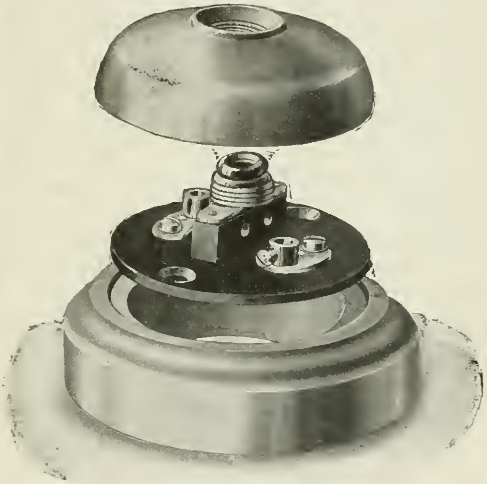


Fig. 2.—A New B.E. Co. Ceiling Rose.

A Sand-mixing Machine.

The necessity for using only well-mixed sand in the foundry needs no elaboration. Messrs. Alfred Herbert, Ltd., of Coventry, inform us that they are now producing for stock a sand-mixing machine which aerates the sand, allowing all gas to escape, and crushes all lumps in it; the sand does not need to be milled before being mixed. The machine consists of a pedestal carrying two vertical spindles rotating at a high speed, one within the other. The spindles are driven in opposite directions by bevel gearing from a pulley on a horizontal shaft. The upper ends of the spindles carry two intermoving cages, the bars of which, passing each other in opposite directions at a great speed, do the mixing and disintegrating. The cages are covered by a dome-shaped casing which directs the mixed sand on to the floor and prevents it from flying about. The centre of the dome carries a hopper, into which the unmixed sand is fed, and from which it drops into the centre of the cages. The hopper can be lifted off for the purpose of cleaning. The mixer will deal with about 7 cwt. of sand per minute, its net weight is 2,401 lb., and it occupies a floor space of 5 ft. 1 in. by 4 ft. 6 in.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

35,528. "Electric fuses." O. Cracoanu. December 17th. (Germany, December 17th, 1919.)

35,626-7. "Protective devices for electrical power transmission systems." G. H. B. Bernard and E. M. Royce (Bernard). December 18th.

35,675. "Electric gas lighting devices." R. E. Wild. December 20th.

35,691. "Clip for regulating height of electric lamps." E. Beckton. December 20th.

35,710. "Junction boxes for electric cables." Callender's Cable & Construction Co. and H. McCrudden. December 20th.

35,715. "Electric circuit breakers, &c." H. Bacon and R. A. R. Bolton. December 20th.

35,734. "Electrical cable sockets or lugs." E. Scharpenberg. December 20th (Germany, January 2nd.)

35,749. "Electrical condensers." H. W. Sullivan. December 20th.

35,755. "Calling devices operated by wireless signals." W. J. Davis. December 20th.

35,768. "Sparking plugs." H. Longton. December 21st.

35,775. "Superposing currents of different frequencies upon existing alternating current systems." A. M. Taylor. December 21st.

35,825. "Electric induction motors." G. H. Fletcher and Metropolitan-Vickers Electrical Co. December 21st.

35,826. "Reflector for electric bulbs." E. Arden-Pye. December 21st.

35,845. "Telephone systems." Automatic Electric Co. and Automatic Telephone Manufacturing Co. (Automatic Electric Co.). December 21st.

35,861. "Telephonic conversation meter." R. Ferry. December 21st.

35,889. "Electric horns for automobiles." R. C. Royston. December 22nd.

35,891. "Trolleys for electric tramways of the overhead conductor system." W. Lawrence. December 22nd.

35,912. "Ignition magnetos." E. Marelli. December 22nd. (Italy, December 24th, 1919.)

35,915. "Electric lamp locking ring." W. Methuen. December 22nd.

35,922. "Electrical instruments." M. B. Field. December 22nd.

35,931. "Means for detecting damaged ramps in train electrical control systems." R. Haddan (Regan) and J. B. Regan. December 22nd.

35,938. "Selector switches for automatic telephone systems." Western Electric Co. (Western Electric Co.). December 22nd.

35,950. "Thermo electric apparatus for heating flowing liquids." C. Massironi. December 22nd. (Italy, May 24th.)

35,953. "Storage battery and recharging system." W. H. Thorpe and M. S. Willing. December 22nd.

35,976. "Electric driving device." Landis & Gyr Akt.-Ges. December 22nd. (Switzerland, December 26th, 1919.)

35,976. "Electro-chemical treatment of petrol cans for removal and prevention of corrosion." G. Inrig. December 22nd.

35,992. "Electric treatment of ores." A. Counas. December 22nd. (France, August 29th, 1919.)

36,015. "Cover for electric conduit boxes." G. Turnock. December 23rd.

36,019. "Electric control mechanism of race games." S. Grossi. December 23rd.

36,054. "Electric lamp holders." A. N. Haddow and A. P. Rotherford. December 23rd.

36,077. "Electric transmission cables." A. M. Taylor. December 23rd.

36,080. "Wireless aerials for ships." R. Tull. December 23rd.

36,082. "Electric switches." T. C. Frampton. December 23rd.

36,084. "Electric lamps with luminous discharge." J. Pintsch Akt.-Ges. December 23rd. (Germany, December 12th, 1917.)

36,086. "Electric valves." Soc. Anon. pour l'Exploitation des Procedes M. Leblanc-Vickers. December 23rd. (France, December 23rd, 1919.)

36,112. "X-ray plates." A. L. Landau and L. A. Levy. December 23rd.

36,116. "Converting direct current into alternating current by electrostatically-controlled installations." L. A. Hazeltine. December 23rd. (United States, November 28th, 1919.)

36,127. "Diaphragm mountings for telephones, &c." W. Stott and Telephone Manufacturing Co. December 23rd.

36,131. "High tension transformers." F. Dessauer and Veifa-Werke Vereinigte Elektrotechnische Institute Frankfurt-Aschaffenburg. December 23rd. (Germany, September 29th, 1915.)

36,132. "High tension transformers." F. Dessauer and Veifa-Werke Vereinigte Elektrotechnische Institute Frankfurt.Aschaffenburg. December 23rd. (Germany, October 7th, 1915.)

36,133. "Transformers." Reiniger, Gebbert and Schall Akt.-Ges. December 23rd (Germany, May 16th, 1918.)

36,134. "High tension transformers." F. Dessauer. December 23rd. (Germany, June 23rd.)

36,135. "Petrol electric, &c., generating apparatus." H. J. Norballe. December 23rd.

36,142. "Electric controllers, starters, switches, &c." J. O. Powell. December 24th.

36,141. "Electrical booking indicator." C. E. Jones and E. W. Rice. December 24th.

36,165. "Telephone systems." Automatic Telephone Manufacturing Co. December 24th (United States, December 27th, 1919.)

36,170. "Electrodes and electrolysis." H. Plauson and J. A. Vielle. December 24th. (Germany, July 6th, 1918.)

36,233. "Wireless transmitting apparatus." N. E. Davis and Marconi's Wireless Telegraph Co. (Davis). December 24th.

36,251. "Valve transmitters for wireless telegraphy and telephony." H. Morris Airey, L. G. Preston, and G. Shearing. December 24th.

36,272. "Supports for filaments in thermionic valves, &c." B. Hodgson, S. R. Mullard and L. G. Preston. December 24th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

4,948. "Electrolysis." M. A. Adam, J. Stevenson, A. T. Mabbitt, and J. Fieldhouse. February 27th, 1919. (154,635.)

11,966. "Hand-cart for transporting and operating wireless telegraph station in forward battle areas." C. A. Oliver. May 13th, 1919. (154,637.)

12,695. "Process and apparatus for the electrolytic decomposition of chlorides." R. Cataldi. May 20th, 1918 (127,255.)

17,620. "Work feeding attachment for electro plating apparatus." A. G. Snell. August 28th, 1919. (154,650.)

18,868. "Process of manufacturing electric steels." J. McConnell. July 30th, 1919. (154,659.)

21,189. "Method of and means for electrically controlling the throttle valve in internal-combustion engines for propelling vehicles." P. F. Smith and P. V. Powell. August 28th, 1919. (154,682.)

21,322. "Dynamo electric machinery." T. L. Reed-Cooper. August 30th, 1919. (154,691.)

21,340. "Moving brush gear for dynamo electric machines." W. F. Grafton and Grafton Dynamos, Ltd. August 30th, 1919. (154,692.)

21,515. "Automatic switching mechanism for use more particularly in telephone or like systems." Automatic Telephone Manufacturing Co. (Automatic Electric Co.). September 2nd, 1919. (154,698.)

21,691. "Electrical treatment of ferrous metals during casting." J. H. Wickett. September 3rd, 1919. (154,711.)

21,808. "Arrangement of electric welding apparatus." A. E. Frankling. September 4th, 1919. (Addition to 134,393.) (154,717.)

21,892. "Electric frequency multipliers." P. Trichard. September 5th, 1919. (154,720.)

22,001. "Universal grinders, particularly of the electric type." A. E. White (Wisconsin Electric Co.). September 6th, 1919. (154,723.)

22,105. "Method of and apparatus for operating synchronous telegraph systems." A. E. O'Dell (Western Union Telegraph Co.). September 8th, 1919. (154,726.)

22,366. "Microphones." A. Thomas. September 11th, 1919. (154,729.)

22,714. "Electric lamps for police and like uses." Hiatt & Co. and A. D. Melson. September 16th, 1919. (154,735.)

22,787. "Galvanic batteries." O. Oldham, G. Oldham, and J. Oldham. September 16th, 1919. (154,737.)

23,616. "Variable limit switch for breaking the circuit of an electric motor operating printing machinery." H. V. James. September 25th, 1919. (154,752.)

25,176. "Pneumatically operated controllers for electric motors." British Thomson-Houston Co. (General Electric Co.). October 14th, 1919. (154,763.)

25,722. "Electrical fuses and distribution boards." H. J. Dean and W. Redmayne. October 21st, 1919. (154,767.)

27,565. "Centrifugally-operated electric switches." R. Haddan (J. B. Regan). November 7th, 1919. (154,779.)

28,199. "Machine tools provided with electro-magnetic chucks or work-holders." W. Carter and F. C. L. Brendell. November 13th, 1919. (154,785.)

30,230. "Electric insulators." E. Haefely et Cie. September 13th, 1919. (151,231.)

1920.

161. "Means for starting internal combustion engines, adapted also to be used for generating electric current." W. S. Jeal, January 2nd, 1920. (Addition to 144,509.) (154,809.)

775. "Electrically-heated garments." A. Negromanti. January 9th, 1920. (154,814.)

3,078. "Electrical connectors." K. W. Johansson. November 7th, 1919. (154,166.)

6,565. "Spark plug cleaner." Champion Spark Plug Co. October 18th, 1916. (138,493.)

8,102. "Process and apparatus for the manufacture of wire by electro-deposition." S. O. Cowper-Coles. March 18th, 1920. (154,833.)

12,135. "Electric welding." J. E. Pollak (Maschinenbau Akt.-Ges. Seebach). May 1st, 1920. (154,849.)

16,431. "Starting of electric arcs in lamps, rectifiers, and the like." Siemens & Halske Akt.-Ges. July 21st, 1919. (148,280.)

19,180. "Electro-magnetic chucking device." F. Krupp Akt.-Ges. June 18th, 1919. (147,141.)

20,414. "Electro-magnetic chucking device." F. Krupp Akt.-Ges. June 23rd, 1919. (148,457.)

23,181. "Electric vehicle controllers." G. L. Meyfarth. August 18th, 1919. (149,921.)

A New Aspect of Lightning Protection.—It has been the general opinion that an overhead distribution system with a dense load and many transformers offers a better target for lightning discharge than one with a scattered load. A recent investigation, reported in the *Electrical World*, however, makes it evident that where a lightning arrester is installed at each transformer the lightning has a multiplicity of paths through which the voltage gradient of the atmosphere may be smoothed out, when the density of the lightning arresters is high, with less trouble at the transformer. From careful tests made on the 4,000 V, 60-cycle distribution system of the Commonwealth Edison Co., it appears that the density of lightning arresters on this system is far more important than the actual type of arrester used. Curves show that where the density of transformers and arresters is 200 per square mile, not only is the percentage of disturbance due to lightning greatly reduced, compared to a density of 100, but the actual number of interruptions is cut nearly in half.

Of equal importance is the matter of protecting underground cables. Where these cables are connected to the overhead lines there is a transition point which is especially susceptible to lightning disturbances and which has given serious trouble in the past. The results obtained indicate that underground cables can be effectively shielded from lightning by increasing the density of arresters in the vicinity of the point at which the cable emerges.

Among the important conclusions drawn from the tests is that trees and buildings constitute effective barriers against lightning discharges. The records in Chicago show that many transformers have been completely shielded from lightning by their presence.

THE

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THE SANE OUTLOOK.

THERE were many occasions during the war when the fact was emphatically brought home to us that it does not help one, in a difficult situation, to be depressed and look on the black side of things. A hopeful and courageous attitude of mind does not carry with it, as a corollary, the dwelling in a fool's paradise. Between the upper limit of a senseless exaltation and the lower limit of black despair, the true and only helpful mental outlook is to be reached by an understanding of the facts of the situation. The more complete the understanding, the wiser the outlook will be, until, as the French proverb says, "*tout comprendre c'est tout pardonner*," which means Omniscience.

In times of warfare the ordinary man cannot gain accurate knowledge. Vital facts are suppressed or distorted, in order that the enemy shall be misled, and so taken at a disadvantage; and it is worse than useless, in such circumstances, to endeavour to obtain knowledge which is better withheld, or to theorise vaguely without adequate—or any—foundation. But in a time of at least nominal peace it becomes the duty of every thinking individual to survey the facts, to absorb them, to get them into their right perspective, and to understand them so far as he may, and to appreciate their bearing on the course of events. In the great majority of instances it will then be found that no situation is so hopeless that it cannot mend, and no state so bad that it cannot be made infinitely worse by panicky and ill-considered action or alternatively nerveless inaction.

There is talk of a slump. What evidence is there? Lack of orders and unemployment. Since unemployment is a natural consequence of lack of business, it may be taken as an axiom that an improvement in trade will give more employment, and we are, therefore, enabled to concentrate on the question of how to secure more orders. Every man who has ever been instrumental in attempting to sell anything knows that, if quality of goods and ability to fulfil the contract satisfactorily may be presumed equal, and neglecting for the moment the factor of the salesman's personality, the determining factors in securing business are:—(1) Price, and (2) delivery. In fact, low price and quick delivery will sometimes make a buyer pass his best friend, and give the order to another maker, for goods known to be not quite equal in quality, provided the difference be not too great and obvious.

To keep up business, then, we must have low prices and quick deliveries. Low prices cannot be quoted unless the costs of manufacture are low. Short deliveries cannot be effected if goods are scarce. Low manufacturing costs are dependent, in the main, on low overhead charges; that is to say, on a high load factor in the factory. So that both considerations, price and delivery, lead us, by the shortest and straightest of paths, to the need for production, more production, and still more production. Production means cheapness, and cheapness induces demand, and demand produces employment. Scarcity, on the other hand, or ca' canny, or restriction of output, brings about dearness, depresses demand, and produces unemployment. Thus we are led to the view that national short time is logically wrong, and can only be justified as a temporary palliative. It involves all the old fallacies about wages funds, limited amount of work to go round, and other similar heresies, the errors of which have been exposed time after time. If low production were the cure for unemployment, last year should have ended with every man fully employed. Yet we know that unemployment is worse to-day than it has been for many a long year. The advocacy of restriction of output proceeds from the same mental viewpoint that favours restriction of the population. If there are too many people, say those who hold this view, the earth cannot produce enough to support them. The truth is, that the more people there are who are willing to *work*, the better off the world is. There are plenty of people willing to draw wages, but that is not at all the same thing.

The policy of restriction of output arises partly from the fear of unemployment, and partly from the feeling that increased production produces benefits, the greater part of which are appropriated by the capitalist employer class. It ought to be more generally realised that every man who saves up a pound and buys a share with it is, to that extent, a capitalist employer. It was announced at the annual general meeting of Messrs. Dorman, Long & Co., Ltd., that 6 per cent. of the shareholders were members of the staff and workpeople, and that they held, among them, some 4 per cent. of the total capital of the company. Directors' holdings are not included in these figures. Any man who wants to secure the profits that fall to the capitalist employer ought to buy shares in the company for which he works, and so become one himself. Mr. Douglas Vickers told the general meeting of the shareholders of Messrs. Vickers, Ltd., that during the last five years the workpeople had had, in remuneration, nine times the amount that had been paid out in dividends to the shareholders. That is to say, the wages paid were only 10 per cent. less than they would have been, had no dividends at all been paid. In such a case the fear of unduly benefiting the capitalist employer is surely the merest bogey.

The fear of unemployment is more serious. Yet we think Mr. Clynes hit the nail squarely on the head when he pointed to the state of things in the cotton industry, and directly contradicted, and proved wrong, those who allege that cotton operatives are out of work because they have produced too much. They are not out of work for that reason, but because their product costs too much, and because would-be buyers have not the means wherewith to purchase cotton goods. If the output of cotton goods had been less, they would have been still more expensive, so that the capacity to purchase would have been lessened, not increased. A greater production without a corresponding increase in the cost of production would have lessened the price, and enabled the demand, which is there all the time, to have been, in engineering language, converted from potential energy into kinetic energy.

Production can be, and ought to be, increased to such an extent that each industry is able to afford to carry its own unemployment. As we have said before, unemployment will then be a direct charge on industry, to be reduced, like other direct charges, by successful direction and management.

There is need for production to-day, just as there was when the demand was so brisk that salesmanship was at a discount, and the capacity of the world for absorption of output was thought inexhaustible, together with the ability and willingness of the consumer to accept any and every kind of passed-on charge. It is necessary to-day to get actively after the business, but unless there is going to be production, selling efforts will be vain. The two things are so intimately bound up together that they cannot exist apart. Brisk demand and cheap production are mutually interdependent, and this fundamental fact must be accepted and acknowledged by employers, workers, and purchasers alike—for the purchaser has his part to play, as well as the others. Timid postponement, holding off for a fall in prices, will only damage prosperity, not increase it. What is the use of deferring the building of a power station until there is no longer a demand?

The surest way to produce a slump, and to make it a bad one, is to believe that there is going to be a slump, that it is going to be a bad one, and that nothing can avert it. As was recently pointed out in our columns, even if Europe is hopeless at present, because of the international exchange situation, there is still the British Empire; and there is still America, where the exchange operates to reduce our prices as compared with American producers.

Panic at the present time would be ruinous, and might deal the British electrical industry a blow from which it would take years to recover. The business is to be had, and it can be obtained, if only we use energetic selling methods, backed by hard work on the part of all concerned.

The Telephone "Ramp."

In the daily Press a "raging, tearing propaganda" is being carried on against what is called "The Telephone Ramp." We hold no brief for the British telephone service; years ago we foretold that if it were taken out of private hands and entrusted to a Government department, it would deteriorate in efficiency and would result in a financial loss. No prophetic powers were needed for that prediction; it was the obvious lesson of experience.

But having resolved upon the nationalisation of the telephones, the public has no right or ground for complaint at the inevitable consequences. "Serves you jolly well right" is the verdict of the unbiased observer; "you asked for trouble—now you've got it."

From another point of view also the "'Hello' Hullabaloo," as it is called by the *Globe*, is misconceived. Everyone knows that to-day's equivalent of a pre-war penny is about 2½d. The railway penny has been replaced by 1.75d.; the postage penny by 2d. On what grounds, then, should the telephone penny be left undisturbed? The annual charge is to be raised from £5 10s. or £6 10s. to £8 10s., and the charge per message from 1d. to 1½d.—an increase of practically 50 per cent. all round. The expenses have increased enormously, and the total cost per message in London to-day is 1.75d. Flat-rate or "unlimited" subscribers paying £20 for one line have been able to initiate from 5,000 to 10,000 calls a year, costing them, on the basis of the lower figure, *less than 1d. per message*. From a selfish point of view, it is not surprising that the flat-rate subscriber objects to the revision of prices!

Let us interpret the present situation by the application of cold common-sense. It simply means that at the existing rates telephone subscribers are helped to pay for their service out of the pocket of the taxpayer to the tune of £2,000,000 a year. If a subsidy to telephone users is a desirable thing and in the public interest, let it go on by all means—but let it be clearly understood by the public, and let us have no humbug about a "telephone ramp."

That the introduction of the new rates has been effected without the least regard for tact and suavity is, of course, quite true; but it is the invariable result of nationalising a public service, which soon assumes the airs of government and turns the right to service into a grudging condescension. There is no novelty in that. Even in municipal hands, service is apt to be replaced by depotism. In 1912 we gave up the right to expect an efficient, cheap, reliable, and willing service; but some people do not seem to have awakened to the fact yet. The only hope for the improvement of the telephone service lies in denationalisation: is it even now too late to apply that remedy?

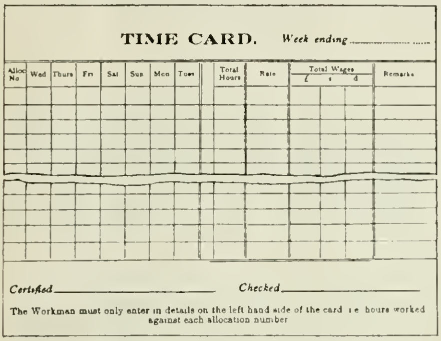
COSTING AS APPLIED TO THE ELECTRICAL INDUSTRY.

By A. CLEGG, A.C.I.S., F.C.W.A.

Costing is a very large subject, and it is not proposed to enter into the merits or otherwise of all the different methods, but simply to give details of a system of costing adopted by a company generating and distributing electricity in this country.

In an undertaking furnishing a single product like electricity the method of single cost can be adopted, but there are generally departments dealing with the wiring of consumers' premises, laying mains, and construction of substations to provide for, and we have to adopt the job system of costing for these.

The object of costing, as readers are doubtless aware, in the case of electricity, is to ascertain the cost per unit produced or sold, to reduce waste in material, time, and stores, and to supply data to the management for fixing the selling price. I think it will be agreed that the value of knowledge concerning the working costs of a modern generating station cannot be over-estimated, and that with the upward tendency of both wages and materials (especially coal, which represents 50 per cent. of the costs), it is necessary to have a comprehensive system.



TIME CARD. *Week ending* ....

Alloc No	Wed	Thurs	Fri	Sat	Sun	Mon	Tues		Total Hours	Rate	Total Wages £	s	d	Remarks

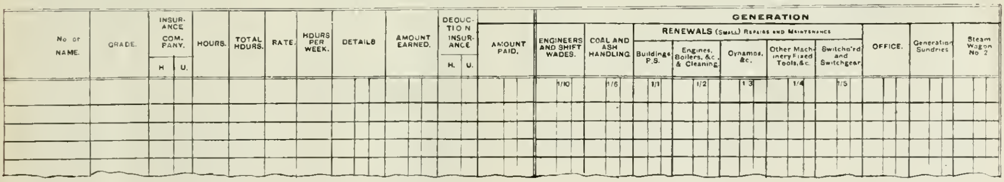
Certified ______________ *Checked* ______________

The Workman must only enter in details on the left hand side of the card i e hours worked against each allocation number

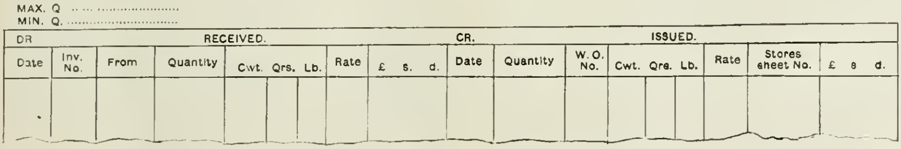
Fig. 1—Obverse of Time Card.

There is one main point to be borne in mind in drawing up a system of costing for an electricity undertaking, and that is the form of accounts prescribed by the Board of Trade. As both municipal and company supply authorities have to comply with these requirements, it is advisable to have the main heads as a basis; further sub-divisions can be made as required, but they will all eventually have to be brought back to the Board of Trade headings in the books of account.

Fig. 3.—Pay Roll.



No or NAME.	GRADE.	INSURANCE COMPANY.		HOURS.	TOTAL HOURS.	RATE.	HOURS PER WEEK.	DETAILS	AMOUNT EARNED.	DEDUCTION INSURANCE		AMOUNT PAID.	GENERATION										
													ENGINEERS AND SHIFT WADES.	COAL AND ASH HANDLING.	RENEWALS (Small) Repairs and Maintenance					OFFICE.	Generation Sundries	Steam Wagon No 2
		H	U.							H.	U.				Buildings P.S.	Engines, Boilers, &c., & Cleaning.	Dynamos, &c.	Other Machinery Fixed Tools, &c.	Switchbo'rd and Switchgear			
													1/10	1/6	1/1	1/2	1/3	1/4	1/5			



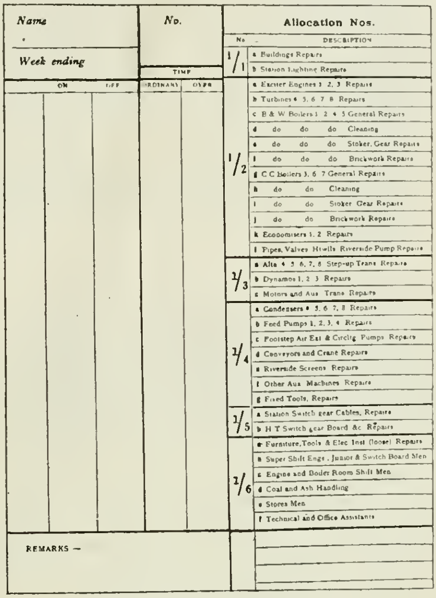
MAX. Q ....

MIN. Q. ....

DR		RECEIVED.									CR.		ISSUED.								
Date	Inv. No.	From	Quantity	Cwt.	Qrs.	Lb.	Rate	£	s.	d.	Date	Quantity	W.O. No.	Cwt.	Qrs.	Lb.	Rate	Stores sheet No.	£	s	d.

Fig. 4.—Stores Ledger.

Generation Costs—Having dealt with costing in a general manner, we will proceed to show how the cost of generation is arrived at. The main costs represent coal, wages, water, and general stores, but as the author has already written an article on coal records,* giving details of the system of keeping them, he does not intend to deal with this item hereunder.



Name	*No.*	Allocation Nos.	
Week ending	TIME	No	DESCRIPTION
ON / OFF	ORDINARY / OVER	1/1	a Buildings Repairs b Station Lighting Repairs
		1/2	a Exciter Engines 1 2, 3 Repairs b Turbines 4 5, 6 7 8 Repairs c B & W Boilers 1 2 4 5 General Repairs d do do do Cleaning e do do do Stoker, Gear Repairs f do do do Brickwork Repairs g C C Boilers 3, 6 7 General Repairs h do do Cleaning i do do Stoker Gear Repairs j do do Brickwork Repairs k Economisers 1. 2 Repairs l Pipes, Valves Hwells Riverside Pump Repairs
		1/3	a Alts 4 5 6, 7, 8 Step-up Trans Repairs b Dynamos 1, 2 3 Repairs c Motors and Aux Trans Repairs
		1/4	a Condensers 4 5, 6 7, 8 Repairs b Feed Pumps 1, 2, 3, 4 Repairs c Footstep Air Ext & Circltg Pumps Repairs d Conveyors and Crane Repairs e Riverside Screens Repairs f Other Aux Machines Repairs g Fixed Tools, Repairs
		1/5	a Station Switch gear Cables, Repairs b H T Switch gear Board &c Repairs
		1/6	a Furniture, Tools & Elec Inst (loose) Repairs b Super Shift Engs., Junior & Switch Board Men c Engine and Boiler Room Shift Men d Coal and Ash Handling e Stores Men f Technical and Office Assistants
REMARKS —			

Fig. 2.—Reverse of Time Card.

Wages.—There are many time-recording machines on the market, each possessing special features. The one used in the undertaking with which the author is conversant is a "Gledhill-Brook"; this type is an automatic time card recorder, and it was chosen because:—(1) it does not require an attendant to deal with time-keeping; (2) it automatically records late comers; (3) the whole of the running cost headings can be printed inside and the employé can allocate his own time. The above is an example of a time card, fig. 1, the reverse side of the card being shown in fig. 2. It might be mentioned that in order to prevent one employé booking on or off for another employé, the racks containing the cards and the recorder should be near the foreman's desk or stores office, where they can be under constant supervision.

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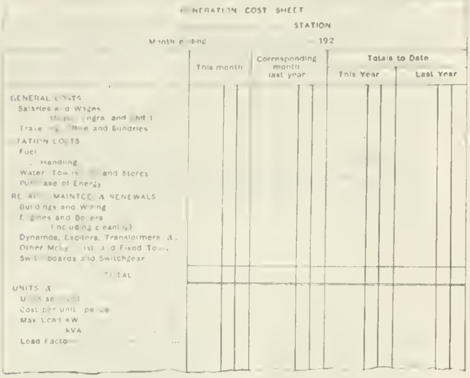
* Elec. Rev., October 8th, 1920, p. 455.



GENERATION COST SHEET

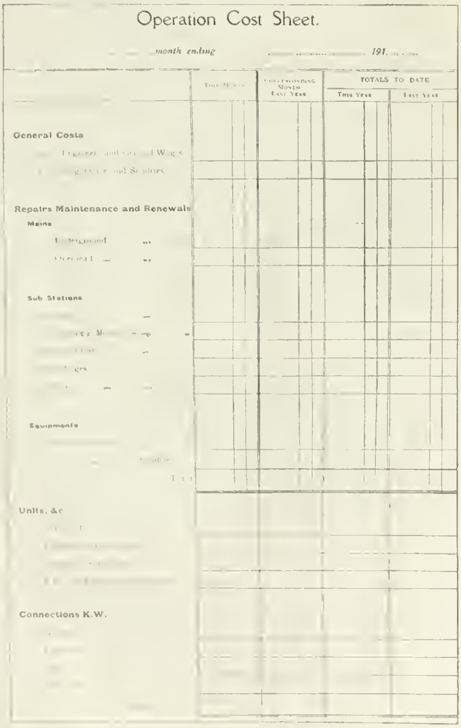
STATION

Month ending 192

	This month	Corresponding month last year	Totals to Date	
			This Year	Last Year
GENERAL COSTS				
Salaries and Wages				
([illegible] ngers and Shift)				
Trave[illegible] [illegible] and Sundries				
STATION COSTS				
Fuel				
„ Handling				
Water, Tow[illegible] and Stores				
Purchase of Energy				
REPAIRS MAINTCE. & RENEWALS				
Buildings and Wiring				
Engines and Boilers				
(Including cleaning)				
Dynamos, Exciters, Transformers &c.				
Other Mc[illegible] [illegible] and Fixed To[illegible]				
Switchboards and Switchgear				
TOTAL				
UNITS &				
U[illegible]				
Cost per unit pence				
Max Load KW				
KVA				
Load Factor				

Fig. 5.—Generation Cost Sheet.

At the end of the week, the time cards having been checked by the foreman and initialed by the station superintendent, are forwarded to the head office, where the wages clerk using a calculating machine arrives at the amount payable to the employé. This is entered on the pay-roll, which is ruled with headings as on the time card; the allocation of the man's time is, therefore, very simple. In the following example the headings are reduced to the Board of Trade headings, fig. 3.



Operation Cost Sheet.

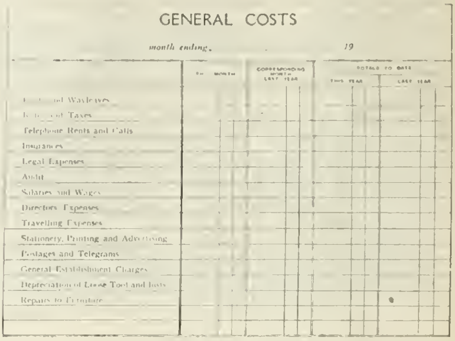
month ending 191.

	This Month	Corresponding Month Last Year	Totals to Date	
			This Year	Last Year
General Costs				
[illegible] Engineers and [illegible] Wages				
[illegible] Office and Sundries				
Repairs Maintenance and Renewals				
Mains				
Underground				
Overhead				
Sub Stations				
Equipments				
Total				
Units, &c				
Connections K.W.				

Fig. 6.—Operation Cost Sheet.

Stores.—It is not intended to enter into details of how goods are dealt with when received into the stores, but it may be of interest to give a ruling of the stores ledger, from which it will be seen that provision is made for keeping "maximum" and "minimum" stocks, fig. 4.

No goods are allowed out of the stores without a requisition, which is drawn up in a very simple form; the only comment necessary is that only certain authorised persons are allowed to sign requisitions, and they must also fill in the allocation. These allocations are mainly the same as those on the wage card, with the exception of oil, rags, &c. The requisitions are priced daily by the stores ledger clerks, and entered weekly on a stores allocation sheet, which is signed by the station superintendent.



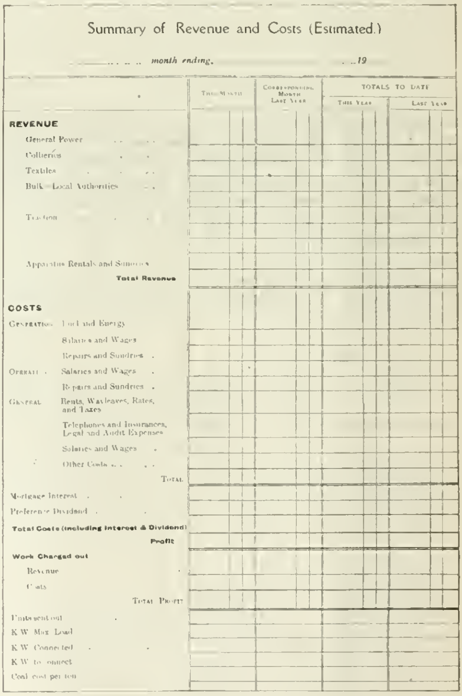
GENERAL COSTS

month ending 19

	This Month	Corresponding Month Last Year	Totals to Date	
			This Year	Last Year
[illegible] and Wayleaves				
Rates and Taxes				
Telephone Rents and Calls				
Insurances				
Legal Expenses				
Audit				
Salaries and Wages				
Directors Expenses				
Travelling Expenses				
Stationery, Printing and Advertising				
Postages and Telegrams				
General Establishment Charges				
Depreciation of Loose Tool and [illegible]				
Repairs to Furniture				

Fig. 7.—General Cost Sheet.

General.—We have now dealt with wages and stores, and it will be seen that the station superintendent has signed both record sheets at the end of the week, and had an opportunity of criticising them before they reach the cost clerk. It may have puzzled the reader to know what the numbers and letters by the side of the allocations on the time card mean; this is simply a short cut in allocating. The first one means No. 1 station, the second one means the number in the Board of Trade accounts; the staff soon learn these by heart, and it is easier to write 1 1A than "repairs



Summary of Revenue and Costs (Estimated.)

month ending 19

		This Month	Corresponding Month Last Year	Totals to Date	
				This Year	Last Year
REVENUE					
	General Power				
	Collieries				
	Textiles				
	Bulk—Local Authorities				
	Traction				
	Apparatus Rentals and Sundries				
	Total Revenue				
COSTS					
Generation	Fuel and Energy				
	Salaries and Wages				
	Repairs and Sundries				
Operation	Salaries and Wages				
	Repairs and Sundries				
General	Rents, Wayleaves, Rates, and Taxes				
	Telephones and Insurances, Legal and Audit Expenses				
	Salaries and Wages				
	Other Costs				
	Total				
Mortgage Interest					
Preference Dividend					
Total Costs (including Interest & Dividend)					
	Profit				
Work Charged out					
	Revenue				
	Costs				
	Total Profit				
Units sent out					
K.W. Max. Load					
K.W. Connected					
K.W. to connect					
Coal cost per ton					

Fig. 8.—Front Summary Sheet.

buildings," or 1/6d than "coal and ash handling." We now come to the point where the cost clerk takes hold. Each week details under the various headings are tabulated for wages, petty cash, and stores, and are brought forward on to the cost sheet below each month (fig. 5). The amounts of coal burnt and water used are estimated, and the proportion of salaries and office expenses on generation work is arrived at. The same process is gone through to arrive at the operation or distribution department's costs only, instead of time-cards, as the men are spread over a large area, weekly time-sheets are sent in ; the allocations of the wages-sheets are different, of course, but follow the Board of Trade form with sub-divisions (fig. 6).

The management cost-sheet is practically all estimated; the basis of estimate is the previous half-year, plus any additions which are known to be likely to occur, such as general advance of rates, taxes, &c. (fig. 7).

Fig. 9.—Works Order Register.

Works Order No	Date of Issue	Name	Description	Dept	Order Book folio	Order No	Quot No	Amount of Quot	Estimate of Cost	% of Profit	Date of Account	D B folio	Amount of Account	Analysis of Cost			Total	Difference between Estimate and Actual Cost		% of Profit	Remarks
														Salaries & Wages	Stores & Invoices	Sundry Expenses		Plus	Minus	Actual	

Enquiry £ COST SHEET
Estimate No
W O Issued to Wiring Dept. 19
Description
Quotation No.
Acceptance Dated Name Sheet No W/O No

19 . . Date	Particulars	Total £ s d	Petty cash	Petty cash Voucher No	Invoice No.	Stores Fo.	Wages					Motors, &c	Switch-gear, &c	Cable	Tubing	Sundry Material	Lamps		Material returned	
							Hours	Rate	£	s	d								Analysis	Amount

Fig. 10.—Prime Cost Sheet.

When all the above three costs are completed, the acconnts are transferred to a front summary-sheet (fig. 8).

There then remains the amount of revenne from sale of energy to be arrived at. Most of the accounts are sent out monthly and, therefore, there is very little estimating to do. Summary-sheets are entered up from the accounts rendered, and these supply information about the units sold under various classes, with the revenue therefrom. We have still to obtain the estimated interest accrued from loans and bank, rentals and sundry receipts, and profit on work done and in progress for consumers, interest payable on mortgages, preference shares, bank (if overdraft), &c. ; the cost is then complete except for technical data, which can be obtained from various weekly or monthy reports from the generation and distribution departments.

Costing—Sales Wiring Department.—The system of costing adopted for this class must be "job costing." It is necessary, therefore, to have a works order book, from which a number is given before a job can be commenced (fig. 9).

The clerk in charge of this work must see that all details are in order before the number is given. For instance, if a quotation is sent and accepted, he should obtain a copy of the quotation, and the order from the consumer, and note any special terms and the estimated cost of the job. When these are all in order he can issue a works order-card bearing the number of the job to the wiring department, which then proceeds with the job, using the number on the time-sheets and material requisition notes.

A prime cost-sheet is then made out by the works order clerk, on which the whole costs of the various items are posted from wages-sheets, petty-cash vouchers, invoices, and stores issues from time to time as the job proceeds. The prime-cost sheet is in the above form (fig. 10). It will be seen that this is split up under headings ; the benefit of these is specially noticeable where the quotation is net, plus a percentage of profit, because in most cases details have to be given, and the material going out at various intervals can all be brought together for rendering the account.

It has been very difficult to quote for jobs except on a net cash, plus percentage, basis, owing to the fluctuations in the prices of materials and wages, and a clause somewhat as follows, is often inserted :—

"This quotation is based on the cost of material and labour to-day, but if such cost is increased either before the commencement or during the execution of the work the quotation shall be increased by the amount of any additional cost of material or labour, and of any costs or expenses which may be occasioned by carrying out the work."

This all tends to increase the work of the cost clerk, as he must keep note of the date of quotation and order, and, if prices have changed, bring the same to the notice of the sales superintendent when sending the bill, to see if the extra can be charged.

On time and material jobs it has also been found advisable to get someone in authority to sign the time-sheet on behalf of the consumer, agreeing to the hours worked, and a space on the time-sheet provides for this. When the job is finished, the prime cost-sheets are closed and totalled, submitted to the sales superintendent for verification, and the bill is sent ; the details can then be entered into the works order register, showing the amount against the estimate, under the headings of wages and materials, account number, &c. Prime costs can then be filed for future reference, together with a copy of the quotation, order, works order card, &c., and the whole information can be got from the one source.

THE RATING OF ELECTRICITY SUPPLY UNDERTAKINGS.

At a meeting of the Surveyors' Institution, Westminster, Mr. H. Stewart Logsdon discussed the subject of "Rating, as Affected by Recent Legislation," and referred to the Statutory Undertakings (Temporary Increase of Charges) Act, 1918, which applies to electricity, water, and hydraulic power undertakings. He said this Act empowered the appropriate Government department to authorise local authorities carrying on statutory undertakings to increase their charges by such amount, not exceeding 50 per cent. of their statutory maximum charge, as would enable the undertaking to be carried on without loss. Charges could be increased in the case of other statutory undertakings by such amount as would enable the payment of three-quarters of the standard or maximum rate of dividend (if any) on the ordinary stocks or shares, or three-quarters of the pre-war rate of dividend, whichever was lower. The value of the properties to which the Act applied (with tramway and gas undertakings which had been specally dealt with in other Acts of Parliament) had been more directly affected by the war than any others, and where no order under the Act was in force, their rateable values being based upon the accounts, usually proved so low as to result in a large decrease in the assessments; indeed, in many cases the rateable value was reduced to a minus quantity. The chief factors which contributed to such a result were (*a*) The enormous increase in the tenant's working expenses, due mainly to the great advance in the cost of coal and all management expenses; (*b*) the larger share which was given to the hypothetical tenant as his remuneration. This was based upon a percentage of the capital which it would be necessary for him to invest to equip the undertaking adequately to enable him to work it satisfactorily. He did not think any convincing argument could be raised in support of the view that the tenant's share should not be increased, it being obvious that a tenant contemplating renting, say, an electricity undertaking, would find that the equipment constituting the tenant's property had risen enormously in cost. The consequent result of taking the usually accepted percentage upon this greatly increased capital expenditure was to give the tenant a larger proportion of the net receipts than in pre-war days. In the third place, the cost of repairs, insurance, and renewals of the landlord's part of the property also far exceeded any estimate based on pre-war prices. The balance of the net receipts (if any), after providing for the tenant's share and the cost of the repairs, &c. (statutable deductions), provided the fund out of which the rent and rates had to be paid, unless the latter had been previously deducted among the working expenses. From this it would be seen that if the usual method of valuation was adopted in future—unless the gross receipts were substantially increased—the hypothetical tenant would obtain an increased share at the expense of the landlord. In his opinion, this was unreasonable, for the landlord's interest in the undertaking had increased in value in the same way as the tenant's, and consequently he should be entitled to a rent at least as high as before the war. This was an anomaly created by present-day conditions which could not, however, disturb the basis of assessment, namely, the rent which a tenant would give. The effect of an "order" under this Act to some extent modified this position by partially maintaining the rateable value, but his experience was, speaking generally, that the increased charges authorised had not been more than sufficient to meet the increasing cost of the working expenses, which left little, if any, of the increased receipts to affect the rateable value. The Act was of temporary duration, and in fact, would be in force for a period of two years only after the official termination of the war. If the rateable value of such undertakings was in future to be calculated on the hitherto accepted principles, and produced a satisfactory result, a permanent increase in the statutory charges must be authorised. The post-war conditions had produced many anomalies in our existing rating system, and the time had arrived when the whole subject should be taken under review, and the law and practice amended to meet the requirements of present-day and prospective conditions. The method of valuing for rating purposes public undertakings such as electric tramways, railways, &c., which were not in existence at the time of the passing of the Acts which governed the present-day practice, led to many difficulties and unsatisfactory results. The present system of leaving the assessments in the hands of the overseers, who were not compelled to make a regular and periodic revaluation (except in the Metropolis), was very unsatisfactory. In many instances he knew of assessments in force to-day which were made very many years ago, when circumstances and values were entirely different. It would, in his view, appear to be of general advantage, and lead to equity of assessment, if it were compulsory for the authorities outside London to make a complete and periodic revaluation, similar to the quinquennial valuation in London; indeed, there did not seem to be any valid reason why the two parts of the country should be differently treated. Any revision of the rating system would be incomplete which did not provide for a uniform method of dealing with machinery in valuing rateable hereditaments which in some parts of England was taken into account in estimating rateable value and in others absolutely ignored.

THE PHYSICAL SOCIETY'S EXHIBITION.

The eleventh annual exhibition of electrical, optical, and other physical apparatus held under the auspices of the Physical Society of London and the Optical Society was opened at the Imperial College of Science and Technology, South Kensington, on the 5th inst., and remained open for two days. The attendance of visitors was on the whole good, and much interest was shown in the various exhibits, some of which were, of course, not new, but others have been much improved in recent years. The exhibition is always looked forward to eagerly, inasmuch as it affords an opportunity of studying the development that has been made in scientific instruments by the leading British manufacturers.

Some 50 firms exhibited apparatus, and features that were specially appreciated were the numerous experimental demonstrations that were given of the apparatus exhibited and the lectures that were delivered; for instance, Sir W. H. Bragg, K.B.E., F.R.S., discoursed on "Sounds in Nature," and Prof. C. R. Darling on "Some Unusual Surface Tension Phenomena." Prof. C. L. Fortescue and Dr. Bryan demonstrated some uses of a thermionic valve, explaining a number of well-known circuit arrangements, all the parts of which were exposed to view. The apparatus was shown connected up for illustrating the effects of "space charge" and "saturation," and for determining quickly the characteristics of the valves. The use of the valve as both an audible and high-frequency generator was demonstrated, as well as the "heterodyne" method of receiving continuous-wave signals, and certain other interesting phenomena of "beats."

Messrs. R. W. Paul and F. Twyman demonstrated, by interferometry, the distribution of temperature around a hot body. The variation of the refractive index in gases being linear with increase of temperature, if a hot body be placed in an interferometer of the Hilger type, various bands are formed around the body which are isotherms. The convection currents in air, from electrically-heated wires, were shown both with and without baffles. The method of investigation was suggested by Mr. Cuild.

Emeritus Professor Archibald Barr, D.Sc., LL.D., was to have lectured on the optophone, an instrument which enables the totally blind to read ordinary print. Owing, however, to indisposition he was unable to do so, but Mr. F. Morrison, his deputy, performed his task admirably.

Following the lecture, Miss Mary Jameson, who has been blind from birth, convincingly demonstrated the possibilities of the instrument. She read with accuracy, although she had only been using the optophone for about five weeks, lines that had been selected at random from a book, proving that the results which may be obtained by the use of the device are beyond dispute. Several medical men and eye specialists, who have followed the development of the instrument, hold the same opinion. For the moment (we hope to furnish technical details at a later date) it will suffice to record the main principle of the optophone as follows: A beam of light is made to traverse a line of printed matter, and is reflected therefrom on to a selenium cell. The amount of light which reaches the cell naturally varies according to whether it is reflected from the black type or white background of the printed page, and this variation in turn changes the resistance of the selenium cell, allowing a larger or smaller current of electricity as the case may be to flow through it and actuate a pair of telephone receivers worn by the operator. The sound heard in the telephone receivers by the user is in the form of a musical note, and with practice the *motif* of different letters, and indeed of complete words, can be easily differentiated. Dr. E. E. Fournier d'Albe was the inventor of the instrument.

The Hewittic Electric Co., Ltd. (formerly the Westinghouse Cooper-Hewitt Co., Ltd.), had a "brilliant" display of applications of the mercury vapour arc. A small rectifier converting single-phase a.c. at 110 volts into d.c. at 120 volts was employed to supply energy to a spherical medical lamp outfit for the treatment of skin diseases, wounds, &c., by ultra-violet light. The efficiency and convenience of this method of rectifying alternating current was amply demonstrated, a notable feature being the silent operation of the apparatus. The rectifying bulb is fixed at the back of the control panel, and the starting resistance and other accessories are grouped with it. The bulb being in the operating circuit, it is essential that it should always be delivering energy if the arc is to be maintained. If the demand is an intermittent one as, for example, in a spark coil, a shunt of sufficient value must be connected in circuit. A shunt is also necessary to start the bulb against a counter e.m.f. as in battery charging. Immediately the bulb is in operation the shunt is cut out automatically or by hand. A practically constant output efficiency of 85 per cent. is obtained at 220 volts from one-quarter to full load. A special type of rectifier has been introduced by the company for the requirements of kinemas. This automatically comes into operation when the carbons of the projecting arc are brought into contact. Another device exhibited by the firm was a stationary type tracing printing machine in which two powerful mercury lamps about 5 ft. in length supply the light, the cylinder of the machine being of lead glass to prevent injury to the eyes of the operator. Other exhibits were photographic lamps for use in kinematograph studios and enlarging outfits.

Messrs. H. Tinsley & Co. exhibited a very varied collection of instruments, including an artificial track-circuit in operation; a self and mutual inductance standard constructed according to principles laid down by the United States Bureau of Standards; Tinsley's vernier potentiometer, described in our issue of October 1st, 1920 (p. 427); and a thermo-electric compensating potentiometer, the first of its type to be made in this country, which instrument has a range of from 1 to 10,000 microvolts; a current regulator for use with the last-named instrument; tuning fork stroboscope, an instrument which measures speeds by means of a rotating disk and a constant periodic charge through a neon tube, which discharge is obtained through an induction coil whose primary is excited by the current passing through a contact on the tuning fork; a double Kelvin bridge with standards; an automatic wireless transmitter for aeroplanes, which we have already described, in which a commutator with a series of Morse signals is driven by clockwork in such a manner that any particular message is transmitted by moving a lever; and a number of Wheatstone bridges, &c.

Mr. F. Harrison Glew demonstrated radio-activity, and showed his radium applicators which are prepared with special composition; the latter is claimed to be unalterable by radium and, therefore, does not need to be re-made like ordinary varnish applicators.

Marconi's Wireless Telegraph Co., Ltd., had on view the No. 11a marine direction finder which embodies the new "sense" device. Formerly the direction finder gave the bearing of a transmitting station only, *i.e.*, it did not show whether that bearing of the observed station was, say, "aft" or "forward" of the vessel taking the observation. The new "sense" device gives this information with certainty, the result being achieved by superimposing an open aerial upon the ordinary direction-finding aerial. The two minimum points on the scale are first ascertained in the usual manner, after which the open aerial is superimposed (with the addition of a resistance in the circuit to overcome the "wiping out" effect) which makes it possible to determine which of the two bearings given is the true one. The four-electrode valve amplifying detector was specially designed for use on board ship where the cost of installation and maintenance must be reduced to a minimum. The chief feature is the employment of a single valve of a new type, having four electrodes and performing the function of three separate valves, viz., high frequency amplification, rectification and low frequency or note magnification.

The Edison Swan Electric Co., Ltd., exhibited a number of its "Pointolite" lamps, which were fully described in our issue of January 2nd, 1920 (p. 9). These have been developed in both directions there now being sizes of 30 c.p. and 4,000 c.p. The 30-c.p. size (fig. 1) which is produced at a very low cost, takes a current of .45 amp., and has been brought forward principally for employment with reflecting galvanometers. The 4,000-c.p. size has been designed principally for kinema projection work, giving out a very long and cool high-power beam. In the pyrometric type exhibited, the temperature of the positive electrode may be varied between 1,200 and 2,800 deg. C. The standard pattern of resistance employed with these lamps is capable of being used on all d.c. voltages from 100 to 250. A two-pin plug is used in connection with several pairs of holes to obtain the correct resistance corresponding to the voltage employed which is indicated on a scale. Fig. 2 shows a 100-c.p. lamp connected through a standard resistance.

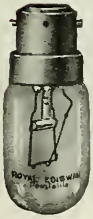


Fig. 1.—30 c.p. "Pointolite" Lamp.

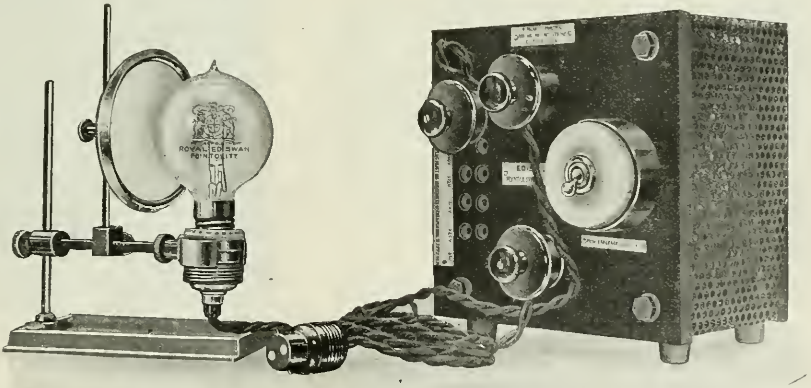


Fig. 2.—100 c.p. "Pointolite" Lamp and Standard Resistance.

Messrs. Watson & Sons (Electro-Medical), Ltd., displayed a number of examples of high-pressure and X-ray apparatus. A sphere-gap voltmeter graduated in kilovolts and centimetres was shown. This instrument is provided with accurately constructed spheres of 10 cm. diameter, and is useful in connection with h.p. transformers and induction coils for radiology. The "Sonic" bedside X-rays outfit was exhibited. This is a very compact set consisting of a static oil-immersed transformer operating from an ordinary a.c. supply. A Coolidge self-rectifying radiator tube is employed which obviates the necessity of providing a rotating rectifying device. A tapping is made on the secondary winding of the transformer for the heating circuit of the tube. The whole outfit is complete in one unit, and mounted on a small cabinet, on castor wheels, which contains the transformer. The energy is switched on and off by means of a foot switch or a pear switch. Another exhibit was a boiling X-ray tube for deep therapy treatment, that is, treatment with hard radiations. A "Sonic" X-ray group with kenetron valve and a heavy-discharge type induction coil with a "Dreadnought" mercury interrupter was also shown. In addition to these there appeared a diathermy apparatus for raising the internal temperature of the human body. Two types of electrodes were shown, those for penetration and others for surgical treatment.

Mr. J. St. V. Pletts exhibited the new Davis-Pletts slide rule, of which he is the patentee; it is manufactured by Messrs. John Davis & Son (Derby), Ltd., and presents some remarkable features. For one thing, it is entirely British made—and reflects credit on the makers. Its chief recommendation, however, is its greatly extended scope of application, which should render it especially useful to electrical engineers dealing with telephonic and wireless telegraphic formulæ, long overhead transmission lines, and other subjects involving the use of exponential or hyperbolic functions. The log-log scale, and its reciprocal scale, are placed respectively along the upper and lower edges of the face of the rule, and are related to the upper log scale in such a way that the numbers on the latter are the common logarithms of the numbers opposite them on the former; by this means the non-recurring log-log scales can be indefinitely extended. Further, scales are provided on the slide for all the ordinary exponential, circular, and hyperbolic functions, arranged to read on the same log scale, so that the product or ratio of any such functions can be obtained. All such compound functions as e^x sin a and log a cosh x can be obtained with a single setting of the slide and cursor, and every combination of the various functions is obtainable with two or more settings. The numerous scales have been ingeniously packed into the available space, and the scope of the new rule is astonishing; it should greatly shorten a class of calculations which are very tedious, and liable to error, when made by the usual methods.

Messrs. Evershed & Vignoles, Ltd., had an extensive show of measuring instruments of many types, including a number of their well-known "Megger" testing sets of different patterns, voltmeters, ammeters, &c. A "Dionic" water tester was exhibited. This is an improved form of the well-known apparatus for detecting and measuring traces of impurity in water so minute as to escape chemical analysis.

The complete apparatus is shown in fig. 3, where G is a glass tube to contain the water under test, and A and B are the electrodes connected to a direct-reading conductivity meter M, and a continuous-current hand-driven dynamo E. The thermometer T measures the temperature of the water under test, and is capable of being lowered or raised in the water, so altering the effective cross area of the liquid path. This thermometer is supported in a sliding holder L which moves in guides H H, and which carries an index I ranging over a scale J calibrated in degrees Centigrade. After the water to be tested has been poured into the funnel F has filled the tube G, the reading on the thermometer is noted, and its sliding holder is moved until the reading of the index I on the scale J corresponds with the thermometer reading. This operation compensates for the change of conductivity due to temperature, and the reading given on the dial of the meter M is the conductivity of the water at 20 deg. C. By turning the handle W of the dynamo, a current is generated which traverses the meter and the water in the conductivity tube G. The pointer of the meter is deflected, and comes to rest at some point upon the scale which directly indicates the conductivity of the water in the tube corrected to 20 deg. C. The test is completed as soon as the pointer has come to rest, that is to say, in two or three seconds.

The conductivity meter measures directly, and without calculation, the conductivity of any electrolytic solution in the tube to which it may be connected. The indication is given by an index which ranges over an engraved scale, graduated in units of conductivity. The unit is the reciprocal of one megohm. In the conductivity meter for dilute solutions the scale extends from zero up to 2,000 units.

The tube is so constructed that by pouring water into the funnel F, and allowing it to overflow through the outlet pipe O, every part of the tube is thoroughly washed out. A drain pipe D of pure rubber is provided at the bottom for the purpose of drawing off the contents at the conclusion of a test.

Among the uses to which this apparatus may be put are the testing for leakage of cooling water into a surface condenser; boiler priming; measurement of "hardness" of water; ascertaining the correct proportion of quicklime to be added in "softening" water; testing water supplies or river water, &c.

Needham's "Pulsator" system of speed control was demonstrated by means of a small motor and sliding resistance representing the engines of a boat. The apparatus is designed to accurately measure and control the speed of engines by an absolutely new method. The system depends for the constancy of its indications upon an electrical condenser and a non-inductive resistance. Its action is analogous to the operation of a Wheatstone bridge, giving a wide range and great accuracy. The essential instruments of the system comprise a rheostat serving either as a speed transmitter or meter, or both; a "Pulsator" driven by the engine whose speed is to be measured or controlled; and balance indicators showing when the "Pulsator" is revolving at a speed corresponding to the position of a contactor on the rheostat. The speed transmitter in the case of a ship is mounted on the bridge with one of the balance indicators immediately adjacent. The other indicator is mounted in the engine room. The instruments are connected up by suitable wires, and can be operated from an ordinary lighting circuit. The action of the apparatus in speed-controlling is as follows: The transmitter, which has a dial graduated in revolutions per minute, is set to the desired speed, and the pointers of both indicators will then deflect to indicate either "reduce" or "increase," depending upon the nature of the change being effected. The engineer will then adjust the speed gradually until the pointer of his indicator comes to rest at "Steady," showing that the signalled speed has been attained. The bridge indicator reaches its "steady" position simultaneously. In measuring speed the dial of the meter is moved until the indicator registers "steady," when the reading in r.p.m. can be taken.

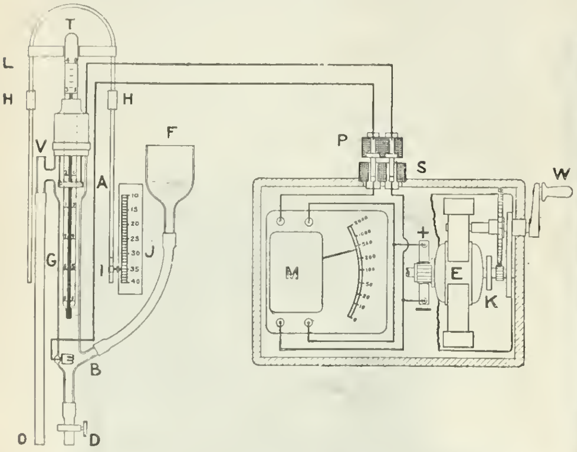


Fig. 3.—"Dionic" Water Tester. Showing Automatic Compensation for Temperature.

The high pressure d.c. motor-generator set exhibited by the firm at last year's exhibition has been considerably improved. As noted in our issue of January 16th, 1920 (p. 89), the set was then designed to give an output of 15 mA at 5,000 volts by means of three small magneto-generators in series on one side of the motor. The number of generators has now been increased to six, three on each side of the motor, and the same current output is obtained, but at a pressure of 12,000 volts. The design of the generator is such that the terminal e.m.f. is practically free from ripple. The firm demonstrated the apparatus with a cathode ray tube to show some of the possibilities of the cathode ray method of investigating rapid changes of current.

The Marconi-Osram Valve Co., Ltd., showed a selection of various types and sizes of transforming, receiving, amplifying, and rectifying valves.

(*To be continued.*)

AN ELECTRO-MEDICAL EXHIBITION.

In response to an invitation from The Edison Swan Electric Co., Ltd., we visited a few days ago the showroom extension recently opened at 123, Queen Victoria Street, E.C. 4, for the display of electro-medical apparatus.

The production of X-ray apparatus by this firm is a recent innovation, but its efficiency and general appearance make it apparent that "Ediswan" radiographic outfits will soon be well known. The exhibit inspected was a complete unit for an operating table measuring about 7 ft. by 3 ft. The table itself is well constructed, the upper part being of three-ply wood combining elasticity with strength. The X-ray tube carriage is fitted with ball bearings, and is easily moved to any position beneath the table. A useful device embodied in the carriage is a "periscope." The side of the tube container has a lead glass window through which the image of the tube is reflected on to a mirror fixed to the inside of a shutter in the side of the carriage. This facilitates inspection with no risk of injury from the rays. The induction coil employed is the "jointless section" heavy-discharge type wound to give as little reverse current as possible. The insulation is principally paper, instead of wax, making the coil suitable for use in hot climates. Each section of the coil is one wire thick, the wire being wound on paper disks in opposite directions for each alternate disk. A special coil for low-voltage work is also manufactured by the firm, primarily to meet the requirements of medical men who do not possess an electricity supply. This may be used in conjunction with "Ediswan-Acme" large capacity accumulators, which are made up in 12-volt units, each mounted in a wooden container, highly finished, and fitted with a carrying strap. These are supplied in two capacities, viz., 44 amp.-hour and 66 amp.-hour. The coil is fitted with a high-speed hammer break, and is made in three sizes to give 10-in., 12-in., or 14-in. sparks. The "Premier" continuous current interrupter fitted in the exhibited set is a coal-gas turbine interrupter, the internal parts of which are substantially built of cast iron. This type is not affected by mercury and does not burn. The only attention required is the replenishment of the mercury at two- or three-month intervals, and the oiling of the motor and main spindle bearings. The mechanical rectifier in use with this interrupter is based on the type patented by Mr. Leslie Miller, A.M.I.E.E. In this rectifier the reverse of the induction coil, due to the "make" of the primary circuit, is stopped by a revolving disk of insulating material. The periphery of this disk is perforated at the correct intervals, allowing only the useful current to pass to the X-ray tube. Mica disks were originally used, but owing to the difficulty experienced in obtaining large disks of this material "paxolin" is now employed, and has proved an efficient substitute. The interrupter and rectifier are enclosed in a sound-proof cupboard, as shown in fig. 1. Another type of interrupter produced by the firm consists of a pear-shaped steel bowl mounted vertically above a small motor, to the armature of which it is attached. Inside the bowl is placed a small quantity of mercury which, by centrifugal force, travels up the side until it reaches the greatest diameter where it is received by a groove, and forms a complete rotating ring inside the bowl. On a vertical spindle in the inside of the bowl a fibre wheel revolving on ball bearings is fitted, slightly out of centre, so that its edge engages with the mercury ring and is rotated by it. A copper segment is fitted across the fibre wheel which cuts in at intervals, allowing a momentary current to pass. The

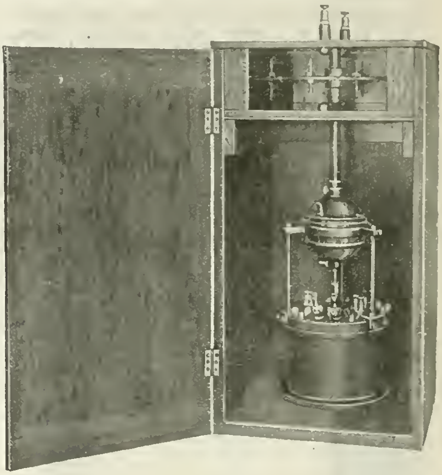


Fig. 1.—"Premier" Interrupter with Mechanical Rectifier.

rapidity of interruptions approximates to that of the electrolytic interrupter, and is obtained without gearing and with the motor running at its normal speed. Ten thousand interruptions per minute are obtainable with this device. The dielectric used is paraffin oil which is separated from the mercury by centrifugal action. On the "Premier" a.c. interrupter a synchronous motor is fitted; electrolytic interrupters are also included among the products of the company. The switchboard used in conjunction with the apparatus may be either of the wall or trolley patterns. The wall type is shown in fig. 2. This is a highly finished, black-enamelled board behind which the necessary resistances are fitted. These resistances are wound on hollow insulating tubes, which allow a rapid dissipation of heat and prevent the spirals sagging if overheated. The ammeter is graduated from zero to 12 mA, and by means of the multiple contact switch the current passing through the tube can be gradually increased from less than 1 mA to the maximum capacity of the coil. The centre of the board is occupied by a fine-wire resistance with a sliding contact giving a fine speed adjustment for the motor of the interrupter. Separate tumbler switches are provided for a pilot lamp, the motor, and the coil. For the last a pedal switch with a quick breaking action is provided in addition. The trolley pattern switchboard is similar in design, but is also fitted with a special quick-break double-pole switch. The board is mounted on a strong trolley fitted with rubber-tired castors. The "Ediswan" X-ray tube stand is a highly finished piece of work with adjustments for height and lateral and vertical angles. The tube container is of lead-lined wood with a lead glass inspection window.

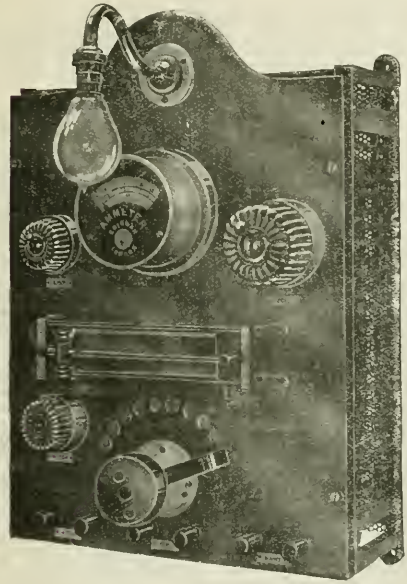


Fig. 2.—X-ray Switchboard.

In addition to the X-ray apparatus the showroom contains a wide range of other electro-medical devices. One of these is the radiant heat bath, in which are fitted six carbon filament lamps. The case is of heat-insulated wood, and is so constructed as to fit many parts of the human body. The heat given out is stated to be very effective in cases of rheumatism, &c. Small baths mounted on insulated stands, fitted with electrodes on each side are shown. Many portable galvanic and faradic batteries are included in the display. The "Universal" earth-free machine is a set devised to meet a number of electro-medical requirements. The current is supplied by a small double-wound motor driven from an ordinary lighting circuit. The machine can be connected up in different ways to supply galvanic or faradic currents, to operate a small inspection lamp, or to provide the heating current to a cautery needle. By means of an eccentric and plunger fitted to the motor shaft, an interrupted current can be supplied. through a water resistance, to cause alternate contraction and expansion of the muscles. The motor may also be used to drive a vibrator for massage treatment through a flexible shaft. Very effective results may be obtained with the company's portable high-frequency sets, which are marvels of compactness. These are constructed for connection to a lighting circuit, they weigh only 10 lb. each, and measure 10¾ in. by 7¼ in. by 9¼ in. The accessories comprise a handle, surface electrode, rake electrode (for treatment of the hair), and a saturator (which, it is claimed, banishes insomnia).

Although not strictly electro-medical, the Ediswan "Saloon" hair dryer is worthy of mention. This consists of a small motor and fan, with a heating element (400 watts) which may either be fitted to the air nozzle or in the end of an aluminium flexible tube. The whole of the machine is light enough for application by hand, but a heavy metal base is also supplied.

Our readers, who are already acquainted with the multifarious activities of the Edison-Swan Co., will find it worth their while to visit the showrooms to view this very excellent exhibition of the company's developments in a new field.

ELECTRICITY AND AGRICULTURE.

The tenth report of the Development Commissioners for the year ended March 31st last has been published recently by H.M. Stationery Office (price 2s. net). This is a voluminous publication dealing with a wide field of research and practice in the realms of agriculture, stock breeding, rural transport, harbour improvements, fisheries, &c. Electricity has played but a small part in the work of the Commissioners, but one or two points of interest to electrical people are recorded. Dealing with transport in rural districts, the report states that this function has now been transferred to the Ministry of Transport, but the Commissioners express regret that while these questions remained within their reference they were unable to recommend the Treasury to approve more than a small fraction of the applications submitted to them. This was not owing to intrinsic defects in the schemes, most of which were for making or extending light railways, but to the stipulation in the Development Act which forbade advances from the fund to an association of persons or a company trading for profit. As no alternative agencies offered themselves, or could be found for undertaking the development of rural transport, the Commissioners found themselves powerless to make recommendations to the Treasury. The one exception—that of the Brandsby Light Railway—was a case where the promoters, the local landowners, were prepared to agree to conditions which satisfied the Law Officers of the Crown that no profits could possibly accrue to any one—a criterion that not unnaturally failed to recommend itself to the other applicants with whom the Commissioners negotiated over a period of years.

It is interesting to note that experiments in electro-culture, carried out by the Commissioners, have met with success, although previously it was thought that the benefits of electricity in this direction were, at the best, doubtful. The effects of high-pressure electrical discharges upon the growth of crops were tested in the following manner: Wires were stretched above the crop and charged to a potential of about 50,000 volts, with the result that a small current passed through the air to the crop below. The most striking point about the majority of earlier experiments of this nature is the neglect of measurements of the current used, and on this account one electro-culture experiment could not be compared with another, and there was no certainty whether too much or too little discharge had been allowed to take place. To test the action of the current and to fill this serious gap there were started a series of plot experiments in different parts of the country, a series of pot experiments, and also laboratory experiments with single seedlings. In all these experiments careful measurements were made of the current supplied, and special experiments were directed to the determination of the maximum and minimum current which could be used. The plot and pot experiments have now been continued for a number of years, and converging evidence from the field and from the laboratory indicates very clearly that by such treatment the growth of a cereal crop can be markedly increased. Differences as high as 50 per cent., 38 per cent., and 35 per cent. in favour of the electrified areas have been observed in a number of cases. It has further been shown that the plants are sensitive to a very small current, so it is easy to give a discharge which reduces, instead of increasing, growth. The amount of electric energy supplied to the individual plant is exceedingly small, for the total energy supplied *per acre* is only as much as that required for a 50 candle-power lamp. If the cost of the installation required to produce and distribute electricity in actual agricultural practice can be kept low, a new method is available for increasing the yield of crops.

The report makes reference to schemes for supplying electric power to farms, citing as an exemplary scheme the Hereford Corporation's wide activities in this direction, referred to in previous numbers of the Electrical Review. Mention is made of a grant to the Chester Corporation for a survey of the water power of the river Dee, the result of which was very promising.

French Lamp Exports.—According to statistics published in the *Bulletin* of the French Chamber of Commerce in Turin, France exported to Italy during the period from January 1st to March 31st, 1920, 1,731,000 glow lamps, worth 605,850 lire. For the year these figures would represent, roughly, 6,924,000 lamps, valued at 2,423,000 fr.

THE PROPOSED ENGINEERS' CLUB.

An earnest endeavour is being made to found an Engineers' Club in London. The idea is a very excellent one, and it ought to be carried out on the broadest possible lines. The term "Engineer" should be made elastic, and should include those who, in the words of the charter of the Institution of Civil Engineers, turn the great forces of nature to the use and convenience of man. A club catering more or less for engineers has been tried on one or two occasions, and has not matured satisfactorily; what should be attempted now is an Engineers' Club in the widest sense, domiciled in London, with a membership obtained not from London alone, but from the provinces and our overseas Dominions.

The provision of a common ground, free from all political bias, where engineering thought can find a congenial atmosphere, must be of inestimable value to the development of a profession and industry on which largely depend the safety and well-being of our Empire. If we want to listen to a paper on "Taxation in the year 2021," or on "The propelling machinery of Noah's Ark in B.C. 5000," why should there not be a common meeting-place where we could dine in comfort before the debate, and wipe away all asperities when it was over in a sociable smoke and drink together?

Nothing can help engineering the one great constructive force to-day, as it was yesterday and will be for all time—more than a gathering together of its vital component parts on the lines indicated above. Such a club, where members from the provinces and overseas could find a home, would provide the means.

It is impossible to look upon the financial aspect of such a venture with pre-war eyes. A subscription which might have been ample six years ago, owing to enhanced values, must now be more than doubled. An Engineers' Club in London should not be started with less than 1,000 original members, at an annual subscription of, say, ten guineas.

The scheme for the financing of an enterprise of this kind must receive close attention at a later date, and due regard must, of course, be paid to favourable terms for provincial and overseas members. The difficulties are fully realised, but are believed to be not insurmountable. To make the Club a success it must be run as a *club*, and not as a glorified saloon bar. The latter course has been adopted by certain clubs in London to-day.

The Club should aim at giving the best service possible at the lowest cost. It should be a club established for the benefit and advantage of its members, run on co-operative lines, and not a camouflaged hotel worked for the sake of profit. Four things are essential to bring about the end in view: First, the assurance of the moral support of all engineering interests; secondly, the necessary financial support; thirdly, the setting up of a really strong and representative honorary committee, composed of men who would give a large amount of time, trouble, and attention to the formation and conduct of the Club; and, fourthly, the finding of a man of experience who could run such a club economically and successfully. No amateur, however good, could fill the bill. The Club would need the best that money could buy; a full-time man of great experience in management, buying and catering, of long and varied knowledge of club management, and a gentleman—in the best meaning of the word—would be essential.

There should be a generous bedroom accommodation, for the country membership will be large; and for the same reason it might be well to have a linking-up arrangement with the Engineers' Clubs in Manchester and Birmingham.

We are glad to announce that a strong preliminary committee, comprising prominent men in the civil, mechanical, electrical, gas, transport, iron and steel, shipbuilding, and other branches of engineering is being formed, in order to explore the possibilities.

As it is vitally important for the framers of a scheme to have some idea of the magnitude of the probable membership, readers who are in favour of such a club are invited to send their names either to the offices of this paper or to Mr. Edmund L. Hill (Secretary of the Federation of British Industries), 39, St. James's Street, S.W. 1, who has kindly consented to act *pro tem.* as honorary secretary to the committee.

Report on Air Ministry Competitions.—The Report upon the competitions between various types of aeroplanes and "amphibians" which took place during August and September last says a great deal with regard to points in design making for safety and comfort. It is noted with satisfaction that very few items of equipment of foreign make were utilised by competitors, and these were practically confined to petrol gauges. The magnetos fitted were all of British design and manufacture, and the Report states: "While there is little doubt but that when a few mechanical details have been improved, the British magneto will be the best in the world, the results of the competitions show that the British magneto manufacturers are now abreast of any of their foreign rivals."

LEGAL.

Electricity Obtained by Fraud.

At Old Street Police Court, S. D. Goldberg was summoned for unlawfully causing to be laid electric lines to communicate with an electric line belonging to the Stepney Borough Council on or about November 8th, and, further, fraudulently abstracting, consuming, and using electricity, the property of the Borough Council.

Mr. G. H. Young, prosecuting, said defendant and two others made application to the Council in writing to be supplied with electricity for certain premises to be converted by the defendant into a billiard saloon. An inspector from the Council, who went for the purpose of removing a meter board, discovered that two wires had been connected with the wire belonging to the Council, and with four lamps, in such a way that the electricity passing through did not go through the meter. The electrician said it was done by Mr. Goldberg's orders. Defendant was seen afterwards, and said the lamps had only been on for an hour or two, and if there was anything to pay, he was willing to pay it.

Defendant said his electrician did it, but he (defendant) was liable as he employed him. It was only a temporary connection, for three-quarters of an hour.

Mr. Clarke Hall said he was sorry his power to fine was limited to £5 in each case, because he thought it was a gross fraud. Defendant would be fined £5 and £2 2s. costs on each of the two summonses.—*Bethnal Green News.*

Theft.

Harry Risley, 34, electrician, employed at Bellamy's Wharf, was sentenced to three months' imprisonment with hard labour at the Tower Bridge Police Court on January 6th, for stealing goods valued at £243.—*The Times.*

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Cost of Living on the Gold Coast.

In the current issue of the Electrical Review a letter appears from "'Phone Engineer" asking for particulars of life on the Gold Coast. I have spent five and a half out of the past six years there. The climate, as is generally known, is not healthy for Europeans, but if ordinary care is taken it is not as black as sometimes painted. It is very damp all the year round, and produces a good crop of rheumatism and kindred complaints. The heat is not as great as in India or Egypt during the day owing to the moisture, but the nights are hot as a rule. The average temperature is about 90 deg. Malaria is very prevalent, but not serious provided it is not taken too lightly and quinine is taken regularly.

The cost of living is high compared to that at home. Bungalows are usually provided free for a single man, in which case, including a cook, steward, boy's washing, &c., the cost per month will come out at about £15 to £20, according to the style of living. The food very much depends upon the district where one is situated. If on the railway, a seaport, or near either, fresh meat can usually be obtained of a greater or lesser degree of toughness at about 2s. 6d. per lb. Chickens are generally plentiful, as are also eggs and fruit. Tinned goods form a great part of the European's diet—bacon, vegetables, &c., which can be obtained from any of the numerous traders' stores in the colony. Clothing, generally speaking, is dear, and a sufficient supply to last the tour should be taken from home. If "'Phone Engineer" is considering going out to "the Coast" I should be pleased to give him any more particulars he may require.

Mine Engineer.

January 8th, 1921.

[We are much obliged to our correspondent for these useful particulars, and for his offer to give further information. Letters addressed to this office will be forwarded to him.—Eds. Elec. Rev.]

A Generator Problem.

In further reply to "Wireman," I should like to suggest that in addition to testing the voltage across the shunt field, he should also test which is the positive and which is the negative shunt lead. He should also ascertain which is the positive and which the negative machine terminal. This he can easily do by means of a polarised voltmeter. If the voltmeter indicates that the voltage across the shunt field is less than that across the machine terminals, the machine will run self-exciting if the positive field lead is connected to the positive terminal and the negative lead to the negative terminal. If the field leads are connected up in the reverse way, the machine will not build up, because the voltage generated by the residual magnetism will send a current through the field windings in such a direction as to oppose and destroy the residual magnetism, no matter what polarity it may have.

It does not necessarily follow that because a shunt-wound machine runs as a motor it will also run as a self-exciting generator without altering the connections. It will only do so on condition that the direction of rotation is that suitable for the conditions obtaining. If the machine in question proves to be designed for separate excitation from a 480-V supply, the reason for not building up as a shunt generator is obvious. If connected to a supply, as a shunt motor, it would certainly run, but at a dangerously high speed owing to the weak field.

I do not quite follow "Wireman's" explanation of series and compound connections. It would have been better had he given a sketch of arrangement. The compound winding will perform its function of regulating the voltage according to load, whether the generator is self-exciting or not.

T. A. Robertson.

Glasgow.
January 8th, 1921.

Referring to "Wireman's" correspondence of the 1st inst., in connection with the above, I am of the opinion that the machine referred to is a compound-wound interpole generator, and that the compound winding mentioned by him is actually the interpole winding.

If "Wireman" cares to get in touch with me direct, I shall be pleased to give him any assistance I can in the matter.

C. A. Besley.

39, Newfoundland Road, Cardiff.
January 8th, 1921.

Excessive Charges for Service.

In reply to an application for a ten-point installation of electric light in a small villa about 20 ft. back from a road in which mains are already laid, the electrical engineer of an Urban District Council recently quoted a price of £15, for installation charges.

Together with the cost of wiring, the whole installation would have cost about £41, which is quite prohibitive for houses of this class, and if similar charges are being made throughout the country the immediate future of electric lighting would seem to be very gloomy.

As is most common with public authorities, the letter was abrupt to the verge of rudeness, the applicant being informed that if he decided "to adopt electric lighting this sum, in accordance with the instructions of the Council, must be paid before the work could be put in hand."

It is hardly necessary to say that the applicant did not decide to adopt electric lighting.

X.

January 10th, 1921.

[According to the Electric Lighting (Clauses) Act, 1899, the undertakers can only charge for so much of the service line as may be laid upon the property of the consumer, if the premises are within 60 ft. of a distributing main.—Eds. Elec. Rev.]

German Competition in the Electrical Trades.

We regret that "W. H. M.," in his effort to avoid personalities, should have so poor an opinion of our knowledge of economics. A blow at one's little hobbies is always the most unkindest cut of all, but we take comfort in that "as yet."

If we understand your correspondent aright, he suggests that our determination not to buy German machinery is causing more unemployment in this country. Let us see where this leads us. We refuse to buy from Germany, and for the sake of the argument, cannot, or will not, purchase machinery of other foreign origin. We, therefore, in order to keep our business going, buy the machinery from British manufacturers, and so we increase unemployment, which, as Euclid would say, is absurd.

There is a certain kind of cane used by chairmakers in this country, which, we understand, grows only in Germany. If we were chairmakers, and refused to buy this cane, we should, undoubtedly, increase unemployment. "W. H. M." will readily see the difference in these two cases.

We will do our best to reply to your correspondent's questions.

1. Germany does not intend to pay her war debts, but if forced to do so, can pay with the wealth produced by her agriculture, her mines, her manufacturing industries, and by the profits made in trading with those neutral countries which have been enriched by the war.

2. Yes, and the greater the quantity sent over here, the larger the number of British factories which will close down.

3. We never mentioned the word "rings" in our letter. Rings can either increase the prosperity of a country or be its curse. It depends entirely on the policy of the rings.

4. If "W. H. M." had thought a moment he would not have asked this question; how can our manufacturers dump their goods across a high protective barrier? Apart from this, we doubt if any manufacturers, exposed to free foreign competition and dumping, could ever make their goods in sufficient quantities to dump profitably. We reiterate that the producer is the creator of the real wealth of a country—the agriculturist, the miner, and the skilled artisan—with the assistance of the capitalist, and the trained technical expert. The great distributing systems—ships, railways, wholesalers, retailers, export and import merchants are, of course, indispensable, and, by their enterprise and efficiency, add greatly to the wealth of the country; but injure the producers, either by excessive taxation, strikes, the policy of ca' canny, unrestricted foreign imports, or dumping, and you strike a mortal blow at the prosperity and well-being of our land. At the same time, and what is of equal importance, you are endangering the national security of our country. Has the war taught "W. H. M." nothing? Surely he remembers how, in the early days of the war, our armies were handicapped—little optical glass, less chemical glass, and few explosives, owing to a decaying dye industry. We wonder how many of our lads were sacrificed through the lack of these native industries, strangled by German competition.

One of our correspondents tells us he has sent a copy of your leading article to his local M.P.—an excellent idea, which we have copied, and, in view of the Bill shortly to be presented to Parliament, one we should like to commend to your readers.

London. **E. P. Allam.**
January 10th, 1921.

The correspondence on this subject in your columns is very interesting. With regard to one of the questions asked by "W. H. M." in your issue of the 7th inst., it is, of course, notorious that the "rings" in the electrical industry, and in others, are largely responsible for inflated prices, and also for the restriction of trade, though whether they can be held responsible for the latter in its *present* legal definition is another matter. It follows that they are responsible for some of the unemployment in the country. It is natural that the rings should wish to keep out German and other goods, as their aim is to eliminate competition and fix their own prices accordingly. The buyer and the consumer are, of course, the sufferers. If you and "W. H. M." are agreeable, I would like to get into touch with him. The prejudice against *German* goods is natural enough, but the whole question is very much wider than this, and calls for clear thinking and action.

Play Fair.

January 8th, 1921.

May I refer "All British" and other correspondents to extracts from the last two paragraphs of your leading article in to-day's issue of the Electrical Review?

"Surely it is a matter of plain common sense . . . . and it should be our earnest endeavour to turn out the maximum quantity of goods at the lowest possible prices. *That is what the Germans are doing already.* [Italics are mine.] Let us beware lest, beaten in war, they defeat us in the arts of peace . . . . and let each 'do his bit.'"

That is what I tried to say in my first letter!

W. H. M.

January 7th, 1921.

The Life of Metallic Filament Lamps.

Is it not about time some protest was made against the metallic filament lamps which at present are being turned out on the market? Wherever one discusses the question, one hears the same complaint—inferiority.

I have burning at the present time two out of six "Brimsdown" lamps bought before the war—one in a table lamp which is continually being moved. The remaining four all burned over three years. There is a legend that the life of a lamp should be 1,000 hours. I have tried all the leading makes, and I should imagine that 250 hours average is about the maximum one can expect from lamps purchased in the last 12 months. As for the half-watt type, these are infinitely worse. I purchased eight ten days ago—six burnt out in three days, and were returned to the factors who supplied them, who also tendered the information that they were having a tremendous number of complaints, and having to return lamps to the makers in hundreds.

Besides concentrating on prices, could not the lamp ring make an effort to see that a consumer gets a fair return for his money, and by so doing help the electrical industry generally?

The failures referred to are not mechanical breakages, but lamps which go out after a short run in perfectly undisturbed positions. Perhaps some large users will give their experience.

Dudlux.

January 10th, 1921.

Shop Displays.

My attention has been directed to a letter dated December 23rd appearing in one of your recent issues, from the managing director of Messrs. Watson, Marsh & Co. (Hampstead), Ltd. I am sorry that the writer should trouble you with his personal grievances. A vague charge is made against my Association, to which it is impossible to reply in the absence of anything definite. Suffice it to say that Mr. Cohen personally thanked our solicitors for their help in matters which really related to clients of Messrs. Watson, Marsh, and thanks were also received from the clients concerned.

I should hardly think that the public are concerned with the circumstances under which Messrs. Watson, Marsh & Co. resigned as from April 30th, 1921, from the membership of the N.F.E.A., or the fact that Messrs. Watson, Marsh & Co., were pressing for the rebates under the cable makers' agreement before they became due, and at a time when they themselves had not paid up the contributions to the subsidy fund of the N.F.E.A. I submit that it would be far better if Messrs. Watson, Marsh & Co., instead of writing about "union amongst members" practised loyalty themselves to their own Association.

Leonard G. Tate,
General Secretary.
London. *Electrical Contractors' Association (Inc.).*
January 8th, 1921.

A Curious Phenomenon.

Your correspondent's letter *re* gas burners brings to mind a similar case I met with some years ago; this time, however, it was arc lamps. These were repaired during the day and put on test during overtime, *i.e.*, 5.30 to 10 p.m. About 7 p.m., and from then onwards, we were greatly bothered by a continual but intermittent flickering of the arc, accompanied by a "sing" or drone, according as the arc lengthened or shortened. Being then much younger, I was greatly puzzled, though assured by one of the "sparks" that it was due to wireless. I have never met the phenomenon since, and the "spark" being a romancer was not really believed. Perhaps some of your readers may have been up against it also, and have an explanation. The "sing" of the arc certainly supported the wireless theory.

E. N. E. Husbands.
Lincoln.
January 6th, 1921.

A Fiery Test.

The note in this week's Review on a remarkable test of an electric iron recalls a similar but unintentional test which came under my notice. I was called to a large house where "some of the lights had gone out," and on tracing the fault down to the drawing room I found a hole burnt through the oak floor underneath the sofa and the iron—a 3 lb. "Magnet"—under the floor; it had been placed under the sofa out of the way and never switched off. As your article says, the plating had "gone west," but the wooden handle was only scorched. The fuse had been blown by the iron falling on to the flex and burning it through. The heating element was uninjured, and after being cleaned up, the iron was put into service again, and to my knowledge was in use eighteen months afterwards.

Not Burnt Out.
January 8th, 1921.

On page 21 of your current issue the "Electric Heating Co., of Croydon," describe "a remarkable test" of their "electrical iron." A 6 lb. iron was mounted on a wood plank 14 in. wide and 4½ in. thick, and the current was switched on. In 13 hours the iron had become a white hot mass of metal, and had burned its way through the board.

If the current taken by the iron was in excess of the normal rating, then indeed it was a remarkable test. But, on the other hand, if the current was normal, then surely the iron should not become a "white hot mass," but should dissipate its heat when it had reached its best average ironing temperature. I can understand an iron burning the wood, but I do not understand the iron becoming a white hot mass. I shall be glad to hear from the makers on this point, and also to have the views of your readers.

L. O. Meyer.
Bedford.
January 7th, 1921.

Electricity Supply from Surplus Sources.

In your issue of December 24th there is a description of a small hydro-electric plant which is stated to be unique, "inasmuch as there is no other similar plant in this country which feeds surplus energy into a town's public supply network."

Concerning this, I would ask why this should be so. Is there any valid objection to this course being adopted on a large scale? If works all about the country can take a supply of electrical energy from the mains through a meter, is there any reason why a works that happens to have surplus energy should not dispose of it by discharging it into the public supply mains through a meter, and being credited with it?

Some firms have long ranges of boilers supplying steam at low pressure for heating and boiling. If instead of the boilers being pressed to, say, 60 lb they were pressed to 200 lb., it would require only a few per cent. more heat units, and the steam if passed through an engine or turbine would develop a great deal of electrical energy at merely nominal cost, which could be fed into the public supply mains.

Other possibilities of generating electrical energy cheaply are blast-furnace and coke-oven gas, exhaust from internal-combustion engines, streams, &c., and if all such sources of generating energy were developed, the result in the aggregate would be very large, and the benefit to the country considerable. If it were known that any surplus energy could be passed into the public supply mains, many people and companies who have potential sources of energy would proceed to develop them, and such schemes as the Severn barrage might take a back seat for a time. It has been suggested that companies which use a lot of steam for manufacturing purposes and require very little power should place their works beside other manufacturers who require a great deal of power and have very little use for steam, but moving works involves a large outlay, and it would be unnecessary if surplus electrical energy could be discharged into the public supply mains.

Albert Charles Pain, M.I.Mech.E.
Birmingham.
January 7th, 1921.

[The answer may perhaps be found in the facts, which have been noted in our pages, that power companies have to provide stand-by plant practically equivalent to the surplus power supply; that many works have surplus energy at times and on days—as at week-ends—when the power companies cannot use it; and that consequently the power companies cannot offer a good price to the works for the surplus energy, nor can they sell it to the public at a low rate, in view of the capital charges on plant and mains.—Eds. Elec. Rev.]

A Freemasons' Lodge for Birmingham.

I have heard it mooted for several months that several Freemasons who are electrical engineers in the Birmingham district think it desirable that a lodge should be formed in Birmingham, confined to electrical engineers. I shall be pleased if you will give this publicity, and would thank all those interested to communicate with me.

V. Delebecque.
57, Bridge Street,
Walsall.
January 7th, 1921.

Home Lighting Economies.

With reference to "Voltman's" home lighting economies and Mr. C. A. Copinger's suggestion in the current number of the Review, may I offer the following idea? Instead of connecting several 230-V m.f. lamps in series on a 230-V circuit, would it not be more economical to use 50 or 100-V m.f. lamps (for four or two points respectively) in series? These lamps can, I believe, be obtained in as low a c.p. as 5, taking about 6 watts. Supposing that "Voltman" has four dark corners to light, and uses four 50-V 6 watt m.f. lamps in series; at 6d. a unit this will only cost him 0.16d. per hour—not a ruinous figure!

Vere Burgoyne.
London.
January 10th, 1921.

Preparing Estimates.

Do any of your readers know of an up-to-date text book dealing with the work of preparing estimates for general electrical work and giving suggestive data?

Estimating Engineer.
January 3rd, 1921.

The A.E.G.—Addressing the shareholders at the recent annual meeting, when the report and accounts for 1919-20 were adopted, Herr Rathenau is reported to have expressed satisfaction that the former peace rate of dividend of 14 per cent. had been reached, although he admitted that it was a paper mark distribution, because the earnings were in paper marks. It had been considered necessary to create a new foundation for the benefit of the workmen by the allocation of 12,000,000 marks for the purpose. The donation was prompted by the feeling that the company must recognise that the men had made every effort to increase the production during the difficult situation, the amount averaging 200 marks per head. As to the future prospects, the chairman remarked that the stock of orders was not uniform, but was so far satisfactory. The course of business with the Felten and Guilleaume Co. was developing according to expectations, and the conditions in the case of the other investments were also satisfactory.

Wages Questions in Sweden.—Negotiations are proceeding in Sweden between the Employers' Association and the Electrical Employers' Association on the one hand and the Electrical Workers' Union on the other, with regard to the conclusion of a new agreement for the whole of the country. In the case of electricians employed by installation contractors a minimum wage of 2.85 kr. per hour is now being demanded. It appears that since the end of 1914 the wages of this class of workmen have increased by 265.7 per cent., whereas the cost of living, as shown by the latest figures of the State Social Administration, has advanced by 181 per cent. between 1914 and October 1st, 1920.

BUSINESS NOTES.

Dissolutions of Partnership.—Central Light and Power Co., electrical engineers and general electric lighting and power installation contractors, Friar Lane, Leicester.—Messrs. F. T. Middleton, J. Orton, and T. Wright have dissolved partnership. Debts will be attended to by Mr. J. Orton and Mr. T. Wright, who will continue the business.

Hanbury & Wilson, electrical contractors, 3a, Padiham Road, Burnley, Lancaster.—Mr. C. K. Hanbury and Mr. T. H Wilson have dissolved partnership. Mr. C. K. Hanbury will attend to debts and continue the business in his own name.

Peerless Engineering Co., Cole Hill, Burnley Road, Halifax.—Messrs. J. A. Hogan and H. & E. Blackburn have dissolved partnership as from December 31st, 1920. Debts will be attended to by Messrs. Bairstow and Atkinson, chartered accountants, District Bank Chambers, Commercial Street, Halifax.

Horace Boot & Partners, consulting engineers, 7, Victoria Street, S.W.—Mr. H. L. P. Boot and Mr. R. J. Spencer-Phillips have dissolved partnership. Mr. H. L. P. Boot will attend to debts and continue the business.

Hampshire Electrical Co., electrical engineers and fitters, 83, High Street, Gosport.—Mr. W. N. Walters and Mr. W. W. Wilson have dissolved partnership. Debts will be attended to by Mr. W. W. Wilson.

Up-to-date Electrical Co., and Attwood & Co., electrical engineers, 433, Foleshill Road, Coventry.—Messrs. R. E. Parker and F. B. Attwood have dissolved partnership. Debts will be attended to by Mr. R. E. Parker.

Company Liquidations.—Leyburn Electric Supply Co., Ltd.—Meeting of creditors is called for January 24th, at the company's offices, Leyburn. Mr. P. Dobson, liquidator.

Cannon Motor and Electrical Works, Ltd.—Particulars of claims must be sent to the liquidator, Mr. P. G. Clegg, 10, Cannon Lane, Brighton, by February 8th.

Trade Announcements.—Messrs. A. King & Co., of Leith Electric Works, Prince Regent Street, Leith, inform us that they have taken into partnership Mr. Andrew S. Gray, A.M.I.E.E., who has rendered valuable service in their employment for many years as chief draughtsman and, latterly, as manager.

Messrs H. W. Smith & Co, Ltd., electrical wire and cable manufacturers, of Lydbrook, Gloucester, have opened a sales office at Central House, Kingsway, W.C. Telephone No. : Regent 2368.

The Chloride Electrical Storage Co, Ltd., inform us that the telephone number of their London office has been altered to Victoria 5542.

Messrs. Dyer & Young, electrical engineers and contractors, of Stanstead, Essex, inform us that in addition to their tramway supplies, they are making a speciality of rewinding small armatures, field coils, &c., and refitting commutators of all sizes.

Messrs. Donovan & Co., electrical manufacturers and suppliers, of 47, Cornwall Street, Birmingham, owing to increased business, have taken larger premises at 16, Cornwall Street, which will be used as bulk stores of electrical accessories, &c. The offices and sales department will remain at 47, Cornwall Street.

The Blake Motor Co., electrical engineers, have opened premises at 169, Yorkshire Street, Rochdale.

The Westminster Tool and Electric Co inform us that they have now completed the equipment of their new Westool Works, Putney Bridge Road, and are manufacturing, in all sizes, the Mark 1 pattern of the Westool electric portable drills; the No. 2 size, which has just been completed, it is stated, is giving exceptionally good results. Fitted with a No. 2 Morse taper socket, the tool weighs complete 42 lb, and will drill a hole ⅞-in. diameter in mild steel 3¾-in. deep, in a minute. The Westool Mark 1 type drills are fitted throughout with ball bearings, and have an exceptionally short overall length, while giving an effective feed nearly twice that of other electric drills.

Messrs. Bawden & Co., of 45, Nowhall Street, Birmingham, who are shortly opening a branch in Melbourne, Victoria, are desirous of getting into touch with British manufacturers who are open for representation in that country. They would also be pleased to receive lists and prices in duplicate of electrical and mechanical supplies.

Messrs. Guy Chantrill & Co, electrical engineers and exporters, have removed to 6, Norfolk Street, Strand, W.C. 2.

Catalogues and Lists.—The Midland Electric Manufacturing Co., Ltd., Barford Street, Birmingham.—Ten illustrated leaflets, No. 102 to 111, dealing with various types of iron-clad switches and cut-outs, fuse bridges, distribution boards, &c.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C., 4.—Leaflet F. 2 397, a priced leaflet illustrating "Doriclite" semi-indirect all-glass pendant bowl fittings; also a "sticker" illustrating the "Kingsway" telephone extension arm.

Paterson & Service, 33, Bath Street, Glasgow.—List No. A 25, net trade price list of electric lighting accessories, including cables, wires, insulating materials, lampholders, wall plugs, &c.

R. B. Hand & Co., Ltd., 63, High Holborn, W.C. 1.—An illustrated price list of "Hand" refill batteries for pocket lamps and torches.

Donovan & Co., 47, Cornwall Street, Birmingham.—Export list No. 8,120. An illustrated and priced sheet of electrical accessories, including switchboards, ammeters and voltmeters, cut-outs, lampholders, switches, &c. Prices include packing and delivery f.o.b. British port; c.i.f. prices can be quoted.

Swedish General Electric, Ltd., 5, Chancery Lane, W.C. 2.—Stock lists, No. 26, d.c. and single-phase a c. motors, and d.c. electric drills, No. 27, two- and three-phase motors, single-phase commutator motors, transformers, &c. Illustrated and priced.

Meldrums, Ltd., Timperley, near Manchester.—"Meldrum's Magazine." This is the second edition of the magazine, dealing with the destruction of waste of all kinds and the employment of the heat generated. Photographs are used to illustrate various types of destructor made by the firm.

L. G. Hawkins & Co., 116, Charing Cross Road, W.C. 2.—An illustrated booklet dealing with "Miller" lamps and fixtures and their applications.

Piggott Electrical Co., Ltd., 21, New Bridge Street, E.C., 4.—"Electrical plant" and monthly sale register, dealing with generating sets, d.c. and a.c., motors, dynamos, motor-generators, rotary converters, &c.

Isis Electrical Co., 57, Albert Road, Aston, Birmingham.—An illustrated leaflet giving prices of fancy ceiling plates and hooks, and other lighting fittings.

The B.E Co. (of London and Birmingham), Ltd., Hendon House, 57, Upper Thames Street, E.C. 4.—The "Beco" booklet (13 pp.) of electric fires and heating appliances, giving illustrations and prices of a large variety of fires, kettles, irons, soldering irons, &c.

Bankruptcy Proceedings.—G. Dolby, electrician, 39, East Marsh Street, and 120, Freeman Street, Great Grimsby.—Receiving order made December 31st, 1920, on debtor's own petition. First meeting, January 15th; public examination, February 3rd; both at Grimsby.

Company Registrations, 1920.—Statistics compiled by Messrs. Jordan & Sons, Ltd., 116 and 117, Chancery Lane, W.C. 2, regarding the registration of companies at Somerset House during 1920, include the following:—"Electric, gas, &c.," 194 companies, with a total capital of £1,956,100; "Engineers," 483 companies, capital £11,016,330; "Kinemas," 342 companies, capital, £11,601,060; "Mines, coal, &c.," 331 companies, capital £27,217,362; "Oil," 113 companies, capital £27,210,310; "Railways," 16 companies, capital £1,196,100; "Telephones," 7 companies, capital £1,612,000.

Lead Report.—Messrs. G. Cawson & Co., writing under date January 8th, say:—The market this week has been rather disappointing after closing so firm last week. The price of prompt metal reacted to £22 15s., but the closing, however, is firmer again owing to some signs of shortage. Closing prices are:—

Prompt and January	£23 10 to £23 15
February and March	£23 15 to £24 0
April	£24 0 to £24 5

Messrs. James Forster & Co. say:—Consumers have been inquiring lately for considerable quantities of lead, both for early and forward delivery, and a good business has been done, up to £25 10s. having been reported paid on Tuesday for January delivery. However, in many cases business has been postponed on account of the erratic condition and continued uncertainty of the London market. Consumers generally, we believe, are working on very short stocks.

Foreign Trade.—December Figures.—The following are the values of imports and exports of electrical goods and machinery in December:—

	December. 1920. £	*Inc. or dec.* £	*12 months,* 1920, *Inc. or dec.* £
Imports.			
Electrical goods, &c. ...	282,276	+ 140,454	+ 621,739
Machinery	1,727,901	+ 13,333	+ 4,911,369
Exports.			
Electrical goods, &c. ...	1,340,282	+ 707,441	+ 5,896,368
Machinery	7,173,029	+3,677,810	+32,716,436
Re-exports.			
Electrical goods, &c. ...	23,741	+ 11,948	+ 56,442
Machinery	127,109	+ 52,428	+ 778,519

The A.E.G. in Luxemburg.—It is reported that the A E.G. has purchased for 750,000 fr. an establishment in Luxemburg for the location of the offices and stocks formerly kept at Metz. The company's trading operations for the West of Europe will be conducted from the Luxemburg works.

Work for Unemployed.—The Ministry of Transport has published a statement regarding the carrying out of arterial road schemes as a measure for the relief of the present unemployment. The fund available for free grants to authorities to enable them to proceed with the construction of these roads amounts to £5,200,000. It is proposed to advance 50 per cent. of the cost of the schemes from this fund, and the remainder, if necessary, may be loaned by the Government. The conditions to be observed when grants are applied for are: that the schemes are sound from an engineering point of view, that they have reference to an important road, that the work is necessary, and that not less than 50 per cent. of the total cost will be expended in wages for unskilled men. Schemes outside the Metropolitan area of an approximate total cost of £2,750,000 have been approved.

Calendars.—Messrs. Downes & Davies, 1 and 3, Stanley Street, Liverpool, have produced a most attractive wall calendar. "Martha" is a charming and captivating study, and her presence will add tone to any office or private apartments; the date slips are quite unobtrusive.

Allied Steel Makers and Founders, Ltd., have sent us a useful hanging calendar with monthly date slips for 1921, each slip showing views of the allied works at Braintree, Bradford, and Leven.

From Messrs. A. S. Wolf & Co., electric tool manufacturers, 115, Southwark Street, S.E., we have received one of their serviceable wall calendars; the monthly date slips have a column set apart for daily memoranda. Messrs. Wolf will be pleased to furnish a copy of their calendar to any reader upon request.

Messrs. W. H. Willcox & Co., 38, Southwark Street, S.E., have forwarded us one of their useful "Date Remembrancers," with monthly date slips.

A Dutch Floating Exhibition.—What might be described as a floating exhibition is being organised at The Hague, not only for Dutch traders, but for all European merchants and business men who care to take part in the venture. Last September a "Syndicate for Industrial Fairs by Steamers" was founded, and the *Macedonia*, of 6,100 tons, was chartered as an exhibition ship for the display of all kinds of goods, the total space available for exhibits being 5,000 cb.m. A complete commercial organisation will sail on the *Macedonia*, including departments for accounts, sales, correspondence, credit, banking, a commercial inquiry bureau, &c. All these facilities are at the disposal of subscribers, who will be charged a fee of 2,800 fr. per cb.m. of exhibition space, and a commission of 10 per cent. will be claimed by the syndicate on all business done during the voyage. Two directors of the syndicate will sail on the *Macedonia* in order to control the enterprise, and two competent business men will precede the exhibition ship to herald her arrival and to make all necessary arrangements in every port of call. It is proposed, first of all, to follow the eastern coasts of North and South America. A sum of ten million florins will be necessary if the exhibition is to be carried out on the scale at present planned.—*Reuter's Trade Service* (The Hague).

Italian Dock Electrification.—At a meeting of the Savona Harbour Board, the installation at an early date of electrical ship-unloading plant at the port was discussed. The provision of four sets of electrically-driven coal-discharging plant was also considered; these would be in addition to the 12 sets of apparatus which have already been constructed.—*Reuter's Trade Service* (Rome).

Book Notices.—"The Transport World and Motor Freight Exchange," Vol. 1, No. 1, January 6th, 1921. London: Benn Bros., Ltd. Price 4d.—This is the first number of a journal to be devoted to the road carrying industry. Besides being the organ of the industry, it will endeavour to bring transport owners and freight producers together by means of a special section. The articles appearing in this issue include "The Return Load Problem—A solution," "The Attitude of the Railways," "That Ministry Again!"—being an objection to the new motor-car number plates, and an appreciation of the President of the Society of Motor Manufacturers and Traders, Mr. A. S. Mays-Smith.

"The Slide Rule." By C. N. Pickworth. Seventeenth edition. 134 pp., 39 figs. Manchester: Emmott & Co., Ltd. Price 3s. 6d. net.—The preface to this, the seventeenth, edition states that the sustained demand for this very successful work has resulted in an early call for a new edition. Slight revisions have been effected, and descriptions of new slide rules introduced.

"Annual Report of the Board of Regents of the Smithsonian Institute for the year ended June 30th, 1918." 612 pp. + 54 plates. Washington: Government Printing Office (Publication 2,549). Price 75 cents.—Includes a very full survey of the year's work, with an appendix consisting of miscellaneous papers. Among the latter are "The Problem of Radio-active Lead," by Theodore W. Richards, and "Wind Power," by James Carlill.

"The Electrical Engineer's Diary, 1921." Thirteenth edition. London: S. Davis & Co. Price 10s. 6d. post free.

"The Relation Between the 'Bight,' 'Span,' and 'Dip' of Catenaries." By Rollo Appleyard, O.B.E., M.Inst.C.E. Extracted from the minutes of proceedings of the Institution of Civil Engineers by permission of the Council. From the Author.

"An Amazing Presumption; or, an Outrageous Attack on the Great Panjandrum." By Skepticus. 164 pp. London: J. Heywood, Ltd. Price 5s. net.

"*Journal* of the American Institute of Electrical Engineers." Vol. XXXIX. No. 12. December, 1920. New York: The Institute. Price $1.

"Telegraphy, Telephony, and Wireless." By J. Poole. Pp. vii + 120; 68 figs. London: Sir I. Pitman & Sons. Price 3s. net.

Sample Room at Rotterdam.—H.M. Consul-General at Rotterdam, in a dispatch recently received in the Department of Overseas Trade, states that a small temporary building, measuring 10 metres by 4 metres and 2·25 metres high, is available for use as a sample room for the Commercial Department of the Consulate. United Kingdom firms wishing to have samples of their manufactures exhibited should forward these direct to His Majesty's Consul-General at Rotterdam, at the same time advising the Department of Overseas Trade of any action so taken. It should be noted, however, that samples other than those of "no commercial value" would be liable to import duty on arrival in Rotterdam, and the size of the proposed sample room should also be borne in mind.

New Swedish Cable Company at Korsnaes.—A new company has been formed at Korsnaes for the purpose of taking over Korsnaes Koppartraad och Kabelfabrik (Copper wire and cable works). The share capital is fixed at Kr. 150,000 in shares of Kr. 500 each.—*Reuter's Trade Service* (Stockholm).

Argentine International Exhibition.—The proposal to hold an International Trade Exhibition in Buenos Aires in 1922 has been received with great favour, and strong Government support is expected. All diplomatic representatives in Argentina are being invited to consider the scheme and to urge their respective Governments to take part. A sum of 10,000,000 pesos is to be raised for the purpose of constructing the buildings, and the greater portion of the amount is already assured.

The exposition will be on a much larger scale than the exhibition of 1910, held during the centenary celebrations, at which British firms obtained orders for locomotives, rolling stock, and machinery to the value of nearly one million sterling. The exhibition will be entirely of a commercial and industrial character, and it is hoped to gather together a representative show of every kind of textile manufacture, general mechanical, chemical, electrical, and chemical engineering exhibits, all classes of machinery, machine tools, agricultural machinery, hardware of all kinds, tractors, paper-making, envelope-making, and printing machines, furniture, and domestic appliances of every kind. Every facility will be given to manufacturers and shippers to engage in trade propaganda, and no efforts are to be spared to make this the most successful exhibition of the kind ever held in any Latin-American country.—*Financial News.*

Motors for Australia.—The Office of His Majesty's Trade Commissioner at Melbourne has forwarded to the Department of Overseas Trade specifications, &c., relating to a call for tenders by the Victorian Government Railways for the supply and delivery of three-phase a.c. motors, starting apparatus and accessories (Contract No. 33,697). Tenders, which should be endorsed "Tender for the supply of Motors, &c.," and addressed to the Secretary for Railways, Spencer Street, Melbourne, must be received by March 2nd, 1921. Local representation is necessary. Copies of the specification, &c., can be seen by United Kingdom firms interested, on application to the Inquiry Room, Department of Overseas Trade, 73, Basinghall Street, E.C. 2. (Ref. 4,188/E.D./P.N.)

Employment of Women, &c., Act, 1920.—The Chief Inspector of Factories notifies the following changes which are effected by the above Act:—Under Section 1 the employment of any child under 14 years will be illegal on and after January 1st, 1921, unless the child was already so employed at that date.

Section 1 also prohibits the employment at night of any young person or woman, except that young persons over 16 years of age may be employed on work which, by reason of the nature of the process is required to be carried on continuously day and night, in the following industries:—(*a*) Manufacture of iron and steel; processes in which reverberatory or regenerative furnaces are used; and galvanising of sheet metal or wire (except the pickling process); (*b*) glass works; (*c*) manufacture of paper; (*d*) manufacture of raw sugar; (*e*) gold mining reduction work.

The practical effect of these provisions is:—(*a*) To raise the age for night work from 14 to 16 years in the case of blast furnaces, iron mills, paper mills, and glass works; (*b*) to prohibit night work for any young persons in letterpress printing works, electrical stations, and china clay works.

Australian Merchants and Surprise British Deliveries.—The *Exchange Telegraph* Melbourne correspondent says:—"Complaint is made by Australian merchants and their bankers that, although when orders were placed 12 months ago with English manufacturers they were unable to give an undertaking when they would be likely to be fulfilled, goods are now being delivered without a word of warning by cablegram or letter, the manufacturers being unable to find a market elsewhere. In the meantime the importers at this end have in many cases obtained stocks elsewhere, and consider it is doubtful whether they are under a legal or moral obligation to accept the merchandise. However, they have been doing so. The question of imports was discussed in an interview between Mr. Hughes and members of the associated banks, but no action was decided upon. It is likely, however, that importers will find it still more difficult to finance shipments unless inwards trade declines quickly in volume.

Tradesmen Using the Royal Arms.—The *London Gazette* for January 4th contains lists of tradesmen in London and elsewhere who hold appointments to Royalty with authority to use the Royal arms.

American Dumping in Norway.—The general depression which is affecting Norwegian industries in general, is also hitting the electrical manufacturing works in that country. Questioned on the subject about a week ago, Mr. Ellerstorfer, of the Norsk Elektrisk and Brown-Boveri, of Christiania, is reported to have stated that the company was not receiving any large contracts, as the orders offering were being placed in other countries. It was estimated, he said, that State and municipal orders for a total of 18,000,000 kr. had been allotted to Germany and the United States during the past four months. The former was able to compete on account of the low value of the mark, while the Americans were practising dumping methods. If conditions did not change and many new orders were not obtained, it would be necessary for the company to restrict working, probably in February.

Scientific Time Saving.—A higher appreciation of the value of time in the scientific management of industry as a means of reducing costs of production was advocated in an interview (reported in *The Times*) by Mr. D. B. Morison, chairman of Messrs. Richardsons, Westgarth & Co., Ltd.

The most striking losses of time, he said, occurred at the starting and stopping of each working shift, but still more serious was the loss resulting through all sorts of useless and unnecessary movements by men when doing light work, and by their neglect to utilise their strength to the best advantage when doing heavy jobs. As examples, he mentioned that at their own shell shop at Middlesbrough in the early days of the war their output of 8 in. shells stuck for some time at a weekly average of 350. Careful investigation proved that quite a lot of energy was being wasted, particularly in the handling of the shells and the distances through which they were moved between the various operations. When suitable rearrangements were made, the output went up, as if by magic, to 700 a week, and eventually to 1,000. A similar case that lately came under his notice was that of the stamping of multi-throw crank shafts for motor cars. In this country a good output for a certain crank shaft was 100 per shift of nine hours. In America, with practically the same machinery, the output was 700 per shift.

"These instances," remarked Mr. Morison, "are indicative of what can be done, and, if more attention were given to the art of saving time, a great step forward would be made in cheapening production. That country which best appreciates the full meaning of 'Time saved is time gained,' and acts upon it, will be the first country to relieve its unemployment and the first to recover from the ravages of the war."

Testing Electric Detonators.—Attention is directed by the Mines Department to the practice of testing low-pressure electric detonators by passing a small current of electricity through them in series with a galvanometer. Explosion of the detonator has resulted in some cases in injury to the operator. All danger can be eliminated by placing the detonator to be tested in a strong iron pipe or other suitable receptacle before passing the current through it. By this simple precaution the danger from flying fragments of the metal tube of the detonator is entirely done away with, and it is desirable that all persons engaged in such an operation should be warned of the attendant danger and the ready means by which it can be avoided.—*Board of Trade Journal.*

Employment of ex-Gunners.—A certain proportion of the Royal Artillery Commemoration Fund is devoted to aiding ex-artillerymen and their dependents. Part of the scheme is the employment exchange for finding suitable work for ex-gunners, and in connection with this "Gunners' Friends" have been established in various parts of the country to get into touch with any men who are unemployed, and also to persuade local employers to find these men suitable work. More of these "friends" are required, and those who are willing to be enrolled are asked to communicate with The Employment Department, R.A. War Commemoration Fund, 50, Warwick Square, S.W. 1.

High Cost of Production and Slackened Demand.—Writing in *Unity* on "Increased Output and Industrial Efficiency," Mr. Charles Tennyson, C.M.G. (Deputy Director, Federation of British Industries), says:—

"One of the reasons why manufacturers are finding it difficult to dispose of their goods is that the costs of production have risen to a height which the consumer appears to find prohibitive. The principal reason for this increase in cost is undoubtedly the fact that wages have risen in money value to two or three times the pre-war level, while in many cases the actual production per man has not increased, but has rather decreased, owing to the reduction of working hours and other reasons. This means a very great increase in the cost of labour per unit of production. The production cost of every article is largely, indeed very largely, composed of labour costs. Even in the case of raw material used for the finished product, such as a mineral, the cost is very largely the cost of labour required to extract it from the ground. Similarly the cost of transport is built up of the actual operating labour and of the cost of labour employed in producing the fuel, rolling stock, permanent way, ship, or other means of conveyance."

Industrial Courts of Inquiry.—As there appears to be misunderstanding in some quarters on the subject, it may be advisable to explain the position of Courts of Inquiry under the Industrial Courts Act, 1919.

The two principal permanent features of the Industrial Courts Act, 1919, are the provisions which:—

(*a*) Set up a permanent Court of Arbitration (termed the Industrial Court) to which recourse can be had by parties to industrial disputes, if both parties to the dispute consent. In this connection certain alternative methods of settling disputes are provided.

(*b*) Empower the Minister of Labour in case of disputes, whether apprehended or existing, to appoint a Court of Inquiry, one of the objects of which is to put before the public an impartial account of the merits of the dispute.

The Industrial Court is a permanent arbitration tribunal to which differences are referred for determination by consent of both sides. A Court of Inquiry is a body appointed by the Minister of Labour *ad hoc* to inquire into a particular dispute, irrespective of whether or not the dispute has been reported to the Minister. While, in appointing a court, the Minister would, in accordance with the policy of the Department, endeavour to secure the concurrence of both sides to that course, such consent is not necessary under the provisions of the Act. A Court of Inquiry consists of a chairman and such other persons as the Minister may appoint, or the Court may consist of one person only. Under the Conciliation Act, 1896, the Minister of Labour had power to cause an inquiry to be made into the facts and circumstances of a dispute, and this course was adopted in certain instances.

The provisions of the Industrial Courts Act with regard to the appointment of Courts of Inquiry are directly due to the recommendations of the original Whitley Committee on the relations between employers and employed. This committee, in the course of their inquiries, gave consideration to the part which should be taken by the State in the event of those directly concerned in industry being unable to adjust their differences themselves. The committee pointed out that the interests of the community may require that there should be an unbiassed and independent examination of facts and circumstances connected with any dispute between employers and employed, and they recommended:—

"Where the parties are unable to adjust their differences, we think that there should be means by which an independent inquiry may be made into facts and circumstances of the dispute, and an authoritative announcement made thereon, although we do not think that there should be any *compulsory* power of delaying strikes and lock-outs."

Courts of Inquiry have been appointed under the Industrial Courts Act with successful results in the case of (1) coal trimmers, (2) transport workers. It will be observed that the Industrial Courts Act, following the recommendations of the Whitley Committee, contains no powers to delay a strike or lock-out; nevertheless it appears desirable that, wherever practicable, parties should avoid proceeding to a stoppage of work pending investigation by such a court.

Chinese Trade.—*The Board of Trade Journal* of December 30th, gives some impressions received by Mr. H. H. Fox, C.M.G., H.M. Commercial Counsellor in China, after a six months' tour of the principal commercial and industrial centres of this country. Mr. Fox found an unexpected degree of interest being taken by British manufacturers in China, but most of the trade was done through merchant houses; it is thought advisable that British manufacturers should watch with closer attention the changes in demand and fashion. The best channel for the sale of British goods is through the British merchant firms who have their own houses in London or Manchester, with branches at least in Shanghai and Hongkong, and preferably in Tientsin and Hankow as well. Many of the Chinese merchant houses are old-established and reliable, possessing an intimate knowledge of the requirements of the country through long and often costly experience; but the difficulty is that there are not enough to serve the interests of all the British manufacturers, but their number is increasing, and will increase further as the trade develops and British goods come forward more freely. Mr. Fox recommends a wider use of the information collected by the Department of Overseas Trade. He found abundant testimony to the commercial honesty of the Chinese and the satisfactory nature of the business done with China. He thinks, however, that credit in this respect is largely due to the British merchant houses of China which stand between the British manufacturer and the Chinese dealer, taking the risk of fluctuations in exchange and prices, carrying the goods when consignees are found wanting, and supplying the necessary guarantees of measure and quality. These considerations make it difficult to recommend direct dealing with native firms, although there are, of course, exceptions. In the engineering business, more particularly in the electrical branches, Mr. Fox found a gratifying activity among many of our largest manufacturers. He points out that, in the case of a vast and partially developed country like China, immediate results must not be looked for, but once a firm's position is consolidated an expanding trade is assured. The determining factor in the sale of goods to China in the past was cheapness in which direction British traders were handicapped. With the industrial growth of the country, however, the Chinese will want and be able to purchase a better class of goods. The Chinese know British goods to be of sterling quality, and if the standard is maintained, foreign competition need not be feared.

Trade with Mexico and Ecuador.—Complaints are being made in Mexico that it is next to impossible to obtain supplies of British-made electrical materials, the local impression being that the United Kingdom is neglecting her overseas markets in order to fill her home demand. This is strongly resented, and American travellers are receiving more attention than would otherwise be the case. The country is being inundated with electrical and other price lists from United States firms, who are promising speedy deliveries. The situation in Ecuador is much the same. There is a demand for electric light and power cables, wires and switches, in Quito, but it is said that an English catalogue or price list is rarely seen.—*The Times Trade Supplement.*

Wages in the Tramway Industry.—The Secretary of the Ministry of Labour states that the Minister of Labour has decided, in pursuance of his powers under the Industrial Courts Act, 1919, to appoint a Court of Inquiry in connection with the dispute in the tramway industry arising out of the workers' claim for an increase in wages. The Court will be constituted as follows:—The Right Hon. Sir David Harrel, G.C.B. (chairman), Sir Herbert Rowell, K.B.E., Messrs. Harry Gosling, C.H., G. H. Hume, and W. F. Purdy, O.B.E., J.P. The terms of reference are:—"To inquire into the causes and circumstances of the dispute between the employers' representatives and the workpeople's representatives on the National Joint Industrial Council for the Tramway Industry, and to report thereon to the Minister of Labour." The secretary is Mr. H. C. Emmerson, Ministry of Labour, Montagu House, Whitehall, S.W. 1., to whom all communications should be addressed.

A preliminary meeting was held on January 11th. Certain points of procedure were settled, and it was agreed that the inquiry should be held in public. The Trade Union side will open the case at the first meeting of the Court on January 26th, at 10.30 a.m.

A New Year's Party.—On January 1st a New Year supper party was given by Mr. H. P. Girling, M.I.E.E., to his garage, electrical, and foundry employés. It was held in the commodious garage building, which was suitably decorated with flags and evergreens and with carpets laid on the cement floor—an excellent room for the purpose. About 60 sat down to supper, which was followed by a short address by Mr. Girling, who expressed his pride in having got together such a fine spirited staff of employés. He also made the pleasing announcement that he hoped shortly to pay all employés still under him a bonus of 5 per cent. on the wages earned during the last financial year.

Protection of Key Industries.—The Government's Bill dealing with the prevention of dumping and the safeguarding of key industries, as well as with the very difficult problem of collapsed exchanges, is ready to be introduced as the first measure of the new session. No list of the products of which it is proposed, in the interests of our key industries, to prohibit the importation is yet available.—*The Times.*

For Sale.—Islington Borough Council Electricity Department invites offers for one 120-kW horizontal compound engine, together with fly-wheel alternator and exciter; Farnworth Urban District Council has for sale a 250-kW direct-coupled Belliss-Morcom-British Westinghouse dynamo, complete with Ledwards condenser, pumps, switchboards, &c. By direction of the Disposal Board, Ministry of Munitions, Messrs. L. Farmer and Sons will conduct an eight-day sale by auction, commencing February 8th, at the Royal Arsenal and Dockyard, Woolwich, of engineering machine tools, plant, and machinery, electrical equipment, telegraph, telephone and wireless stores, &c.; Mr. M. Marshall, by direction of the Disposal Board, will sell by auction on January 24th and following days, at the Central Stores, 83, Georgetown, near Glasgow, a quantity of engineering and electrical plant, including motors, generating sets, electrically-driven machine tools, &c. Assets Auctions Co., Ltd., will sell by auction on January 20th, at 119-121, Newington Causeway, S.E., a quantity of electrical goods, including motors, generators, bells, conduit, &c. See our advertisement pages to-day.

New Italian Company.—The Department of Overseas Trade states that 14 important Italian manufacturing and electricity supply undertakings have formed a company, with a capital of 5,000,000 lire. The objects of this company, which has been named the Società Italiana per l'Accumulazione Termoelettrica, Milan, are the manufacture of thermal storage electric cooking ranges and all other heating apparatus for household and industrial purposes.

The E.P.E.A. Award.—As the result of conferences with the non-complying local authorities the date for strike notices to take effect has been postponed. In the case of the South Wales undertakings the deferred date is January 21st, and for the West Midlands undertakings January 26th. Whilst going to press we were informed by the secretary of the E.P.E.A. that it had been decided definitely to withdraw the services of the Ilford technical staff at 10 p.m. yesterday (Thursday).

LIGHTING AND POWER NOTES.

Ammanford.—PROV. ORDER.—The Urban District Council is applying to the Electricity Commissioners for a special order to authorise the Council to generate and supply electricity within the urban district.

Ashford (Kent).—PROPOSED ELECTRIC LIGHTING PLANT.—The Urban District Council has decided to obtain an estimate for the installation of an electric lighting plant at the gas works, together with the probable profit or loss to the ratepayers on such an undertaking.

Bacup.—LOAN.—Bacup Town Council has resolved that application be made to the Electricity Commissioners for sanction to the borrowing of £30,000 for the purpose of extending he electricity undertaking.

Barrow.—HYDRO-ELECTRIC PROPOSALS.—At a Town Council meeting on January 3rd, the Electricity Committee's recommendation that the necessary preliminary steps be taken to obtain a Provisional Order from the Electricity Commissioners for powers to proceed with the scheme for the utilisation of water power (River Leven) at Backbarrow, and that the electrical engineer be instructed to prepare plans, detailed estimates, &c., was referred back for further consideration. The recommendation that a consulting engineer be engaged to prepare and submit a report on the proposed scheme was also referred back.

Blackburn.—COST OF STATION.—The Electricity Committee has approved revised estimates amounting to £850,000, for the completion of the new electricity generating station and installation of plant. The Council is applying to the Electricity Commissioners for sanction to borrow £600,000, being the difference between the amount already sanctioned, and the amount of the new estimate.

Bolton.—SLIP-JOINT CONDUIT PROHIBITED.—At a meeting of the Electricity Committee the electrical engineer reported upon the practice of certain contractors of using slip-joint conduit in the wiring of premises for electrical installations, which he regarded as unsatisfactory. It was decided to give notice to all electrical contractors in the borough that, on and after March 1st next, the Corporation will not approve of any installation in cases where slip-joint conduit has been used, and this regulation is to be embodied in the general conditions and regulations under which the Corporation will supply electricity.

Bradford.—MAINS EXTENSIONS.—The Electricity Committee is asking the Corporation for general authority to undertake the provision of extensions of mains to new properties and other new supplies, at an aggregate cost of £10,000.

Burnley.—NECESSITY FOR EXTENSIONS.—On January 6th, the chairman of the Electricity Committee spoke of the necessity for an early extension of the electricity undertaking. The electrical engineer said the present generating capacity was 5,250 kW. Additional plant was on order which would bring this to its maximum capacity, viz., 8,250 kW. He anticipated plant capable of generating an additional 8,000 to 10,000 kW would be necessary to meet probable requirements during the ensuing five years.

WORK FOR UNEMPLOYED.—At a meeting of the Town Council on January 6th, when the unemployment problem was considered, Mr. Sutcliffe said they had work in the electricity department which would provide full-time employment for about 400 men if they could get a sufficient number of cable jointers. Nearly 300 people wanted electricity in their houses, but they had not men enough to carry out the work.

Burton-on-Trent.—LOAN.—Application is to be made by the Corporation to the Electricity Commissioners for sanction to borrow £26,000 for supplying neighbouring districts with electricity.

Church Stretton.—PROPOSED PRICE INCREASE.—The Church Stretton Electric Supply Co. has notified the Urban District Council that it has applied to the Ministry of Transport for permission to increase the charge for electricity for lighting purposes from 10d. per unit to 1s. 2d.

Continental.—BAVARIA.—According to a report from Munich, the Bavarian Finance Minister has discussed with an American business man the question of raising a large loan in the United States in order to build works to harness the hydraulic power of the Walchen See in the Bavarian Alps and of the middle course of the Isar. In financial quarters a sum of 20,000,000,000 marks is talked of. The sum seems very big if it is remembered that about 1,000,000,000 marks have been judged as necessary fully to construct the works. Nevertheless, the fact that an offer has been made to America to cede Bavarian water-power as a mortgage appears to be a most important economic and political matter. The waterfalls and torrents in the Bavarian Alps could produce immense power and lead to the electrification of all the railways. It is further stated that England is interested in the matter, and this may lead to competition.—*Daily Telegraph.*

It is reported that the Government has accepted the offer of American and French capitalists to finance the above scheme.—*Evening News.*

ITALY.—His Majesty's Consul-General at Milan reports that the Società Idroelettrica Cisalpina, Milan, formed in March, 1919, with a capital of 2,000,000 lire paid, has decided to increase its capital to 30,000,000 lire by the issue of 56,000 new shares at 500 lire each, for the purpose of carrying out the projected hydro electric plant in the Liro Valley, Valtellina.

Crewe.—HOUSE WIRING.—The Town Council has referred to the Electric Supply Committee a proposal that the Corporation should undertake the wiring of private houses.

Derby.—DIRECT LABOUR.—The question of extending the power station buildings by direct labour was debated at a meeting of the Town Council on January 5th, when a report in favour of this method was presented, with a recommendation to appoint a works manager at a salary of £500 a year. The chairman of the Electricity Committee strongly opposed the proposal to employ direct labour, urging that there were no technically skilled hands of the type required for such work among the unemployed. Men would not leave the employ of contractors to work for the Corporation. There would also be a difficulty in getting the necessary materials. Mr. W. R. Raynes declared, however that there would be no difficulty in getting either the men or the materials. The officials of the men's Union in the town had promised to help the Corporation to start a works department. The proposal was carried by a large majority.

Doncaster.—Concession to Kinemas.—The Electricity Committee recommends that picture theatres with continuous performances of not less than seven hours each week-day, shall be allowed a discount of 10 per cent on all energy supplied at kinema rates. The discount is to take effect as and from December 1st last.

Dover.—Permission to Supply Electricity.—The Town Council having received from the Deal and Walmer Gas Co. the authority for the supply of electricity to Deal if the supply is three-phase, alternating current, has replied that the Council can only supply single-phase at 100 periodicity.

East Ham.—Loan Sanctioned.—The Town Council has received sanction to a loan of £5,428 for mains.

Ellesmere Port.—Bulk Supply.—The District Council is in negotiation with the Mersey Power Co., Ltd., for a bulk supply of electricity for the district. The Ministry of Transport has been asked for an extension of time for the carrying out of the compulsory provisions included in the Ellesmere Port and Whitby Electric Lighting Order, and has also been asked to urge the company to expedite the negotiations, with a view to an early supply of electricity being forthcoming.

Grampian Electricity Supply Scheme.—Falkirk.—At a conference, on January 7th, attended by representatives of the burghs of Falkirk, Stirling, Grangemouth, Alloa, and Armadale, it was agreed to ask the Electricity Commissioners to secure provision being made in the Grampian Power Co.'s bill whereby the burghs would be able to get a supply, if necessary, under conditions and on terms to be mutually arranged.

Forfar.—During a discussion of the Grampian scheme, it was suggested that the town should generate its own electricity, and a committee was appointed to consider the whole question.

Dundee. — Regarding the proposed provisional order, Mr. Harry Richardson, Corporation electrical engineer, informed the Electricity Committee that in his opinion were the order passed in its present form, the syndicate would have power to erect a steam plant in [the vicinity of the city boundary and generate power there. There was, from the Dundee point of view, great danger in the Bill. Once the syndicate had electricity to sell, it could come right into the city area. The syndicate might cut its prices in order to get a footing inside the city area. It was decided to petition against the granting of the Order.

A recommendation that orders be placed at once for steam plant for the extensions at Carolina Port was agreed to. Referring to a suggestion that the contractors should allow for any drop in the price of material or labour, Mr. Richardson said he preferred getting a fixed price.

Glasgow.—Electricity Shortage.—The Corporation's electricity supply will not be in full working order till the end of the month, when the Electricity Department states that the present restrictions will be removed. The breakdown at Dalmarnock is more serious than was at first thought, and only by special permit will power supply be available on working days between 2 and 5.30 in the afternoon. Consumers who can change to night shift working have been recommended to do so, and those who use electricity for heating have been asked to reduce consumption to a minimum between the above hours.

London.—Fulham.—Owing to the unsettled state of the markets, the Electricity and Lighting Committee recommends that no annual contracts for the supply of electrical and engineering stores be entered into, but that the electrical engineer be instructed to purchase in the open market at the lowest prices obtainable as and when required.

Maidenhead. — No Opposition to Company. — The Town Council has decided not to oppose the application of the Bourne End and District Electricity Corporation, Ltd., for an order to supply electricity in the Cookham area for which the Council has powers.

Newark.—Electricity Scheme.—Mr. C. H. Wordingham, consulting engineer to the Council, has expressed the opinion that it would be more costly to bring electricity in bulk from Nottingham than to have a generating station at Newark. He did not consider the river Trent could be relied upon to give a consistent power, and he advised the generation of electricity by steam. He suggested a scheme for Newark which could be developed in three stages, and the initial capital expenditure would be £158,500. The total cost per unit sold would work out at 2·29d., but at the end of five years the charges would be reduced to 1·45d. In the second stage there would be an increase of £42,750 on the capital expenditure for the larger plant, and at the end of five years, the third stage, involving an expenditure of a further £122,000, would be required. No action has been taken either for or against the scheme, but it is stated that the firms in the Newark district will be circularised and asked to express their opinions upon it.

Newport (I. of W.).—Price Increase.—In reply to the protest entered by the Town Council against an application by the Isle of Wight Electric Light and Power Co. for permission to increase charges for electricity to 1s. per unit, the Ministry of Transport states that it considers the increased charge, which has been approved, quite reasonable.

Southport.—Electricity District. — The Southport Town Council has decided against the recommendation of the Electricity Committee in favour of the proposed inclusion of the borough in the area of the suggested Mersey and West Lancashire Joint Electricity District. The Corporation feels it advisable to wait for the new Bill which is expected to be brought forward early in the next session to see how electricity undertakings are to be dealt with financially. At the same time, the Council has decided to instruct the town clerk to represent Southport at the inquiry to be held by the Electricity Commissioners in Liverpool on January 25th.

Wimbledon.—Report on Undertaking.—The Town Council has decided to engage Mr. Charles P. Sparks, at a fee of £120, to advise whether extensions to the undertaking are necessary, and if so, to what extent; whether it is necessary to change the system of supply, and if so, in what manner; whether any economies can be effected in the working; and whether it would be beneficial to the undertaking to link up with some other works, instead of extending the generating station. The Council has offered to purchase the undertaking of the Fixed Price Lighting Co., Ltd., for £4,000, but the company considers the offer inadequate.

Windermere.—Price Increase.—As a result of the protest of the Urban District Council against the application of the electric light company for power to increase the charge for electricity to 1s. 3d. per unit, the Ministry of Transport has fixed the price at 1s.

Watford.—Transfer of Supply Powers.—The Urban District Council has agreed to purchase from the Chesham Electric Light and Power Co. the latter's powers to supply electricity to the parish of Kings Langley for £300.

TRAMWAY AND RAILWAY NOTES.

Australia.—Trade Union Proposals.—At a conference held in Melbourne, a number of representatives of tramway employés' Trade Unions resolved that steps be taken to form one big Union for the whole of the tramway workers in the Commonwealth. This would be effected by amalgamating existing Unions with the Australian Tramway Employés' Association, which has branches in a number of the principal towns of Australia.

Bradford.—Railless Cars.—Because of the high cost of ordinary tramway track renewal, and with a view to economy for the future, the Bradford Tramways Committee has authorised the general manager (Mr. R. H. Wilkinson) to apply to the Ministry of Transport for power to extend the existing railless car system on the Idle, Eccleshill, and Thackley routes. This means substitution of railless cars for the existing service of ordinary railed cars. The new double-deck railless car will be used, and it is proposed to run 12 such cars in place of the eight ordinary cars now serving these three districts. All the lines on these routes are marked down as needing relaying, and it is felt that, even allowing for the cost of the new railless double-deck cars, the system will be a great saving as against the cost of renewing track.

Doncaster.—Track Renewals.—The Tramways Committee recommends that £12,000 be borrowed with the sanction of the Ministry of Transport, for repairing the single track, and the laying of another track alongside on the Balby route from Cleveland Street to a point beyond Balby Bridge.

Gateshead.—Opposition to Transport Scheme.—The Town Council has decided to oppose the Durham County Council's Transport Bill, which seeks powers to run cars and omnibuses on certain routes in Gateshead. So far as the linking up of the proposed tramways with the Gateshead and District Tramways was concerned, the Council saw no necessity to oppose the Bill, but it considered that the proposal to provide and work tramways in the borough was objectionable, and should be strenuously opposed. The Council declined the application of the County Council for consent to its proposals to lay down tramways at the Low Fell boundary.

Halifax.—New Loop Required.—Queensbury District Council has asked the Tramways Committee to construct an additional loop on the Queensbury tramway track in order to avoid car stoppages in bad weather at the exposed point at Stocks Gate, where two cars were blown over recently.

Resignations from Committee.—At a special meeting of the Tramways Committee, on January 7th, to consider the position created by the Town Council's repeated refusal to accept the recommendations of the appointment of Mr. J. Galloway as general manager for a year and the payment of £250 per annum for three years to Mr. J. D. Caird, traffic manager, who is incapacitated by illness, Alderman C. F. Spencer (chairman of the Tramways Committee), Alderman A. Broadley (vice-chairman), and Mr. R. Stirk (chairman of the Tramways Sub-Committee) resigned office, on the ground that, as a result of the Council's general attitude to the Tramways Committee, they could not continue their work. Alderman Spencer has been chairman for many years.

Liverpool.—LOSSES ON 'BUSES.—At the City Council meeting, on the 5th inst., the chairman of the Tramways Committee stated that it was estimated that on the past year's working there was a loss on the motor-'bus service of £40,000, but that at present it was only intended to withdraw the 'buses from the Moss Lane and Lawrence Road routes.

Sunderland.—EXTENSIONS.—Extensions are being carried out at the Philadelphia depôt of the Sunderland District Tramways, Ltd., with a view to developing the resources of the undertaking. The depôt has been extended to accommodate 12 more cars, and new workshops have been erected. Eight new cars have been purchased from the Brush Manufacturing Co., Ltd., Loughborough, with electrical equipments by the British Thomson-Houston Co., Ltd.

TELEGRAPH AND TELEPHONE NOTES.

Belgium.—NEW WIRELESS STATION.—The Department of Railways will shortly begin the construction of a powerful wireless station, which will be capable of transmitting messages to North and South America and to the Congo.—*Reuter's Trade Service* (Brussels).

Caucasus.—WIRELESS TELEGRAPHY.—It is reported that communication has been established between Tiflis and Paris by means of wireless telegraphy.

China.—WIRELESS CHAIN.—According to the London correspondent of the *Shanghai Times*, writing in the London *Daily Mail*, a fine spirit of enterprise is being shown in the establishment of a chain of wireless stations which will link Peking, the seat of the central Government, with Kashgar, 3,000 miles away, in Chinese Turkestan. Kashgar will then be within reach of the wireless stations in India, and so with other countries. The scheme is being carried out by Marconi's Wireless Telegraph Co., Ltd., to the order of the Chinese Government. One high-power station has been equipped at Urga, in the Province of Kansu, 800 miles from Peking, and these two places are already in communication. Urga is also in touch with Shanghai and Hankow, and messages can be received from the long-distance stations in America. Another similar station is being established a thousand miles farther on at Urumchi, and it will be in operation in about three months' time. Subsequently the terminal station of the series will be erected at Kashgar.

Germany.—PORTABLE TELEPHONES.—A new portable telephone will give Berlin subscribers an opportunity of telephoning from any room, says *The Times*, by means of an apparatus which can be carried from room to room. The new fitting is to come into use immediately, and the cost is to be small.

India.—TELEPHONE EXTENSION.—A Government telephone service has been established between Bombay and Surat, says *Indian Engineering*; the service was inaugurated for public use on December 10th last.

Meteorological Forecasts.—NEW SERVICE.—Early in the New Year a system of wirelessed weather reports from ships of various nations at sea will come into effect. Col. E. Gold, assistant director of the Meteorological Office, states that a code had been agreed upon by weather experts of France, Denmark, Sweden, Norway, Holland, Italy, Spain and Great Britain. Reports will be sent from ships by means of groups of figures, and, so far as this country is concerned, the figures will be decoded at the Air Ministry in Kingsway, W.C. At first the reports will come from the North Atlantic, and what is chiefly looked for is much greater accuracy in forecasting weather changes. In time, too, ships should be able to plot their own charts of the weather ahead of them from point to point.

New Wireless Service.—ENGLAND TO FRANCE.—A new public telegraph service between England and France was opened on January 8th. High-speed duplex wireless transmission will be employed, and the service will be conducted by Marconi's Wireless Telegraph Co., Ltd., and the Compagnie Générale de Télégraphie Sans Fil, these companies operating under licences from the British and French Governments. The current telegraph rates between the two countries will apply. Telegrams to France intended for transmission by this new service may be handed in at all times at the Marconi Co.'s London offices, Fenchurch Street, and Marconi House, Strand, and at any postal telegraph office within the United Kingdom. Messages so tendered must be marked "*via* Marconi." For this service high-speed automatic apparatus such as was used so successfully between Geneva and London during the sitting of the Assembly of the League of Nations will be employed.

A *Reuter's Trade Service* telegram from Paris states that the rate of transmission attained during the opening day was 175 words per minute.

FRANCE.—NEW WIRELESS STATION.—The first stone of what will be, according to the *Daily Telegraph*, the most powerful wireless telegraph station in the world, was laid at Sainte Assise, between Cesson and Mélun, on the 19th inst.; its construction will take at least two years.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aberdeen.—February 21st. Corporation Waterworks Department. Electrically-driven pumping machinery. Specifications, £5 (returnable), from Water Engineer's Office, 41½, Union Street, Aberdeen.

Australia.—SYDNEY.—January 31st. Municipal Council. h.p. and l.p. cable (specification No. 628). Electric Lighting Department, Town Hall, Sydney.

SOUTH AUSTRALIA.—P.M.G.'s Department. March 2nd. Telephone parts, Schedules 558 and 559; telegraph and telephone material, Schedule 560. (January 7th.)

MELBOURNE.—March 31st. Electricity Commissioners. Plant for the Morwell power scheme. Telephone wire and pin-type insulators. (See this issue.)

Belgium.—Commune of Ixelles at Brussels. 5,000-kW, 5,000-V, 3-phase alternator, exciter and condenser. A copy of the specification (in French) may be seen on application to the Department of Overseas Trade (Room 48), 35, Old Queen Street, S.W.1.

January 19th. The Belgian Post and Telegraph authorities at La Salle Madeleine, Brussels. Supply of telephone commutators and other telephonic apparatus. The specification (No. 545) may be obtained for 1.75 francs from the above address.

February 1st. Municipal Council, Antwerp. Rotary converters with switchboard, for No. 77 Wharf of the Bassin Canal. Specification in French can be seen at the Inquiry Room of the Department of Overseas Trade, 35, Old Queen Street, S.W. 1.

Municipal authorities of Wenduyne-sur-Mer, Western Flanders. Conversion of the local electricity supply from continuous to alternating current, together with the supply of about 350 electricity meters, 30,400 lamps and 20 electric motors. It is possible that a small transformer station will later be required.

February 11th. Municipal authorities of Tirlement. Electricity supply in the town; (1) the supply of electrical energy; (2) the establishment of a distribution system; and (3) the concession for the supply of electrical energy for lighting and power purposes. Specification from the Secretariat Communal, Tirlement, on payment of 30 fr. The municipal authorities will decide as to the scheme to be adopted after the tenders have been opened.

Chester-le-Street. — January 25th. Urban District Council. Wiring 512 houses, feeder cables, overhead mains, equipment for sub-station. (See this issue.)

Edinburgh.—January 24th. Electricity Supply Department. Circulating water pipes and valves for the Portobello generating station, Specification No. 30. (January 7th.)

Fife.—January 20th. Education Authority. Electric lighting and heating work at Park Road School, Rosyth, and heating work at Crossgates new school. Schedules from Mr. R. H. Motion, architect, Union Bank Chambers, Dunfermline.

Halifax. — February 3rd. Electricity Department. Twelve months' supply of stores, including electric lighting fittings and accessories, cables, v.i.r., and phosphor bronze, telephone wire, e.h.p. and l.p. cables, meters, &c. (January 7th.)

Keighley. — January 24th. Corporation. Electricity Department. Construction of 6,600-V overhead line to Eastburn. (See this issue.)

London.—HAMMERSMITH. — January 21st. Electricity Department. Three or more water-tube boilers capable of supplying 150,000 lb. of steam per hour. (January 7th.)

January 26th. Electricity Department. Single and three-phase transformers. (See this issue.)

PADDINGTON.—January 24th. G.W.R. stores, including telegraph instruments, electrical apparatus, electric wire and cable, &c. (See this issue.)

L.C.C.—January 31st. Electric wiring installation at the Bethnal Green Weights and Measures Office and Coroner's Court, comprising about 87 switch points and 89 lighting points. (See this issue.)

Lurgan.—January 29th. Urban District Council. Four-core l.p. lead-covered and armoured cables. (See this issue.)

Manchester.—January 24th. Electricity Committee. Six motor-driven circulating-water pumps; three motor-driven boiler feed pumps and one motor-driven pump for weight-tank sump. (December 24th.)

Natal.—DURBAN.—January 26th. Corporation. Supply of telephone cable, paper sleeves, concrete pipes, and various telephone and miscellaneous accessories and materials.

February 16th. One 1,000-kW rotary converter with transformers and switchgear. Specifications of the above may be consulted on application to the Department of Overseas Trade, 35, Old Queen Street, E.C.

New **Zealand.** — NAPIER. — January 17th. Borough Council. One 500-kW electric generating set. Copies of the specifications and blue prints may be seen at the Department of Overseas Trade, 35, Old Queen Street, S.W.

Wellington.—March 1st. Public Works Tender Board. Seven 4,000-kVA single-phase transformers, with accessories, for Lake Coleridge electric power scheme. Copy of the specifications can be seen up to January 20th at the Department of Overseas Trade, Room 48, 35, Old Queen Street, S.W. 1.

South Africa. — Pretoria.—March 10th. Municipal Council. One 20-ton overhead crane, six boilers (350-lb. working pressure), three 3,000-kW steam turbo-generators with condensing plant, five 750-kW converters. Further particulars can be obtained from Mr. T. C. Welley-Dod, general manager, electric lighting department. Specifications (five guineas) from the town clerk.

CLOSED.

Australia.—Sydney City Council. Recommended :—

Supply of four boilers and accessories, £253,356.—Babcock & Wilcox, Ltd.

The bulk of the plant to be manufactured in Sydney.

One 16,000-kW turbo-alternator, £168,000.

The contract provides for the manufacture of the plant in Sydney, as far as practicable.—*Tenders.*

Birkenhead. — Electricity Committee. The British Thomson-Houston Co., Ltd., for the supply and erection, &c., of high-pressure switchgear, for the sum of £4,003.

Bradford.—Tramways Committee :—

2,000 copper rail bonds at scheduled prices (approximately £316).—British Insulated and Helsby Cables, Ltd.
100 steel tramcar tires.—Anglo-Belgian Improvements Corporation.

Bury.—Corporation. Plant for Chamber Hall power station :—

Switchgear.—Ferguson, Pailin & Co., Ltd.
Ash removal plant.—Underfeed Stoker Co., Ltd.

Canterbury.—Town Council :—

Ferguson, Pailin & Co., Ltd.—Switchgear and cables, £2,195.
Hopkinson, Ltd.—Three 6-in. high.pressure valves, £103, plus 1s 10d per ft. for chains.

FORTHCOMING EVENTS.

Edinburgh Electrical Society.—Friday, January 14th. At the Philosophical Institute. At 8 p.m. Paper on "Some Notes on Cables," by Mr. W. F. Mitchell.

Electro-Harmonic Society.—Friday, January 14th. At the Cannon Street Hotel. At 8 p.m. Smoking concert.

Association of Engineers-in-Charge.—Saturday, January 15th. At St. Bride's Institute. At 7 p.m. Social and dance.

Manchester Association of Engineers.—Saturday, January 15th. At the Memorial Hall, Albert Square. At 7 p.m. Paper on "Reinforced Concrete and the Housing of Expensive Plant," by Mr. F. Milner.

National Association of Supervising Electricians.—Saturday, January 15th. At the Holborn Restaurant. At 6.30 p.m. Annual dinner.

Institution of Electrical Engineers.—Informal Meeting.—Monday, January 17th. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Discussion on "The Mental Equipment of an Engineer." To be opened by Mr. P. Pitt.

Scottish Centre (Students' Section).—Friday, January 14th. At the Royal Technical College, Glasgow. At 7.30 p.m. Paper on "Alternating Current compared to Direct Current for Distribution and Supply," by Mr. R. R. Birch.

Liverpool Sub-Centre.—Monday, January 17th. At the University, Liverpool. At 7 p.m. Papers on "Electric Arc Welding applied to Aluminium," by Mr. F. J. Heyes; on "The Chemical and Metallurgical Aspects of Electric Arc Welding," by Mr. J. H. Paterson": and on "The Cost of Electric Resistance Welding," by Mr. L. H. Wilson.

South-Midland Centre.—Friday, January 21st. Annual dinner.

(Students' Section). — Friday, January 21st. At Faraday House, Southampton Row, W.C.1. At 6.30 p.m. Paper on "Electric Welding," by Mr. H. J. Howard.

Royal Society of Arts.—Monday, January 17th. At 8 p.m. At John Street, Adelphia, W.C. Howard lecture, "Aero Engines." By Mr. A. E. L. Chorlton.

Wednesday, January 19th. At John Street, Adelphi. At 8 p.m. Paper on "The Future of Industrial Management," by Mr. F. M. Lawson.

Illuminating Engineering Society.—Tuesday, January 18th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Discussion on "Use and Abuse of Light in Studios for Kinema Film Production." To be opened by Mr. J. C. Elvy.

Institute of Marine Engineers.—Tuesday, January 18th. At the Institute, The Minories, E. At 6.40 p.m. Paper on "The Internal Combustion Engine," by Mr. A. W. Bradbury and Mr. J. J. Fasola.

Manchester Wireless Society.—Wednesday, January 19th. At the Albion Hotel. At 7.30 p.m. Ordinary meeting.

Electrical Contractors' Association (Inc.). — Wednesday, January 19th. At the Connaught Rooms, Great Queen Street, W.C.2. At 7 p.m. Annual dinner.

Chelmsford Engineering Society.—Thursday, January 20th. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Thermionic Valves," by Mr. C. H. Ford.

Chemical Society.—Thursday, January 20th. At Burlington House, Piccadilly, W.1. At 8 p.m. Ordinary meeting.

Institution of Mechanical Engineers. — Friday, January 21st. At the Institution, Storey's Gate, S.W. At 6 p.m. Paper on "The Mechanical Loading of Ships," by Mr. H. J. Smith.

Junior Institution of Engineers. — Friday, January 21st. At the Caxton Hall, Westminster, S.W. At 8 p.m. Lecturette on "Motor Yachts," by Mr. B. H. Joy.

NOTES.

The Circulation of the "Electrical Review."—We notice that our business manager is publishing the certificate of the net sales of the Electrical Review. This may be seen on p. xxvi. of the current issue.

The "Electrical Review" Index. — The Index to Vol. LXXXVII of the Electrical Review, which will shortly be printed, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 6d., post free. Any reader or advertiser, at home or abroad, who requires a copy for binding or for other purposes, is asked to make early application therefor to the Publisher, Electrical Review, 4, Ludgate Hill, London, E.C. 4.

Appointments Vacant.—Instrument maker (£4 to £5) for the Dundee Technical College; electrician for the Holloway Sanatorium, Virginia Water; electrical draughtsman (£800) for an hydro-electric scheme in the Federated Malay States; lecturer in electrical engineering (£500) for the Auckland (N.Z.) University College; assistant mainsman, for the Bury St. Edmunds Corporation Electricity Department; consulting electrical engineer, for the Enniskillen Urban District Council; assistant divisional engineer ($360 per month + 20 per cent., dollar equal 2s. 4d.), for the Posts and Telegraph Department of the Government Straits Settlements; electrical engineering draughtsman (temporary) (£150 + £183), for the Metropolitan Asylums Board. See our advertisement pages to-day.

Correction.—In our notice of the appointment vacant for an electrical draughtsman at the City and Guilds (Engineering) College, on page 852 of our issue of December 31st, the salary was quoted at £550; it should have been £350. The same error occurred in the official notice in our advertisement pages, and was due to the defective copy from which the matter was set up, three members of our staff who independently read the copy at the time arriving at the same result.

Electrically-Produced Lead.—The *Sydney Daily Telegraph* announces that at the lead sulphate works at Launceston, as a result of preliminary tests, the important discovery has been made that metallic lead can be produced from the sulphide (galena) by means of electricity, which has never previously been commercially demonstrated in the southern hemisphere. Under the direction of Mr. James Gitsham, managing director, this test was carried out with success. Pure lead was obtained, and within a short space of time. Up to the present the Lead Sulphate Co. has been forced to send all the dross to the mainland smelters for treatment, but now, with the electrical process, pure lead can be produced at the works.

"Bearing their Blushing Honours Full upon Them."—There is a hymn which says "Kind Words can Never Die," and when the kind words come from such a professedly unsentimental paper as the *Financial Times*, they deserve even an enhanced immortality—at least a deepened one if a lengthened one is impossible. In one of the issues of the *Financial Times* of last week they bewail sorrowfully the "fatal complacency" of employers (the immediate culprits are the Greater London Industrial Council), whom, they seem to think, might stray unsuspectingly into booby-traps, or other pitfalls for the innocent. However, it is not the theme we are concerned with, but the laudatory epithets bestowed on certain members of the Trade Unions, all the more gratifying, we are sure, because they are life-time tributes, and not epitaphs. The Trade Union representatives on the Greater London Council are (we feel the *Financial Times* bowing deprecatingly. like Mr. Arthur Balfour, as it says it), "Some of the most indefatigable and astute of their officers"—and this group contains (and here we feel Mr. Webb's modesty will cause him to blush), "the London District Secretary, to whom Lord Askwith gives a commendatory tribute in his recently-published 'Industrial Disputes.'" Talk about Birthday Honours! Anyhow, the *Financial Times* has set our friends something to live up to.

An Electrical Joint.—An electrical engineer, of Dudley, sends us the following order, written on the back of a butcher's bill form :—

Mr. Jennings
Please give bearer 1 ½ Watt lamb
and oblige
F. H——.

The ruling instinct appears to have guided the customer's pencil in this instance. Doubtless a grocer would spell "current" with an a, and an executioner would order a choking coil with professional appreciation.

The New Gas Regulations.—In accordance with the Gas Regulation Act, 1920, the Board of Trade has appointed Sir R. T. Glazebrook, K.C.B., F.R.S., to be Chief Gas Examiner, and Mr. C. V. Boys, F.R.S., Mr. J. S. Haldane, F.R.S., and Mr. W. J. Butterfield, F.I.C., F.C.S., to be Gas Referees. The Board has also appointed Mr. H. C. Honey to be Director of Gas Administration in the Power Transport and Economic Department, Board of Trade Offices, Great George Street, S.W. 1. Committees have been appointed to inquire whether it is necessary to prescribe any limitation of the proportion of carbon monoxide which may be supplied in gas used for domestic purposes, or of the proportions of incombustible constituents which may be supplied in gas.

British Oil.—There was issued on January 5th, says the *Journal of Commerce*, a copy of the licence granted by the Minister of Munitions to Mr. Reginald Gilbey, of Nottingham, to search and bore for petroleum at Weston, Leicestershire. The licence is to continue in force for two years from October 8th, 1920, with the possibility of a renewal for two years. It is provided that boring must commence within six months of the date of the licence, and the licensee must indemnify the Minister of Munitions against all claims and demands arising directly or indirectly out of any of the operations. Payments by way of royalties, commission, profit, or otherwise, for the petroleum obtained are specifically forbidden. The licence also provides that if any Act of Parliament relating to petroleum within the United Kingdom be passed, the Minister shall have power to amend or vary the terms of licence as he shall think fit, but if these are not approved by the licensee he may surrender the licence.

Electricity Districts.—In our article on "The Electricity Districts" in our last issue, the capacity of the Sheffield power station is given as 68,700 kW. Mr. S. E. Fedden points out that that is the figure at which it stood in March last, but since that date the Blackburn Meadows station, with an additional capacity of 28,000 kW, has been put into commission, making the present total capacity of the undertaking 96 700 kW. Previous to March last the maximum load was 60,593 kW, and during the present winter it has been increased to 65,874 kW.

Blackburn Power Station.—The completion of the super-power station at Blackburn will open up a new industrial era for this locality. The new station, which is bounded on one side by the canal and on the other by the railway, is rapidly approaching the finishing stage. The cost will exceed three-quarters of a million pounds. The plant will be more extensive than originally proposed, owing to the co-operation of neighbouring authorities and the general demand for the utilisation of power for industrial purposes. It is no secret that a number of cotton mills desire to install plant, and new undertakings are awaiting the provision of more power before embarking on their plans. At present the existing Blackburn station is overloaded, and the new service will provide necessary relief, not only in Blackburn, but in Harwood, Rishton, Darwin, &c. The above is an external view of the station.

THE NEW BLACKBURN POWER STATION.

Electrical Education.—New Zealand is alive to the importance of instructing consumers and prospective consumers in the use and advantages of electricity.

A series of lectures and demonstrations on electric power and lighting were arranged by Mr. J. P. Kalaugher, supervisor of manual training under the Education Board, at Paeroa, Te Aroha, Morrinsville, and Matamata. In reporting to the Board, Mr. Kalaugher said there had been a widespread request for instruction in the use of electricity in that area on account of power being available in the near future. The Thames Valley Power Board supplied the apparatus necessary for the lectures, and their cost was covered by the fees charged.

Mr. Kalaugher stated that it was the Board's function to arrange classes in any technical subject required. Electricity was coming to the Thames Valley, and it was going to revolutionise farming. Some 2,300 applications had been received for power. Those people wanted definite information about the possibilities of electric power. The lectures would serve a great public need.—*Auckland Weekly News.*

Transport of Refrigerated Produce.—For town distribution of refrigerated footstuffs it is believed that the electric vehicle is the most suitable, assuming that power can be obtained at a reasonable price, although to obtain really good results with an electric vehicle it is necessary to use one of large carrying capacity. It is claimed that experience has shown that the running costs of a 3½-ton lorry are not more than 20 per cent. greater than those of a 1½ ton lorry. On the assumption that 40 miles per day are run for 250 working days per annum in town delivery by a lorry of which the first cost was £1,500, with electricity at 1·5d. per unit, the use of such a vehicle can be fully justified. Figures were submitted at a meeting of the Cold Storage Association showing that the operating costs with a 3-ton load would be 6d. per ton-mile. Making allowance for empty-car mileage and maintenance, the total costs would be 1s. 3d. per ton-mile gross.—*The Times Trade Supplement.*

Flat Electrode Welding.—A writer to the *Electrical World* points out that the use of flat electrodes in the place of the usual cylindrical type results in a great saving of time, and calls for considerably less skill upon the part of the operator. When operating upon a "V"-shaped opening, the flat electrode will assume a corresponding shape owing to the fact that the arc centres at those points closest to the metal, and thus melts off the electrode for a uniform distance. This relieves the operator of the task of skilfully moving the electrode from side to side, and down into the notch. When using this electrode, it is only necessary for the welder to carry one size, and to use it either flat or edgewise for wider or narrower seams. The flat electrode is also eminently fitted for automatic welding machines since it will give broad runs without side motion.

Electric Rivet Heating.—At a meeting of the Philadelphia section of the American Association of Iron and Steel Electrical Engineers, an official of the American Car and Foundry Co. stated that his firm used electricity for heating rivets in their passenger-car and freight-car departments, effecting a saving of between $1 and $2 per 100 lb. of rivets, as compared with oil heating. Over 100,000 rivets, weighing 45,700 lb. were treated daily. The amount of electricity consumed in this way averaged only about 14 kWh per 100 lb.

Determination of Protective Glass Opacity.—A quick method for determining the opacity of eye-protective glasses to ultra-violet rays has been worked out by the U.S. Bureau of Standards. The photographic method usually employed requires several hours for making such a test, while by the new method, which is radiometric, a test can be made in a few minutes. The test is based upon the fact that all glasses are opaque to radiations of wave lengths of less than 0·3 micron (1 micron = 1/1,000 mm.). It is, therefore, only necessary to examine eye-protective glasses for opacity to ultra-violet radiations of wave lengths of from 0·3 to 0·4 micron. Radiations of these wave lengths are easily obtained without employing a spectroscope by simply filtering the light from a quartz vapour lamp through a suitable glass screen placed over a vacuum thermopile. Measurements of one part in 10,000 are easily obtainable.—*Chemical and Metallurgical Engineering.*

A Cheap Transformer Installation.—A cheap form of customer's rural transformer installation is being supplied by the Miami Valley Electric Co., of Sidney, Ohio, says the *Electrical World*. The installation is simple and is easily installed. It consists of air-brake switches operated from the ground, horn-gap and resistance lightning arresters, choke coils, expulsion fuses and transformer. The approximate cost of a typical installation on a 13,200-V line to supply 110-220 V single-phase service is shown in the following list of materials and labour :—2½-kVA transformer, $135.00 ; switching equipment and lightning protection, $160.00 ; material for earthing neutral and lightning arrester, $2.50 ; one three-wire secondary rack, bolts, washers, and 300 ft. of No. 10 secondary, $5.00 ; labour, two men, four hours each at 50 cents per hour, $1.00 ; total, $306.50.

For the equipment installed complete with a three-wire secondary not exceeding 100 ft. (31 m.) in length a charge of $375 is made to the farmer. This covers overhead cost and the slight difference in construction cost in different installations.

Detection of Armature Short-Circuits.—To test for short circuits in motor coils outside the motor, a quick, reliable and at the same time inexpensive outfit was made by an *Electrical World* correspondent from an old pole piece of a synchronous motor. This pole piece measured about 7 in. long 4 in. wide and 6 in. high (18 cm. × 10 cm. × 15 cm.). A piece of fibre in the shape of the coil was attached to the yoke end of the pole to hold the winding, which consisted of five layers of No. 11 double-cotton-covered wire. Flexible leads were soldered to the ends of the winding. Current was taken from a 110-V alternating-current circuit.

In testing a coil it was placed over the pole piece. Any short circuit in the coil was detected first by a force trying to throw the coil off the core and, secondly, by the heat developed in the short-circuited turns. This outfit has very handy and many other uses may be found for it in the winding shop.

Electrical Bread-Baking.—The *Electrical World* gives details of a store in Salt Lake City where electricity has been substituted for raw fuel in the baking of bread. The supply company looks upon the oven as a very desirable business, as it is in steady use from five to sixteen hours each day, and maintains a fairly high load factor. The investment cost to obtain this business is little or no greater for smaller-size ovens than for the electric range, and the revenue is eight to ten times greater. In most cases no additional investment is necessary, as the load is connected in the commercial section, where feeders and transformers are of ample capacity to handle a greatly-increased load. The baking hours are so arranged by the class of work that the operation seldom overlaps a peak. If the oven is used during the day, it misses the morning peak and is turned off before the evening ; if used during the night, it also misses both morning and evening peaks, thereby improving the load factor by filling in the valley of the load curve that is a problem to all central-station engineers.

An initial six-day trial proved this method of baking to be less expensive than the previous arrangement, and the success of the scheme was so marked that in Salt Lake City no less than 40 of these ovens are in daily use, in addition to 20 in other parts of the supply company's area.

INSTITUTION NOTES.

Birmingham and District Electric Club.—The club held its first meeting of the 1921 session on January 8th, when the president, Mr. A. O. Wynne, gave his presidential address, in which he dealt with the present position of the electrical profession and industry, and claimed that the time was more than ripe for those engaged in the business of electrical engineering to consider some means of setting and insisting upon a standard of fitness and efficiency, and thus form a means of protecting themselves and the public from the results of the ignorance and malpractices of those who ought never to be allowed to practise in a business of such supreme importance to the community as electrical engineering. The club meets on the second Saturday in each of the winter months at the Grand Hotel, Colmore Row, Birmingham, and electrical engineers residing in, or visiting the city, will always find a welcome, and, as a rule, an interesting and useful technical paper or discussion.

The arrangements for the first half session, 1921, include the following items:—February 12th, Mr. C. J. A. McDonald on "Reminiscences of the Test-bed"; March 12th, Mr. H. C. Young, on "Common-Sense Methods of Recording, Costing, and Progress in Shop Management"; April 9th, Mr. F. Forrest on "Supply of Electrical Energy in Birmingham and District"; March 4th, annual dinner.

Liverpool Engineering Society.—The annual dinner will be held at the Exchange Station Hotel, Liverpool, on Thursday, January 27th, at 7 p.m.

Institution of Electrical Engineers.—The following programme of Informal Meetings has been arranged for January:—17th, "The Mental Equipment of an Engineer," by Mr. P. Pitt; 24th, discussion on "Improving the Usefulness of the Institution," Mr. Ll. B. Atkinson (president) in the chair; 31st, "Possible Economies in Housewiring," by Mr. L. Milne. The second annual smoking concert is to be held on February 28th.

Chelmsford Engineering Society.—On January 6th, at the East Anglian Institute of Agriculture, Mr. Thomas Clarkson delivered an instructive lecture on "Motor Transport Economics," outlining the growth of road transport from the pioneer work of the early French engineers up to the present day. He pointed out that by the use of coke as fuel in a steam-driven lorry, it was now possible to carry a three-ton load at a net cost of 1½d. per mile. In the discussion that followed, Mr. C. Johnson pointed out the advantages of electric transport for a short and intermittent haul.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Mr. W. B. Brassington, formerly chief engineer of the Motherwell electric undertaking, has been appointed chief engineer of the joint undertakings of Motherwell and Wishaw, which will in future be controlled as one unit; Mr. David B. Scott, Wishaw, has been appointed mains superintendent of the joint undertakings.

The Röntgen Society has made the first award of the Mackenzie Davidson medal to Dr. F. W. Aston, for a paper on "Positive Rays."

Mr. Hubert M. Freeman, associate physicist of the radio section, Bureau of Standards, U.S.A., has resigned to accept a position with the Westinghouse Electric and Manufacturing Co. —*Science.*

Hackney Borough Council Establishment and General Purposes Committee recommends that Mr. J. G. W. Clements be appointed sales department salesman in the electricity department at a commencing salary of £220 per annum.

The marriage has taken place at Edinburgh of Mr. Colin Russell, A.M.I.E.E., who gained the M.S.M. whilst serving with the Royal Engineers, and Miss Frances Brown, of Edinburgh.

Mr. H. F. Reeman, who, for a number of years, has been power station superintendent to the Llanelly and District Electric Lighting and Traction Co., Ltd., resigned on 31st ult., to take up a position as manager to a manufacturing firm in Lancashire. On leaving he was presented with a gold watch by the members of the staff.

Barrow Town Council has been recommended to increase the salary of the electrical engineer to £950 per annum as from April 1st, 1920, or any variation thereof which may be agreed upon between the Standing Sub-Committee of the Council and the A.M.E.E.

Will.—The late Mr. J. Stubbs, O.B.E., director of the Concordia Electric Wire Co., Ltd., left £36,760 gross, and £29,151 net personalty.

Portsmouth Leader Cable.—Representatives of nearly every Navy in the world witnessed a demonstration at Portsmouth, on the 4th inst., of the electric "leader cable," which was installed some time ago, and by means of which ships can be guided into port in foggy weather, or when the ordinary navigation marks are not visible.

JOINT ELECTRICITY AUTHORITIES.

West of England District Inquiry.

An inquiry into the proposed formation of a Joint Electricity Authority as provided for by the Electricity (Supply) Act, 1919, was opened at Bristol on January 11th, in connection with the Lower Severn District. Sir John Snell, Sir Harry Haward, Mr. H. Booth and Mr. Archibald Page represented the Electricity Commissioners, who were accompanied by their legal adviser, Mr. E. W. Hudson, and their clerk, Mr. D. S. Cumberlege.

County Councils, Borough, Urban District, Rural District, and Town Councils were represented by their legal advisers at the inquiry, and many "electrical" gentlemen were present, including Mr. Roger T. Smith, who in company with Mr. Tyldesley Jones represented the Great Western and Midland Railway Companies, Messrs. H. Faraday Proctor (Bristol), F. Teague (Bath), W. J. Bache (Cheltenham), F. H. Corson (Gloucester), F. Newey (Swindon), W. T. Kerr (Hereford), H. I. Munro (Exeter), C. G. Morley New (Cardiff), S. T. Allen (Wolverhampton), W. Nairn (Bristol Tramways Co.), W. Hardey (Bath Tramways Co.), G. Charlton (Weston-super-Mare Electric Supply Co.), G. L. Coventon (Chepstow E.L. Co.), H. Walker (Bridgwater E.L. Co.), F. Christy (North Somerset Supply Co.), C. T. Allan (South Wales Power Co.), J. H. Edwards (various undertakings), W. L. Madgen (British Electrical Federation), J. W. Burr (Swansea and South Wales Linking-up Committee), T. W. Cole (Provincial Electricity Supply Committee), and Mr. Arthur Ellis, consulting engineer, Cardiff.

In opening, Sir John Snell read the notice convening the inquiry, which stated that any body or person interested might attend the inquiry either personally or by counsel, solicitor, or agent. He mentioned that the present Electricity Acts did not confer any financial powers upon Joint Electricity Authorities, but the Bill which was to be laid before Parliament next session would contain the financial powers necessary to a Joint Authority to borrow money and to issue electricity stock, and powers to local authorities, companies, and persons, to render financial assistance to a Joint Electricity Authority by loans, by guarantee of interest or otherwise. The procedure of the inquiry would be to call upon the chairman of the Organising Committee (Mr. H. Faraday Proctor), which has submitted the scheme to open, and thereafter such witnesses as might appear in support of the scheme would be examined and cross-examined by counsel or solicitors appearing for the various interests in such order as they might arrange between themselves. He had expected that the Organising Committee would have been represented by counsel, but Mr. Proctor as the chairman of the Organising Committee, would present the case on behalf of the Organising Committee, and then would have to put himself into the box as a witness to be cross-examined by those representing the other interests, a not altogether helpful way of doing things, which might lead to some confusion. He was rather sorry for Mr. Proctor, because he had to appear in a dual capacity. Sir John pointed out some inaccuracies in the notice of provisional determination of the first district. He then called upon Mr. Proctor to explain the proposals for the scheme.

Mr. H. Faraday Proctor, in opening his case, detailed the two or three references which had led up to the present stage in the proceedings. General particulars and financial estimates had been prepared and had been submitted to the Commissioners, with the request for the putting in hand of those interim works and estimates more particularly referring to the Beachley generating station in the Forest of Dean. Additional information was furnished to the Commissioners as desired, embracing general statistics and an outline of a scheme showing the feasibility of transmitting energy to various localities in the south-eastern portion of the district on a sound financial basis. These details had not been submitted to other authorities in the proposed districts. The scheme submitted dealt particularly with the constitution of the Joint Authority and the method of securing proportionate representation and the basis of the same. It was deemed to be a *sine qua non* that those bodies or companies which through their representatives were entrusted with the control and direction of the affairs of the authority, including its finances, should be responsible for its solvency. It had been, and was, considered undesirable, and indeed impracticable, for a committee which was not regularly constituted and had not time or means at its disposal to undertake the specific detailed investigation of the engineering problems, more particularly having regard to the fact that the area had not been determined.

Sir John Snell inquired how it came about that the district was in that position, when to the knowledge of the Commissioners other districts which had submitted schemes had submitted the full engineering particulars. He stated that corporations and companies could not possibly criticise the proposals of the Organising Committee unless those particulars were put at their disposal. They ought to have something concrete to go upon. He was disappointed that the Organising Committee had not the information which had been submitted to the Commissioners available for distribution to the various representatives present. It was a little unfair to those representatives not to have the particulars in their hands.

The point raised by Sir John was endorsed by many of those present, and after a conference with his colleagues, the inquiry was adjourned until March 1st, by which date it was hoped that all available information, both technical and otherwise, would be furnished to the various parties interested.

Before adjourning, Sir John stated that the idea to be borne in mind was the improvement of the supply of electricity in the district and its gradual evolution and development. Interests ought to be, on main principles, common. In fairness to Mr. Proctor, he ought to state that he did not blame him or the Organising Committee for the position they found themselves in that morning. The Organising Committee had, after all, taken the initiative in this matter. As this was the first inquiry of its kind, without any settled form of procedure, they would gradually have to formulate as they went along. A certain amount of preliminary work and loss of time was inevitable, but he supposed other districts would benefit at the expense of the Lower Severn.

The sudden postponement of the inquiry was entirely unexpected by the electrical industry, which had looked forward to the investigation with keen interest. It appears that the Organising Committee was hardly prepared for the array of consulting engineers and learned counsel with which it was confronted, and Mr. H. Faraday Proctor—to whose indefatigable labours the Lower Severn District is deeply indebted—found himself in an unenviable position. We gather that the presentation of a technical scheme is regarded by the Electricity Commissioners as an indispensable feature of such an inquiry, and it so happens that of the four proposals which have been published, the Lower Severn Scheme is the only one in which it is lacking. If this procedure is to become standardised, it will obviously be difficult or even impossible to form a Joint Authority for the purpose of exercising supervision over a District without actually engaging in electricity supply.

The postponement of the inquiry is not altogether to be regretted; it will afford an opportunity for the interests concerned to confer with a view to submitting to the Commissioners an agreed and well-thought-out technical scheme, from which contentious elements will have to be eliminated as far as possible, and the incident will serve for the guidance of other organising committees in the preparation of their cases. We understand that the Bath City Council, which was formerly disposed to stand aloof, has assumed a more friendly attitude with regard to the proposals; as a measure of justice, we must point out that in the early stages the Bath representatives insisted on the preparation of a technical scheme as a condition precedent to their adhesion, and to the formation of a Joint Authority for the District.

NEW COMPANIES REGISTERED.

Smith & Ansell, Ltd. (172,491.)—Private company. Registered January 7th. Capital, £7,000 in £1 shares. To take over the business of manufacturers of electric light fittings, &c., carried on by H. S. Smith and B. Ansell at 109, Great Hampton Row, Birmingham, as "Smith & Ansell." The first directors are: H. S. Smith, "Vron," Maney Hill Road, Sutton Coldfield (chairman); B. Ansell, 280, Kingsbury Road, Erdington, Birmingham. Registered office: 109, Great Hampton Row, Birmingham.

Ennis Gas & Electric Supply Co., Ltd. (5,094).—Registered in Dublin January 3rd. Capital, £5,000 in £1 shares. To supply electric light to the town of Ennis. The first directors are: A. Knox, merchant, Ennis; J. O'Dea, merchant, Ennis; J. Brevin, merchant, Ennis; P. Cahn, merchant, Ennis; D. McInerney, merchant, Ennis; M. McInerney, merchant, Ennis; M. McMahon, merchant, Ennis. Solicitor: F. T. Cullinan, 8, Nassau Street, Dublin.

Haslam & Stretton (Engineering and Motor Utilities), Ltd. (172,459).—Private company. Registered January 6th. Capital, £25,000 in £1 shares. To take over the mechanical, electrical, and motor utilities supply business of Haslam & Stretton, Ltd. The first directors are: S. B. Haslam, 11, Windsor Place, Cardiff, engineer; T. Stretton, 11, Windsor Place, Cardiff, engineer; W. Falcon, no address given; G. H. Ockwell, no address given. Registered office: 11, Windsor Place, Cardiff.

Scholey Construction Co., Ltd. (172,385).—Private company. Registered January 1st. Capital, £20,000 in £1 shares. To adopt an agreement with H. Scholey, C.B.E., for the transfer of certain property and rights to use a process relating to an improved method of treating rails, &c., with apparatus for heat treatment "in situ," and to carry on the business of manufacturers of railway and tramway apparatus, rolling stock, engines, and machinery of all kinds, &c. The subscribers (each with one share) are: F. S. Clark, 11, Pancras Lane, E.C. 4, solicitor; E. W. Brett, 25, Kelsey Park Road, Beckenham, Kent, solicitor's clerk. The first directors are: H. Scholey, C.B.E., Rt. Hon. G. H. Roberts, M.P., C. W. Hill, and E. S. Ormsby. The last named shall be entitled to act without qualification. In the event of the said E. S. Ormsby ceasing to act as director, C. P. Sandberg, of 40, Grosvenor Gardens, S.W., shall be entitled to nominate a director in his place during the continuance of the "principal agreement." Solicitor: F. S. Clark, 11, Pancras Lane, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

North Metropolitan Electrical Power Distribution Co., Ltd.—Particulars of £40,000 debentures (of which £25,000 has already been registered) authorised by resolutions of June 17th, 1909, May 6th, 1915, and November 9th, 1920, present issue £15,000, charged on the company's undertaking and property, present and future, including uncalled capital.

Airedale Electrical & Manufacturing Co., Ltd.—Mortgage dated December 18th, 1920, to secure £600, charged on land in or near Ryan Street, Bowling, Bradford, and garage shed, &c., thereon. Holders: S. E. Jackson, 32, Ryan Street, Bradford, and W. B. Lund, 8, Beechwood Grove, Undercliffe, Bradford.

Douglas Engineering Co., Ltd.—Two mortgage debentures dated December 7th, 1920, to secure £3,000 and £1,000 respectively, charged on the company's undertaking and property, present and future, including uncalled capital. Holders. R. J. Corporation, Ltd., 370, High Road, Willesden Green, N.W.

City of Oxford Electric Tramways, Ltd.—Satisfaction to the extent of £1,600 on December 17th, 1920, of charge dated February 20th, 1914, securing £46,000.

Wilson-Wolf Engineering Co., Ltd.—Satisfaction in full on November 28th of mortgage dated March 22nd, 1920, securing all moneys due or to become due, not exceeding £3,000 notified. Also mortgage dated December 30th, 1920, to secure all moneys due or to become due from company to London Joint City & Midland Bank, Ltd., charged on certain freehold hereditaments in Towler Street, Peterborough.

Phonopore Construction Co., Ltd.—Particulars of £5,000 debentures authorised by resolutions of November 15th and December 14th, 1920, whole amount issued, charged on the company's undertaking and property, present and future, including uncalled capital.

Wakelins, Ltd.—Satisfaction to the extent of £1,380 on December 15th, 1920, of debentures dated July 10th, 1919, securing £1,480.

CITY NOTES.

Adelaide Electric Supply Co., Ltd.

From the *Adelaide Register* of November 10th, just to hand, we learn that a meeting of local shareholders was held in Adelaide on November 9th, when Sir Geo. Brookman, the chairman of the local board, who has recently visited England in connection with the question of the transfer of the head office from London to Adelaide, and the heavy burden imposed upon the company by the payment of British income tax as well as local taxation, explained the result of his investigations. Sir Geo. Brookman said shareholders were aware that for some time the directors in London and in Adelaide had endeavoured to secure relief from double taxation. For some years an abatement had been made, and they had hoped that it would be increased and further concessions granted to Australian shareholders. Previously to his visit to London Mr. J. K. Samuel discussed with the board the subject of moving the head office to Adelaide to avoid British taxation on amounts earned and distributed in Australia, and negotiations on that point were continued on his arrival. While the steps were in progress matters were brought to a crisis by the imposition of the company tax of 5 per cent., and the adamant attitude of the Chancellor of the Exchequer on the subject of further relief. The situation had been discussed with the London board from all points, and it was found that to avoid the tax it would be necessary to move the control of the company to Adelaide. Fortunately, it would make no difference, as the company had been practically managed in Adelaide for many years, with the London board settling matters of policy and materially assisting in matters of finance. It had been agreed by the London directors that after March, 1921, the company should be controlled from South Australia. He was pleased to say that the arrangement for the transfer was of a friendly nature, the directors recognising that the tax was unfair, and he asked shareholders to support the payment of £7,000 as compensation for the loss of office. A saving of £12,000 a year would be made immediately, and larger sums as the business expanded. Should the resolutions to be submitted be approved by local shareholders, a meeting would be held in London on January 19th, at which they would be submitted to the English shareholders, who numbered more than 600, and held about 300,000 shares, and he did not expect any opposition from them, as they would indirectly benefit by the savings to the company. Arrangements had been made to continue the office in London. They had a capable secretary, who was also an engineer, and also had the services of Kincaid and Co., the eminent consulting engineers. The interests of the company had been safeguarded in every respect, and they would still retain the sympathy of the London directors.

The following resolution was carried: "That this meeting of local shareholders in the Adelaide Electric Supply Co. approves the terms proposed for the transfer of the control of the company to Adelaide as set out in the notice to the meeting to be held in London on January 19th embodying the resolution to be submitted there."

It was also agreed that the London directors should be paid £7,000 as compensation for loss of office.

The draft notice set out that on and after March 1st the board of directors in Adelaide would consist of Sir George Brookman, Hon. D. J. Gordon, M.L.C., and Messrs. J. K. Samuel and F. W. Clements.

It was also stated that the directors intended shortly to issue the remainder of the ordinary shares, as more capital was required.

Gross revenue for the year ended August 31st, 1920, £238,763, as compared with £185,907 for the previous year. After deducting management and general expenses in Adelaide and London and providing for interest and sinking fund on 5 per cent. debenture stock and interest on 6 per cent. consolidated debenture stock, writing off the cost of issue of "A" preference shares £4,000, placing to reserve for income tax and corporation tax £5,000, to general reserve £5,000, and paying a final dividend of 7 per cent. (actual) on 350,000 ordinary shares, making 12 per cent. free of British tax for the year, there is a balance of £2,103, and £18,360 brought forward to be carried to next account. Capital expenditure to August 31st, 1919, amounted to £1,047,683, plus further expenditure during the year £133,400, making £1,181,083, less £22,481 written off, leaving balance of capital expenditure £1,158,602.

The Compagnie Générale d'Electricité. The report of the directors of the Compagnie Générale d'Electricité, dealing with the year 1919-20, states that the activity of the manufacturing works on the whole was only limited by the scarcity of coal and the irregularity in the transport services. The work of extension or transformation of the means of production was continued. The Pont-en-Royans factory for the manufacture of small electrical apparatus was set in operation in March, 1919, and a second works was on the point of being finished at Saint Marcellin, in order to supplement the former. In the case of the Orleans electrical and mechanical works, the production of motors and transformers in bulk was beginning. The Tubes de Vincey, which works had been in use since February, 1919, had been converted into a separate company with a share capital of 30,000,000 fr., in the formation of which the Campagnie Générale had participated with the Aciéries de la Marine; and the interests taken by the company in the Aciéries et Usines à Tubes de la Sarre had been transferred to the Société des Tubes de Vincey. Proceeding to refer to subsidiary companies, the report mentions that the Ateliers de Constructions Electriques de Delle, which made a speciality of high tension apparatus, had distributed a dividend of 6 per cent. for the past year, and the same rate had been paid by the Compagnie Générale d'Electro-Ceramique. As to the question of the supply companies which were in a serious situation, the report recalls the fact that the Ministry for Public Works had recommended the introduction, in the fixing of sale prices for energy, of an economic index, taking into account variations in the prices for coal and the cost of labour. Certain agreements, some of which were provisional and others were definite, had been arranged on this basis between the concessionnaire companies and the municipal authorities which granted the concessions. It, therefore, seemed that in the course of time the company's subsidiaries would again enter upon a period of normal financial yield. The accounts showed net profits of 7,370,000 fr., or an increase of 885,000 fr. over 1918-19, and a dividend has been declared at the rate of 60 fr. per share, as contrasted with 50 fr. in the preceding year.

M. Azaria, deputy manager, addressed the shareholders at considerable length at the recent general meeting, discussing in particular the crisis which places a heavy burden on everyone at the present time. After giving details, he expressed the opinion that every manufacturing or merchant undertaking should keep a special account to equalise the difference between the real profits resulting from the exercise of trade and the temporary profits derived, without working, from the rise in value of stocks. The crisis was world wide, and the company was impeded by the competition of other producing countries which also sought foreign markets in order to dispose of the products which their inland markets were unable to absorb. As to the question when the crisis would come to an end, the speaker remarked that reassuring indications were beginning to appear; they would no doubt require several months to exercise their full effect.

After referring to the fall in the prices for coal, the deputy manager approached the question of labour. He stated that the mentality of the workman was visibly being transformed; the workman was ceasing to follow those who advised him more and more to restrict his production, and the individual efficiency was increasing in all the company's works. The number of workmen employed by the company and its subsidiaries was 13,682 on June 30th 1920; and had risen to 14,389 by the end of November. In conclusion, the speaker announced that applications for prices were now being made to an extent which had not been known for many weeks past, and it was possible that purchasers were beginning to ask themselves whether the time was not at hand when it would be right for them to buy.

German Companies. The directors of the *Fabrik Isolierter Drahte vorm. C. J. Vogel*, of Berlin, recommended a dividend and bonus at the rate of 35 per cent. for 1919-20, as compared with 18 per cent. in the preceding year. It is proposed to increase the share capital by 11,500,000 to 23,000,000 marks.

The accounts of the *Elektrowerke A.G.*, of Berlin, whose shares are held by the State, show net profits of 349,000 marks on an ordinary capital of 5,000,000 marks. The company, which supplies power to the State nitrogen works at Piesteritz, and also contributes towards the delivery of energy in Berlin, has a State loan of 55,480,000 marks.

The accounts of the *Electrizitats A.G., vorm. Herman Poege*, of Chemnitz, show net profits of 2,514,000 marks for 1919-20, this result contrasting with 1,139,000 marks in the previous year. A dividend has been declared at the rate of 17 per cent., as in 1918-19, and the share capital is to be increased from 22 to 42 millions of marks. The directors state that the stock of orders and degree of activity in the new financial year are satisfactory, and the restrictions in working in certain departments have been mostly discontinued.

The report of the *A.G. fur Elektrizitats Anlagen*, of Berlin, states that allocations to the reserve fund were made in 1919-20 to meet the threatened losses on the works in Konitz and Thorn, which are situated in the district ceded to Poland. Two German supply works were disposed of, as also were the shares held in Russian undertakings. The accounts show net profits of 650,000 marks, as compared with 533,000 marks in 1918-19, and the dividend is at the rate of 6 per cent. on share capital of 10,000,000 marks, as contrasted with 5 per cent. in the preceding year.

Dublin United Tramways Co., Ltd.—The directors have decided to place £30,000 to the track renewals fund, £2,000 to depreciation on investments, to pay the following dividends, less tax, for the half-year ended December 31st, 1920: 6 per cent. on the preference stock and 7 per cent. on the ordinary stock, making 5½ per cent. per annum, carrying forward £13,331.

Anglo-American Telegraph Co., Ltd.—Balance dividends of 1¼ per cent. on ordinary consolidated and preferred stocks, and first and final dividend of 1½ per cent. on deferred stock for the year, all less tax, making 3¾ per cent. on ordinary consolidated, 6 per cent. on preferred, and 1½ per cent. on deferred stock for 1920.

STOCKS AND SHARES.

Tuesday Evening.

The course of Stock Exchange markets is not running quite so smoothly as it did last week. There has been something of a halt in the public demand for most of the active securities, and the talk of cheaper money in the near future has not sufficed to prevent a pretty general setback in active issues. The main reason for the decline is simply that there is not enough business to counteract the usual amount of selling which goes on automatically day by day. Moreover, the buoyancy of last week failed to take fully into account the various elements that make for difficulty in trade conditions to-day: unemployment, high costs, foreign exchanges and the other items in the catalogue of causes that weigh upon industry all round. Home Railway stocks, which were quite a good market last week, have mostly eased off on the latest crop of doubts as to whether the companies are, or are not, paying their way.

In the general protest which has arisen against the proposed increase to be levied upon telephone-users, the Stock Exchange has played its part with other members of the community. Numerously signed petitions have been presented to the Stock Exchange Committee asking that body to take steps to lay before the Government the severe handicap which the suggested increases in rates would lay upon fluidity of markets, thereby causing a loss to the public and to the revenue. The Stock Exchange recognises, of course, that the telephone service cannot be run indefinitely at a heavy loss to the country, but there is a distinct inclination to ask whether such reforms of management cannot be introduced into the existing system as would enable the rates to be substantially less, at all events, than those which it is now proposed to inaugurate.

Underground Electric income bonds retain a rise of 2 points on the week, and the shilling shares are firmer at 5s. 6d., the market in Tube stocks not being affected by the heaviness that has overtaken various issues in the steam group.

We referred last week to the intention of the County of London Electric Supply Company to apply for parliamentary powers for the establishment of a separate concern to deal with its Barking undertaking. It is reasonable to suppose that after the necessary amount of official red tape has been cut, the scheme will be duly passed. Some speculation has arisen in the market as to what will be the result, and if a guess may be hazarded in this column, we would say that the lines of the plan may follow those which prevail in the case of the Charing Cross and City Company. No change has occurred in the price of the ordinary, but the preference are 5s. lower. To give some idea of the way in which cheap shares are coming to market, we may mention that a small parcel of Chelsea 6 per cent. preference changed hands the other day at 2 9/16. As the shares are of the nominal denomination of £5, this gives a return on the money of nearly 12 per cent., and although there is not much market in the shares, the company is one of the soundest in the group. Metropolitan, Westminsters, and Charing Cross ordinary are all ⅛ up on the week.

Edisons, after their dip to 8s. 9d., have recovered to 12s. 6d. There are interesting rumours current in the market with reference to a closer association of this company with one of the other big electrical undertakings, but no definite information is at present forthcoming. Electric Constructions have risen to 17s. 6d.; General Electrics are unchanged.

The Eastern cable group is quotably strengthened with rises in Eastern Extensions, Globe ordinary, Eastern ordinary and Western shares. Moreover, the new stocks of these companies are all better than they were. The cheapest in the list is Western new, which stand at 14½ as against the old shares at 14⅞. Siemens new shares eased off to 8s. 9d., and Henleys at 30s. are ⅛ down. Otherwise there is not much change in the manufacturing market. The British Columbia Electric Railway has declared a dividend on the preferred ordinary of 23s. per cent. free of tax, making £4 13s. for the year, with a dividend of £2 14s. on the deferred, free of tax, making £6 4s. for the year. The deferred stock is 2 points higher, the preferred being a point down, which is certainly surprising in view of the excellent figures. Foreign railways, however, are somewhat out of favour. Brazil Tractions are 1 up at 38, Mexicans are mostly easier, and some dozens of falls have occurred in the lists of dollar securities, owing to the rise in the value of the £ sterling. Amongst the falls which have taken place in these stocks are many concerned with American and Canadian industrials.

Marconis at 2¼ show 1/16 decline, in spite of the new public telegraph service (conducted by the Marconi Company and the Compagnie Générale de Telegraphie sans fil) which opened last Saturday with an exchange of greetings between King George and the French President. It is stated, by the way, that a wild outburst of speculation in industrials has broken out on the Berlin Bourse, and that large schemes are projected, having for their object the amalgamation of various German electrical companies, several of which were well known in this country before the war.

Rubber shares have come down after their improvements. The burst of buying which carried up prices so sharply last week was succeeded by a fair amount of selling on the part of those who have been anxious to get out of their rubber shares for some time past, and a contribution to the fall was afforded by rubber itself going back from 16d. to 13d. per lb. Iron, steel and armament shares, however, keep firm, Vickers further improving to 17s. 9d., while Babcock & Wilcox are better at 2⅜. The provinces are buying their particular favourites in this group, the market for which is one of the firmest round the Stock Exchange.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Jan. 11, 1921.	Rise or fall.	Yield p.c.
Brompton Ordinary	8	12	5⅞	—	£10 4 4
Charing Cross Ordinary	4	7	3½	+ ⅛	10 0 0
do. do. do. 4½ Pref.	4½	4½	2¾	—	8 3 8
Chelsea	3	4	3⅛	—	6 8 0
City of London	8	10	1 1/16	– 1/16	9 8 2
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 2
County of London	7	8	7½	—	10 13 4
do. do. 6 per cent. Pref.	6	6	7¾	- ¼	7 15 0
Kensington Ordinary	6	7	3⅞	—	9 0 6
London Electric	Nil	2½	¼	—	10 0 0
do. do. 6 per cent. Pref.	6	8	2¾	—	10 18 2
Metropolitan	5	6	2¾	+ ⅛	10 18 2
do. 4½ per cent. Pref.	4½	4½	2 1/16xd	—	6 15 8
St. James' and Pall Mall	10	12	6¼	—	9 12 0
South London	5	6	2½	—	9 12 0
South Metropolitan Pref.	7	7	13/9	—	10 3 8
Westminster Ordinary	8	10	4⅞	– ⅛	10 5 4

TELEGRAPHS AND TELEPHONES.

	Dividend 1918.	Dividend 1919.	Price Jan. 11, 1921.	Rise or fall.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	75½	—	7 19 0
do. Def.	33/6	1½	15⅝	+ ⅛	9 12 6
Chile Telephone	8	6	5½	—	*5 9 1
Cuba Sub. Ord.	7	7	6¾	– ¼	10 0 0
Eastern Extension	8	10	15	+ ¼	*6 18 4
Eastern Tel. Ord.	8	10	154½	+ 2	*6 9 5
Globe Tel. and T. Ord.	8	10	15	+ ¼	6 13 4
do. do. Pref.	6	6	8½	—	7 1 2
Great Northern Tel.	22	22	20	—	11 0 0
Indo-European	13	10	80	—	8 6 8
Marconi	25	25	2¼	– 1/16	—
Oriental Telephone Ord.	10	12	2 1/16	—	*6 4 0
United R. Plate Tel.	8	8	5⅞	—	*6 16 4
West India and Panama	1/8	Nil	1/16	—	Nil
Western Telegraph	8	10	14⅞	+ ⅛	*6 11 7

HOME RAILS.

	Dividend 1918.	Dividend 1919.	Price Jan. 11, 1921.	Rise or fall.	Yield p.c.
Central London Ord. Assented	4	4	43½	—	9 4 0
Metropolitan	1	1¼	20	—	6 5 0
do. District	Nil	Nil	15½	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A"	Nil	Nil	5/6	+6d.	Nil
do. do. Income	6	4	62½	+2	—

FOREIGN TRAMS, &c.

	Dividend 1918.	Dividend 1919.	Price Jan. 11, 1921.	Rise or fall.	Yield p.c.
Anglo-Arg. Trams, First Pref.	Nil	6½	2¾ xd	—	10 0 0
do. do. 2nd Pref.	Nil	Nil	⅝	—	Nil
do. do. 5 % Deb.	5	5	64½	+1	9 3 6
Brazil Tractions	Nil	Nil	38	+1	Nil
British Columbia Elec. Rly. Pfce.	5	5	56	—	8 18 4
do. do. Preferred	2½	5	54½	–1	*8 9 9
do. do. Deferred	Nil	8	51½	+2	*11 8 4
do. do. Deb.	4½	4½	64½	+1	7 16 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	87	—	Nil
do. 6 per cent. Bonds	Nil	Nil	29½	–1	Nil
Mexican Light Common	Nil	Nil	12½	- 3½	Nil
do. Pref.	Nil	Nil	22½	—	Nil
do. 1st Bonds	Nil	Nil	60½	–1	Nil

MANUFACTURING COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Jan. 11, 1921.	Rise or fall.	Yield p.c.
Babcock & Wilcox	15	15	2⅜	+ 1/16	6 6 4
British Aluminium Ord.	10	10	⅞	—	11 8 6
British Insulated Ord.	12½	15	1⅜	—	10 18 2
Callenders	25	15	1⅜	—	10 18 2
„ 6½ Pref.	6½	6½	17/6	—	7 8 7
Castner-Kellner	20	17	2⅜	—	7 2 9
Crompton Ord.	10	10	16/6	—	12 2 6
Edison-Swan	10	10	12/6	+ ⅛	—
do. do. 5 per cent. Deb.	5	5	70xd	—	7 2 10
Electric Construction	10	10	7/3	+1/-	11 8 8
Gen. Elec. Pref.	6½	6½	17/6xd	—	7 10 9
do. Ord.	10	10	1 3/16	—	*8 8 5
Henley	25	15	1½	– ⅛	10 0 0
do. 4½ Pref.	4½	4½	8⅛	—	7 4 0
India-Rubber	10	10	⅞	—	
Met.-Vickers Pref.	—	8	1 1/16	—	9 9 4
Siemens Ord.	10	10	1 1/16	—	*9 11 2
Telegraph Con.	20	20	21	—	*5 14 6

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, January 11th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/5	5d. dec.
a Ammoniac Sal	per ton	£110	...
a Ammonia, Muriate (large crystal)	„	£92	...
a Bisulphide of Carbon	„	...	...
a Borax	„	£38	£3 dec.
a Copper Sulphate	„	£40	£1 dec.
a Potash, Chlorate	per lb.	8d.	4d. dec.
a „ Perchlorate	„	1/2	1d. dec.
a Shellac	per cwt.	£20	£3 dec.
a Sulphate of Magnesia	per ton	£18	...
a Sulphur, Sublimed Flowers	„	£13	£1 dec.
a „ Lump	„	£18	£2 dec.
a Soda, Chlorate	per lb.	6d.	...
a „ Crystals	per ton	£8	£1 dec.
a Sodium Bichromate, casks	per lb.	1/-	...
METALS, &c.			
p Babbitt's Metal Ingots	per ton	£95 to £800	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/1½	...
c „ Tubes (solid drawn)	„	1/2½ to 1/3½	½d. dec.
c „ Wire, basis	„	1/1⅝	...
c Copper Tubes (solid drawn)	„	1/5½	½d. dec.
c „ Bars (best selected)	per ton	£130	£2 dec.
c „ Sheet	„	£130	£2 dec.
c „ Rod	„	£130	£2 dec.
d „ (Electrolytic) Bars	„	£83 10	10/- dec.
d „ „ Sheets	„	£143	...
d „ „ Wire Rods	„	£99 10	10/- dec.
d „ „ H.C. Wire	per lb.	1/0	⅞d. dec.
f Ebonite Rod	„	8/6	...
f „ Sheet	„	8/-	...
n German Silver Wire	„	2/9	3d. dec.
h Gutta-percha, fine	„	14/- to 16/-	...
h India-rubber, Para fine	„	1/0½	1½d. dec.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l „ Wire, galv. No. 8, P.O. qual.	„	£54	...
g Lead, English Pig	„	£26	30/- inc.
g Mercury	per bot.	£12 10 to £12 16	30/- dec.
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e „ „ „ medium	„	6/- to 10/-	...
e „ „ „ large	„	12/6 to 25/- & up	...
p Phosphor Bronze, plain castings	„	1/6 to 1/11	...
p „ „ rolled bars and rods	„	2/5 to 2/8	...
p „ „ rolled strip & sheet	„	2/5 to 2/9	...
d Silicium Bronze Wire	per lb.	1/10	...
r Steel, Magnet, in bars	„	1/8	...
n Tin, Block (English)	per ton	£202	£6 inc.
n „ Wire, Nos. 1 to 16	per lb.	4/8	6d. dec.
p White Anti-friction Metals	per ton	£78 to £300	...

Quotations supplied by—

a G. Boor & Co.	*g* James & Shakespeare.
c Thos. Bolton & Sons, Ltd.	*h* Edward Till & Co.
d Frederick Smith & Co.	*i* Bolling & Lowe.
e F. Wiggins & Sons.	*l* Richard Johnson & Nephew, Ltd
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.	*n* P. Ormiston & Sons.
	p ————
r W. F. Dennis & Co.	

America's Industrial Situation.—The Federal Reserve Board's monthly statement reviewing business and financial conditions says:—"Further progress in business readjustment has been the characteristic feature of commercial and industrial development during December. The readjustment has been accompanied by a further decline in prices, bringing the Board's index number to 198 per cent. of the 1913 level, the month's decline being 8½ per cent. The increase of unemployment resulting from reductions of business activity varying from 40 to 75 per cent. of normal has affected labour unfavourably. Wage reductions running as high as 20 to 25 per cent. have accompanied the shrinkage of demand, and there has been falling off in the export trade. Banking power has been well maintained, normal credit accommodation has been extended to legitimate business, and the reserve ratio has grown stronger.—*Reuter's* (New York).

An Electrically-Driven Merchant Vessel.—The *Eclipse*, the first electrically-driven general cargo merchant vessel in the United States, was placed in service in October. It is a vessel of 11,868 deadweight tons, is 440 ft. long, and has a beam of 56 ft. The propulsion machinery consists of a marine turbine-generator set and a three-phase induction motor, which drives the single propeller shaft at a speed of 100 R.P.M. There are also two steam engine-driven, 125-volt, D.C. exciters, and control equipment for manœuvring the ship. The turbine is of the horizontal Curtis type, operating normally at 3,000 R.P.M., and was developed especially for marine purposes. The governing system is so arranged that the turbine is controlled by a variable-speed hydraulic governor at speeds from 20 to 110 per cent. of normal. The three-phase, 2,300-volt generator is especially designed for marine service. An induction motor rated at 3,000 H.P., and running at a normal speed of 100 R.P.M., which gives a total reduction from turbine speed of 30 to 1, is used to drive the propeller shaft. Ventilation is provided by a separate motor-driven blower. A water-cooled resister and a control panel make up the control equipment.—*Electrical Review* (Chicago).

BRAZIL: SOUTH AMERICA'S MOST POPULOUS MARKET.

Brazil emerged from the war in a strong position, and it is probable that the development of her enormous natural resources will be one of the chief characteristics of the coming years. Such is the pronouncement of H.M. Commercial Secretary at Rio de Janeiro in his report on the general economic and financial conditions of Brazil (Cmd. 840. Price 6d.).

It is true that since his words were written some amount of commercial depression has been caused by speculation, and a fall in the price of the products on which the prosperity of the country is based. But no doubt exists that the general economic condition of Brazil has improved fundamentally as a result of the war, that it is thoroughly sound, and that when the temporary depression has passed, Brazil will again offer a fruitful field for British enterprise, particularly in the direction of engineering.

The excess of Brazil's exports over imports during three recent years was as follows:—

1917	...	£18,500,000
1918	...	£8,350,000
1919	...	£51,900,000

The weight of exports during this period varied, however, but little.

The figures of Brazil's foreign trade during the last six years show the inevitable changes brought about by the war with regard to Brazil's suppliers and buyers.* The following table expresses these changes in percentages:—

Percentage of Brazilian exports purchased by:—

	1913. Per cent.	1917. Per cent.	1919. Per cent.
United Kingdom	15	13	7 (estimated)
Germany	14	—	—
United States	32.5	48.5	42
France	10	13	22
Europe	58	38	48

Percentage of imports into Brazil supplied by:—

	1913. Per cent.	1917. Per cent.	1919. Per cent.
United Kingdom	24.5	19	15 (estimated)
Germany	17	.1	.06
United States	15.5	46	50
France	10	4	3.5
Europe	72	33	25

United States.

These statistics of Brazil's foreign trade show how enormous has been the development of American trade owing to the conditions produced by the war. The advantages which the special position of the United States in the great European struggle produced for her generally in the world's trade have been patent in Brazil. She not only took Germany's place as an exporter to Brazil, but also was able to supply many goods which Brazil formerly purchased from Allied countries, especially from the United Kingdom. American traders would be the first to admit that the exporters in the United States did not understand this market at first. Their inexperience in market conditions led to misunderstandings on the part of the Brazilian importer. But the Americans have applied themselves diligently to this market. They have sent down hosts of commercial travellers, and they have learnt much, and of the trade which they inevitably gained much will be permanent.

Competition to be faced.

The National City Bank of New York has opened branches in Rio de Janeiro and Sao Paulo, as well as elsewhere in Brazil. Other banks have also opened, which have met with difficulties, some in the matter of dealing with Brazilian exchange, and the older banks have had little or nothing to fear from them in this respect, but they have certainly grasped the importance of the purely commercial side of banking in the country, and in this respect seem inclined to imitate the policy of German banks. At the present moment American export trade to the country (as to others) is suffering from the high exchange rate of the dollar. But apart from this, it appears certain that British trade can, if the will exist, soon resume its normal leading position in the import trade of Brazil.

The Japanese are devoting a good deal of attention to Brazil as a market for their goods, but it seems doubtful if Japanese trade will be at all permanent with Brazil.

British goods have always enjoyed such a splendid and well-deserved reputation in Brazil that they may almost be said to have sold themselves. But the specious advantages of cheapness and long credits offered by our German competitors had begun, at the outbreak of the war, to create a position for our own trade that might eventually have become serious.

There are many cases where the Brazilian importer, who would have preferred to purchase a British article which he recognised as far superior and worth more money, was obliged to buy from Germany on account of the immediate advantages which he could obtain by so doing.

The Germans interested themselves, too, in every phase of national industrial expansion. They thus found themselves allied with the powerful industrialist class.

The market is no longer the easy market it used to be. Competition is increasing daily. The Germans started it, and it looks as if the Americans would carry it on. There never was a time when so much care and real hard work were necessary. But the possibilities are enormous, and the establishment of more British firms in the country would enable Great Britain to get her due share not only of import trade, but of handling the increasingly varied export of Brazilian products. The internal development of Brazil daily presents some interesting features and prospects, and it is only by having sufficient people on the spot, acquainted with local conditions, that Great Britain can participate profitably in such development.

Stocks of Goods.

It is high time that British manufacturers should convince themselves of the imperative necessity of having stocks of machinery on the spot. In the past they appear to have refused almost entirely to admit this point of view.

The average customer in Brazil will always buy on the spot, even if the machinery offered is not exactly what he requires, in preference to waiting for some months until his order can be executed.

It is therefore essential that standard types of machinery should be stocked. British houses have lost not inconsiderable business in the past through not having had goods in stock. Gas engines, for instance, are stocked by local Swiss houses for account of the Swiss manufacturers.

These remarks apply to cities like Rio de Janeiro and Sao Paulo, and it can therefore be imagined that they apply even more to such towns as Curityba, Porto Alegre, &c., where the farmers go into the towns at fixed intervals, and want to be able to buy at once such stocks of machinery, agricultural implements, &c., as they require, very often in exchange for their produce.

German stocks of electrical and agricultural machinery in the country enabled them to do a big business for a very long time after the outbreak of war, in spite of the fact that they received no direct supplies from Germany.

The articles which Brazil imports from the United Kingdom cover a very wide range. The importance of the British merchant and commission houses in Brazil in creating and developing that trade has been considerable, and although there seems to be a certain current of feeling which perhaps is not shared by manufacturers at home, that direct trade can and should be done without the aid of commission houses, it seems, nevertheless, that British trade with the country cannot be adequately dealt with and increased except with established firms on the spot. On the other hand, there is undoubtedly plenty of room for new British firms in Brazil, especially firms with technical men on their staff, *i.e.*, engineers and chemists. To supply the evident need for technical men should undoubtedly be the concern of the manufacturer, while the local agent or firm should supply the indispensable local knowledge.

Methods of Trading.

More frequent visits to Brazil should be paid by the heads of firms having dealings with the country. Conditions are changing rapidly. Conversely, frequent visits home should be made by those in charge of British interests in Brazil. Greater encouragement should be given to younger men to devote themselves to the interests of the firms who employ them. A great outcry was raised some time back that new American firms were taking young Britons—and very often such as held responsible positions—from British firms. There was nothing so strange about this. The Americans were prepared to pay better salaries, and offered brighter prospects. It is perhaps just as well to take this opportunity of insisting on the need for good catalogues, printed if possible in Portuguese, while heads of firms should offer every inducement to their employés to learn the language of the country really well.

The British enjoy a far higher commercial reputation than any other foreign people in the country, far higher in fact than many British subjects here realise; and if use could be made of this well-deserved reputation, by adapting sound commercial traditions to the rapidly developing commercial needs and progress of the country, by "speeding up" and by making use of modern methods of advertising, &c., British trade to Brazil will soon occupy the first place which it enjoyed for so many years.

The Brazilian commercial delegates who visited the United Kingdom urged that British banks should, if possible, relax some of their traditional rigidity in Brazil. The scope for purely commercial banking (as done by the Germans) is believed to be increasing daily, and this new aspect will have to be seriously considered.

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* It should be noted that Brazil's export trade to the United States consists almost exclusively of coffee and rubber, to which was added during the war, manganese.

Mineral Resources.

For coal Brazil depends almost entirely on what she imports, and the normal annual importation is nearly 2,000,000 tons. Coal exists in the southern States, especially Rio Grande do Sul, but has never been commercially exploited to any extent.

Iron ore is found abundantly, and with a high percentage of hematite. Various projects are on foot for the development of deposits, and there is every prospect of this becoming one of the most important industries in the country. The iron ore deposits in Minas Geraes alone are said to contain more than 3,000,000,000 tons of mineral, the percentage of metal being estimated to average 50 per cent.

Large quantities of manganese were exported during the war, and the value of 500,000 tons exported in 1917, most of which went to the U.S.A., was just double that exported in 1916. The idea of creating foundries in the country, instead of exporting manganese and iron ore, has taken hold of many leaders of opinion in Brazil. The principal difficulty is, of course, the fact that coal is not found in any quantity near the deposits of ore, nor are the supply and quantity yet assured. The use of coke is suggested, while the advocates of the views mentioned above also maintain that electric smelting is not only possible, but entirely practicable in Brazil. It is admitted that an enormous capital outlay would be essential to such a project in a country of such vast distances as Brazil, but it is suggested that the subsequent possibilities are so vast that the problem deserves the most serious consideration. The Government appointed two Brazilian engineers to investigate the question of the extraction of iron ore and coal, and the Mineralogical Department of the Ministry of Agriculture is also studying the question of hydraulic power for electrical furnaces.

Much attention has been directed recently to the commercial possibilities of petroleum deposits in Brazil—(the States of Bahia, Pernambuco, and specially Alagoas). A great future is claimed for such deposits, and numerous investigations are being made. It is claimed that Brazilian petroleum is purely of animal derivation and contains, therefore, more calories and a much less quantity of sulphur. The petroleum "area" has been estimated at 200,000 kilometres, and the deposits are said to be all close to the sea coast.

THE HEATING OF BURIED CABLES.

Discussion at Leeds.

The first meeting of the 1920-21 session of the North-Midland Centre of the I.E.E. was held at Leeds on December 14th, when the British Electrical and Allied Industries Research Association's report on the above subject, which was abstracted in our issues of December 24th and 31st, was enthusiastically received and discussed. Mr. C. J. Jewell, of Wakefield, chairman of the Centre, presided, and there was a good attendance of members.

Mr. E. B. Wedmore, who represented the B.E.A.I.R.A., presented the report, and in a few words outlined the history of the research of the Association. The present report was an intermediate one, he said, and they had a mass of details much of which was of very great interest in itself, but which might be at present a little difficult to apply. They had not reached the stage where the tables could be put into shape for ready application to particular cases.

Mr. S. W. Melsom summarised the work, the details of which were given in the report. The thermal resistivity of some cables was 1,200 in the units given in the report, others would be as low as 460, the difference between those two values varying by something like 20 or 30 per cent. the actual carrying capacity of the cable. That was a new path which they came upon and which they had stepped aside to follow for a long way. Then the air in a duct, so far as could be seen at present, was inert even when the cable was worn and they had the ends of the duct open. He hoped they would hear something about that matter, because he believed a lot of people thought that the heat did actually go through a cable duct if the ends were left open. The problem thus divided itself, first into a question of cables, and then that of the medium in which it was laid. As a result of the comparison between cables simply laid along the floor of a room in air, which was somewhat similar to the conditions when they had a cable cleated along the wall that was touching one of the sides as a conducting medium, they were able to get a certain factor which they had given as the ratio of the currents required to raise the core of a cable to a given temperature when it was laid in the air and when laid in the ground under various conditions used for laying cables solid in bitumen. The factor ranged from 1.22 to 1.25; for armoured cable direct in ground from 1.21 to 1.22, and for a cable pulled into a duct from 0.95 to 0.98. Thus there was a difference in the current-carrying capacity of a cable laid in the duct as compared with one direct in the ground, or solid in bitumen, of something like 25 per cent. From these factors they drew curves in order to compare their values with other people's values. In figs. 3, 4, and 5 they had drawn their results as compared with the German values. In fig. 3 there was a real difference between curves B and A, which was the German value reduced to the same temperature of the same size of cable and values obtained in curve B; the same thing showed, though not to quite so large an extent, in curves 4 and 5. Regarding the thermal resistivity of the ground, figures which were not included in the report were for bone dry soil, 310; for one containing 5 per cent. of moisture, 180; 10 per cent. of moisture, 120; 15 per cent. of moisture, 90. Thus the difference between 5 and 15 per cent. moisture was comparatively small; they might say that so long as they had something like 10 per cent. moisture in their soil all soils were practically alike. The thermal resistivity was governed almost entirely, as far as they could see at present, by the amount of moisture present. Generally the lowest figure obtained was 8 per cent. of moisture in the soil. What they would regard as a dry soil had something like 7 or 8 per cent. of moisture. The highest figures were obtained by Mr. Fawssett in Newcastle, where they had something like 20 per cent. of moisture in the ground. Fig. 6 gave the actual temperature of the ground at a depth of 2 ft. taken over a period of four years; for each year the highest points and the lowest points were really very near together, and the maximum temperature obtained, probably during August, was 18 deg. C. Dr. Marchant's thick lined curve on the same figure was slightly lower on the peaks, and was not irregular because he took mean values.

Mr. E. Fawssett thought credit should be given to the North-East Coast companies for their public spirit in financing his part of the research. The percentage curves at the top of fig. 7 showed enormous divergence in their general characteristics. Those on or above the thick average lines he thought represented the probable true effect as nearly as he could get it from the determination of the conditions at present known. He thought that the great difference in those characteristics was due to some small change in the relative moisture contents. It was conceivable that after heavy rainfall the moisture from 1 to 4 ft. would vary; actually it did not vary very seriously. Analyses had been made of the extra contents of the soil at certain intervals, but 2 or 3 per cent. would have a big effect when they were looking for small figures. It might be of interest to combine the effects of varying cable depths with the seasonal temperature changes in the soil. The latter changed over twice a year; for instance, in February the soil temperature at 1 ft., taking an average of certain years in Liverpool, was, say, 3 deg. C. At 2 ft. it was 5 or 4.6 deg., that was to say, it got warmer continuously as the depth increased, whereas in August it was the reverse, 17 deg. C. at 1 ft., and 15 deg. C. at 4 ft. Those two conditions of different depths might occur in an average run of cable between one and 4 ft., and taking one particular cable laid direct in the ground they might get 293 A at 1 ft., and a minimum in August at 4 ft. of 215 A, *i.e.*, a difference of 15 per cent. in current-carrying capacity in those two little conditions alone. On the top of that they had to consider the large effect of varying moisture contents, and also the class of soil. That was an illustration of the complexity of the problem of issuing tables for current-carrying capacity without a generous factor of safety. In summer conditions the top layer of earth over a cable was the hottest. What happened to the heat of the cable which could not come up to the top? Those of them with mining experience knew that below a certain layer it became hotter. There was a minimum temperature somewhere in summer which was probably at a point not more than 10 ft. deep. The cable might be laid somewhere in the minimum layer. What happened to the heat that was thrown off in that minimum temperature? As far as he could say, it went sideways. The problem considered from a mathematical point of view was quite other than where the heat came straight up to the surface. They got a condition which would never reach finality of temperature.

Mr. Gilling (Bradford) observed that before any practical results could be shown the physical and economical characteristics of cables in use for long periods of time and under working conditions must be known, and should, therefore, be the first problem to be solved. That work appeared to have been left to the last. The suggestion that the effect on the cable of the nature of the ground should be recognised when laying the cable was very valuable, as it was now evident that in heavily-loaded cables the weakest point was that which they had been accustomed to regard as probably the strongest. The difference in carrying capacity of cables in a duct and underground was also definitely shown. Another item of great interest was the fact that a cable laid 4 ft. deep must be rated lower than if laid 1 ft. deep.

Mr. Cooper thought that the jointing of a long length of cable became rather important as well as the current-carrying factor, and that high pressures would cause a greater rise of temperature than the low ones, not just because of the dielectric, but owing to the pressures. In the tests none of the figures had been taken with the working pressure.

Mr. W. M. Selvey explained that the particular feature of a control experiment was one in which one could choose one's condition, and it must be of such a nature that one could repeat it indefinitely and get reasonably the same result. Mr. Melsom had adopted a control experiment to start with, namely, to lay a cable on the floor, and he controlled some of his variants but not others, such as colour condition of surface. He also omitted any reference, which was of considerable importance, to the temperature of the envelope and the space which considerably affected the radiation. Every question of low temperature was one of radiation and exchange between the envelope and the container. Mr. Melsom did not define in what way this cable rested on the floor or how close it was to others, although he (Mr. Selvey) gathered that he could not use the lead sheaths because the cables were in contact. They could have used a thin sheet of mica which would have kept the cables electrically distinct without interfering with the heat problem. Further, Mr. Melsom did not indicate the kind of floor used, so he, the speaker, suggested that his control experiment was not really an efficient one to start with. The control experiment must be beyond doubt; the only satisfactory control experiment was to suspend cables in air by thin threads which were non-conductors. The final report must be edited by one man; for instance, Mr. Melsom had too many variants. Mr. Fawssett had got the genuine goods, but instead of taking as a basis Mr. Melsom's 2-ft. cable, he took a 1-ft. cable. An enormous amount of work had been done by agricultural experts on the capacity for the absorption of air by soils of different composition; they had much data on that question. What they wanted to investigate was really the condition of a soil which refused to part with more than a certain percentage of its moisture at a certain temperature. Obviously if they laid their cable in perfectly dry sand, which might be a control experiment of the maximum limit of heating, the capacity of the cable would be practically nothing. It was possible to select what they chose to immediately surround their cable with. They could to some extent select as well as treat the soil in such a way as to do two things, first, to minimise the amount of moisture that could be driven off by a certain temperature, and, secondly, to increase the envelope of the cable, to increase the periphery, and thereby diminish the temperature which came into contact with the soil.

Mr. French pointed out that there seemed to be a discrepancy as far as he could read the tables or the curves between the figures of the N.P.L. and those given by Prof. Marchant; in one case they had a fall, and in the other a rise of temperature. He agreed with Mr. Selvey that it would be beneficial if one man edited the report; at present the reading of the report was extremely difficult. He missed any definite practical statement of what could be expected from a cable under certain conditions of loading per unit surface radiation; the tests, so far as he could see, gave no conclusion whatsoever as regarded the thermal time constant of a cable. He would have thought that it would have been a very simple matter to do so.

In replying to the discussion, Mr. S. W. Melsom agreed fully with Mr. Gilling and other speakers on the question of deterioration. With regard to the question of adjacent cables, they would very shortly be in a position to give further information. It would never be possible to give a certain figure for the current to which a cable should be loaded. The man who had to consider the figure which he would use had to remember that there would be certain factors which could not be defined in two or three figures, but the figures would have to be given for a condition with a statement of what variable factors would affect them. The cable engineer would have to use his own brains and see how far those conditions were affecting his own practice. Other countries had issued a load curve for cables; those curves were wrong, because sufficient attention had not been given to the variable factors. Dealing with Mr. Selvey's remarks, he pointed out that the floor on which the cables were laid was a wooden floor, and in general they were laid as they would be laid on the ground. The heating from the adjacent cables did not affect the result. The best measure of the suitability of a particular experiment as a control experiment was whether it could be reproduced. On those cables they were able to reproduce the results when laid along the floor with a remarkable degree of accuracy. The experiments required a high degree of skill; with the best will in the world, but without the proper laboratory craft, no one would be able to reproduce them. Mr. Selvey had questioned the validity of the fair statement of Russell's formula for calculating the thermal resistivity of multi-core cables. Russell's formula was based largely on a formula evolved by a German named Moewe; they had had that formula examined by an eminent mathematician, and he pronounced it to be valid. They had made arrangements to check it experimentally.

ELECTRICITY DISTRICT SCHEMES.

By HENRY M. SAYERS, M.I.E.E.

Schemes for the improvement of the existing organisations for the supply of electricity in some of the districts provisionally determined by the Electricity Commissioners have been prepared.* The Electrical Review has published an abstract of that for the Lower Severn District, which has been prepared by a committee representative of the municipal authorities in the district, and in this issue appears an abstract of a scheme for the North Wales and Chester Electricity District prepared by the Corporation of Chester. This had not, at the date upon which it had to be submitted to the Commissioners been considered by the other local authorities and undertakers concerned. The Lower Severn scheme, which one may fairly call the Bristol scheme, has, however, been discussed at meetings and by correspondence between some of the parties, and is to that indefinite extent an agreed scheme. The Chester scheme is not a formally agreed one, though it shows signs of consultation with other bodies in the course of preparation.

It may be noticed that other schemes than those published may have been prepared and submitted to the Commissioners, since it is open to quite a large variety of associations and bodies within the districts to prepare and submit a scheme. The words of the 1919 Act (Section 5 (2)) are so elastic that it is difficult to say that anyone is specifically excluded from the privilege, and until the opening of the inquiry in each case, when presumably an announcement will be made, only the Commissioners can know with certainty what schemes have been submitted, and who is responsible for each. Hence it must not be assumed that no other schemes will be put forward for inquiry than those published; or that the Commissioners will approve of either of these. The Commissioners are at liberty to disapprove of any scheme or schemes, and may (but not must) themselves formulate such a scheme. Hence the two schemes herein considered cannot be taken as examples of the schemes likely to be approved; they may be or may not be, that remains to be seen. At present they are examples of what the bodies which have prepared them consider desirable, and consistent with the very wide provisions of the Electricity (Supply) Act, 1919. Only after one or two of the earlier inquiries have been held and approved schemes promulgated will it be possible to judge what kind of organisation will be favoured by the Commissioners, who may not improbably use their discretion with more regard to the conditions in each district than rigid adherence to a particular model scheme. This latitude is a good point in the Act.

The Commissioners issued a memorandum setting out that schemes submitted should contain proposals for the technical, administrative, and financial organisation to be adopted, and with regard to the technical scheme some estimate should be made of the future demands for electrical energy which the scheme will have to meet. Seeing that the primary object of any scheme is to provide "a cheap and abundant supply of electricity" throughout the district, which shall be an improvement on the existing supply, it appears that the technical features of the scheme must be the core and substance of the whole thing. The administrative and financial organisations can only be judged of by their apparent capacity and suitability for the execution of the technical scheme. To design an administration with certain financial powers without giving an outline of the work it is to accomplish seems rather lacking in meaning. It is difficult to imagine that the Commissioners will make orders giving effect to such incomplete schemes. They will, one supposes, even if they find it proper to adopt the other parts, lock on to them a technical scheme, that is, they will not set up a machine without saying what work it has to do, and seeing that it is reasonably fit to do it.

It is, therefore, surprising to find that the Lower Severn scheme (called "Bristol" for short hereafter) has no technical side at all. Whether any work has been done on that side, statements and estimates prepared of the present condition of electrical supply, of future requirements (and the means of meeting them), plans for extension and cheapening of supply, does not appear from the documents published. From what has transpired of the discussions between the bodies interested it seems that those who prepared the scheme consider it premature to go into these questions. Unless they are seriously misrepresented, they think that the machine should be set up first, and that after that has been accomplished it may be decided what it shall set itself to do. This seems to be a somewhat topsy-turvy way of going to work.

The Chester scheme is based on what seems to be the right principle. It includes statistics of the existing supply undertakings, their plant capacities, maximum loads, and annual sales, a statement of the potentialities of the district, with a list of the principal industrial centres, and estimates of the demands at three future periods of development in each area, which forecast triples the present demand and consumption of electrical energy; and proposals for the erection and equipment of three large generating stations, two of which will utilise proved water powers. The main transmission lines and the location of sub-stations are listed, and estimates of capital expenditure, income, and working expenditure, set out for the three future periods of development. The costs of the existing stations are tabulated, and suggestions made about which of these should be developed, and which should be disused as the bulk supply system becomes available. This is surely the way the work should be done. Although the scheme is that of the Chester Corporation, it is clear that in the preparation of the technical part there has been hearty co-operation of the other undertakers and local authorities, and every consideration given to the requirements and interests of all parts of the district. The work to be done by the Joint Electricity Authority is set out. The constitution and financial powers of that authority can, therefore, be judged with reference to the programme proposed.

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* Dec. 24th, p. 224 and Jan. 7th, p. 11.

To criticise this programme usefully would require about as much time and knowledge of the local conditions as has gone to the making of it. No doubt those interested will have something to say at the inquiry, but they will go to the inquiry with previous knowledge of what has to be discussed and, therefore, prepared to amend it if it seems faulty. The estimates of cost per unit sold, it is interesting to notice, show a very material saving on the present costs from the existing stations. This is a very satisfactory feature, showing that in the opinion of those who prepared the scheme, the objects of the 1919 Act can be realised.

As the Bristol scheme contains no technical section, no comparison of the two is possible. This is to be regretted, because the Lower Severn District, from its diversity of industrial and social conditions, is one for which a reasoned forecast of electrical development should be particularly interesting, all the more so because it includes the Hereford area of supply, in which so much has been done to encourage agricultural and rural demands.

As regards the constitution of the Joint Authority both the Bristol and the Chester schemes follow the wording of Section 6 of the Act in general concerning the interests to be represented, but they both overlook a point in that wording which is of importance. The Act says that a scheme may provide for the establishment "of a Joint Electricity Authority representative of authorised undertakers within the electricity district, *either with or without* the addition of representatives of the Council of any county situate wholly or partly within the electricity district, local authorities, large consumers of electricity, and other interests within the electricity district." The essential element to be represented is the authorised undertakers. A Joint Authority may be set up either with or without representatives of other interests. It is arguable, therefore, that all the authorised undertakers are entitled to representation, to the extent at least of having voting power in the election of members of the authority. The Bristol scheme proposes that the authority shall consist of representatives of "any or all" of the authorised undertakers, which clearly admits of some undertakers having no representation. The Chester scheme defines authorised undertakers in such a way as to exclude any undertakers who have not at the time of the scheme coming into operation expended at least £30,000 on their undertaking. It may be expected that the Commissioners will read the Act as obliging them to give every authorised undertaker some representation on the authority, though not necessarily a representative.

The Chester scheme sets out a very elaborate "constitution" for the Joint Authority. The members are to be elected by classes of constituent authorities, each of which constituents may vote only for representatives for its own class. The voting power is defined in "units," of £1,000 rateable value, £1,000 capital expenditure, and the consumption of 25,000 electrical units per annum, for the cases of local authorities, authorised undertakers, and large consumers respectively, but any constituent authority having a rateable value of £200,000, any authorised undertaker having a capital expenditure of £200,000, and any large consumer with a consumption of five million units will be entitled to appoint one representative on the authority for each such block of rateable value, capital expended, or consumption.

There is an optional element, or rather a double option in this constitution which, if approved, will give the scheme a voluntary character. In the first place, any body qualified for representation may become a constituent member of the Joint Authority by giving four weeks' notice before the date of the first election. In the case of a local authority which is not an authorised undertaker this notice is to state that it accepts "financial responsibility" in proportion to its rateable value. In the second place, after the scheme is sanctioned each constituent authority is to enter into an agreement under seal with the Joint Authority binding itself to the provisions of the scheme.

It may be doubted whether these voluntary features will survive the scrutiny of the Commissioners; local authorities cannot at present bind themselves to "financial responsibility." The original 1919 Bill, and the two 1920 Bills, proposed to give them certain powers to lend money and give guarantees to Joint Authorities, but those provisions are not yet law, now did they sanction so general an assumption of responsibility. Under the Act a scheme has to be approved by the Commissioners, the Minister, and both Houses of Parliament, and when made effective by such triple approval, it will be law. It is unlikely that it will be permitted to any authorised undertaker or important local authority to remain outside, or to come within, the jurisdiction of the Joint Authority, of its own choice. It would be particularly awkward that any authorised undertakers should be within the area of the Joint Authority, and yet without its legal jurisdiction. Possibly some option may be given to the smaller local authorities, large consumers, and other interests, but it will probably take the form of a right to representation on the Joint Authority if they choose to fulfil certain conditions. But as regards authorised undertakers it seems in accordance with the objects of the Act to make the scheme compulsory, which implies the right to representation on the Joint Authority.

Perhaps these voluntary provisions in the Chester scheme are consequences of its preparation by one authority only, which did not like to suggest compulsion of its neighbours. The Bristol scheme also contains provisions for allocating voting power in proportion to units sold in the area of each constituent, whether authorised undertaker or local authority (so that it seems that in the case of a company, both the company and the local authority of the area will get voting power from the same "units sold"), excepting that the County Councils jointly will have a right to appoint three members, these County Council members will have no voting power unless and until the Council or Councils appointing them assume "commensurate financial responsibility." The Bristol scheme does not propose to confer voting power on local authorities on a rateable value basis, in which point it seems more logical than the Chester scheme. The unit voting power is to be 50,000 units sold; this holds up to 500,000 units, which gives ten votes, and, thereafter, there is a sliding scale terminating with one vote per 100,000 units for sales above 2,500,000 units annually. Constituents of the same class may pool their votes, and no single body or pool may be entitled to exercise voting power in excess of 45 per cent. of the votes held by all other bodies. Quite a nice examination question in simple equations to say what maximum percentage of the whole voting power may be exercised by one body. Curiously, the Chester scheme also uses the figure of 45 per cent. as the limit of the proportion of the total number of representatives on the Joint Authority which may be appointed by one constituent. But the result is quite different in the two cases. The Bristol scheme proposes to limit the membership of the Joint Authority to 30. The Chester scheme mentions no number. This will certainly have to be inserted in any approved scheme. The Bristol scheme does not define how "large consumers'" representation is to be allotted, an omission which will require to be made good.

Turning to the duties of the authority, both schemes agree in adopting generally the wording of the 1919 Act, in which they can hardly be criticised, since Parliament has settled them. The Bristol scheme, containing no technical programme, quite consistently embodies no special powers for carrying out such work, the Chester scheme with equal logic embodies powers to construct generating stations, transmission lines, and distributing systems. But it may be said that as the statutory duties of Joint Authorities imply the possession and exercise of these powers, the Commissioners will doubtless see that approved schemes impose the duties and confer the necessary powers. The duties of bulk supply to authorised undertakers and others and the powers of control over authorised undertakers in respect of generation will need to be set out in more detail, so that every authorised undertaker and the Joint Authority will be made aware of their respective rights and duties. However, the Act gives the Commissioners powers, not only in making the scheme orders, but afterwards to supervise the proceedings of the bodies concerned, and will no doubt insert sufficiently definite clauses in approved schemes.

As regards prices for bulk supply, the Chester scheme proposes that the Joint Authority may charge higher rates in districts where the undertaker or the local authority did not become a constituent authority, a curious kind of moral suasion. But it may be doubted whether such holding back will be permitted as above stated.

With respect to financial powers, both schemes propose that the Joint Authority may have power to raise money by the issue of stock, bills, bonds, or temporary loans, in language familiar in local authority Acts. It may be noted that the 1919 Act does not specifically say that Joint Authorities may be endowed with such financial powers. They may be held to be included in the very wide terms "and the scheme may contain any consequential, incidental, and supplemental provisions which appear to be expedient or proper for the purpose of the scheme," but it is not usual for financial powers to be granted to a statutory corporation in such terms, and it is a question whether the Commissioners will be advised that such powers can be given under the 1919 Act. In this connection it is significant that both the amending Bills introduced (and withdrawn) during the session of 1920 contained clauses permitting the Commissioners to confer specific borrowing and consequential powers on Joint Authorities; and it is anticipated that the Government will endeavour to pass the No. 2 Bill of 1920 at an early period of next session.

Whilst this question of financial powers is in a doubtful phase, it is perhaps futile to comment on the two schemes under discussion. They will, in any approved form necessarily conform to whatever statutory provisions may be in force.

Both schemes propose to empower the Joint Authority to levy a deficiency rate upon the constituent authorities, which may be met—in the case of local authorities—out of rate provided funds. It is perhaps hardly necessary to say that to carry out this proposal the local authorities will require statutory authority, and that legislation to this end will not be popular. The Commissioners cannot impose this obligation on local authorities as the law stands at present. But as a condition in any agreement or contract for bulk supply it seems permissible to include liability to a contribution to make up a deficiency in the revenue accounts of the Joint Authority, based on the proportion of the whole supply taken by each consumer. This would not come directly from the rates, in the case of a local authority undertaker, though it might eventually be borne by them. Under present conditions it may be surmised that any direct or indirect call upon the rates by Joint Electricity Authorities will be given, if at all, with great reluctance, and under severe limitations and regulations.

This criticism of the two schemes is necessarily incomplete. The task of drafting the pioneer schemes, with the very scanty detail afforded by the 1919 Act, and the memorandum of the Commissioners which leaves a great deal of freedom to the draftsman is a somewhat delicate one. It is a duty imposed upon no one in particular, so that considerable credit is due to those who took up the task. They have at least given some assistance to the Commissioners by showing what some of the interested parties consider schemes should cover. It would have been better if schemes had been prepared with the general agreement of all the authorised undertakers in a district, but this is a good deal to expect.

Of the two schemes considered, one inclines to think that of Chester the better. It embodies a practical programme, it offers to authorised undertakers and consumers definite benefits and inducements to support it. The Bristol scheme is unfortunate in the omission of such features. No one can read it through and say that it promises any assistance to any class. No doubt those who prepared it thought it better to leave future plans to the deliberations of the authority after it has been set up. It is doubtful whether the Commissioners will agree, or will think that the Lower Severn Scheme gives them all the assistance they had a right to expect.

But seeing that the whole work, in all cases, has been voluntary, and of considerable magnitude, the Commissioners and the supply industry generally will recognise their obligations to those who have blazed the trail. No doubt in a few months there will be a set of standardised clauses which will become common form. Then the essential technical programme which must vary with every district, will get its due attention as the important feature of any scheme

A JOINT ELECTRICITY AUTHORITY.

The Chester and North Wales Scheme.

We abstract below the scheme which has been submitted by the Chester Corporation for the formation of a Joint Electricity Authority for the provisionally delimited North Wales and Chester Electricity District.* A criticism of the scheme appears above, and following our usual practice we only deal hereunder with those points whereon the scheme differs from those of which outlines have already been published.† We shall, therefore, confine our remarks to the technical portions of the scheme, in which it is pointed out that the district embraces an area made up of extreme geographical conditions, parts of which are comparatively densely populated, and parts sparsely inhabited. There are large tracks of rich agricultural land, considerable undeveloped minerals, extensive coalfields and other natural materials required for daily use and a large expanse of mountainous country with a considerable amount of water power; in fact, the district contains the natural resources and facilities for the development of valuable industries of great national importance and value.

The system of supply proposed will be of 3 phase, 50 periods, 66,000 V, and 33,000 V by main overhead transmission lines of 0.1 sq. in. and 0.2 sq. in. section, and local secondary transmission at 3 phase, 50 periods, 6,600 V. It is proposed that a steam generating station shall be erected on the estuary of the river Dee, where there are facilities for a station capable of developing 150,000 kWh, and that the water power resources in the district, estimated as capable of providing 200,000,000 units per annum, shall be utilised as required.

At present there are in operation in the district, giving a public supply, 20 generating stations, of which it is suggested to discard, when a bulk supply is available on satisfactory terms, 18 stations, including the existing steam station at Chester, nine of which are owned by local authorities and nine by companies. The following hydro-electric stations will be retained, of which those having suitable facilities for extension will be enlarged when the demand for electricity makes such a course necessary: North Wales Power Co.'s Cwm Dyli and Dolgarrog, Yale, and Chester stations.

As the demand for electricity arises new hydro-electric stations can be constructed at Dolgarrog, Maen-twrog, on the river Dee, between Llangollen and Erbistock, various small hydro-electric stations for isolated areas, and a steam station on the estuary of the Dee. It is not proposed to ask the Ministry of Transport to construct any of the foregoing works.

Having regard to the exceptional circumstances existing in this district for the generation of cheap electrical energy, it is suggested that the Ministry of Transport's attention should be especially drawn to the particular advantage in this district regarding main line electrification of railways.

Although it is stated that the estuary of the Dee offers facilities for a steam generating station of a capacity of 150,000 kW, and for hydro-electric installations to give 200,000,000 units per annum, it is not intended to convey that these developments would exhaust the resources of the district for the generation of electricity by natural sources of power; the instances referred to merely embrace propositions which have been carefully investigated. There is little doubt that there are other resources from which a considerable additional quantity of electricity could be economically produced. The southern part of the North Wales and Chester district will in all probability be electrically isolated for a considerable time from the northern and western parts, but as it contains many small water power resources there is every prospect on a detailed examination of the conditions of showing that practically all the townships in the southern section can be supplied from hydro-electric developments. The existing plant in the district had a total capacity in 1920 of 19,813 kW, the maximum demand being 13,425 kW and the output 42,227,713 units.

The area includes extensive coal mines, granite, limestone and slate quarries of importance, and the richest lead ore district in the country. At the present time several new industries are being set up, and had a supply of electrical energy been available, there is no doubt that extensive developments would now have been in hand. It is not anticipated that extensive electric traction will develop, other than the electrification of railways, but when electricity supply is available, electric power will rapidly supersede the oil and other engines now in use for agricultural purposes. Given a cheap and efficient system of supply great calls will be made for electricity for domestic purposes, especially in the seaside and other holiday resorts.

The demand for electricity for the foregoing requirements is estimated as follows:—Immediate requirements and first period of development, 36,900 kW demand and 76,250,000 units per annum; second period, 51,200 kW and 109,000,000 units; and third period, 64,300 kW and 135,650,000 units.

The steam station which it is proposed to erect on the estuary of the Dee will in the first instance contain the necessary apparatus for two 5,000-kW turbo generators, comprising water-tube boilers for a working pressure of 250 lb. per sq. in., mechanical stokers, steam superheaters capable of giving 150 deg. F. superheat, feed water economisers, steel chimneys and induced draught, overhead coal bunkers, coal and ash handling plant, surface condensing plant arranged to take water from the river Dee, and three-phase, 50-periods, 6,600-V alternators direct coupled to the turbines. A suitable switchboard to control the generators, and local secondary transmission for the supply of the district within eight miles radius of the generating station, and e.h.p. switch gear and transformers to step-up from 6,600 to 33,000 V, for the control of the main transmission lines. Each unit is to be self-contained, with its condensing plant, battery of boilers, &c. Such an installation operating at 35 per cent. load factor would produce 15,000,000 units per annum.

A complete report on the development of low-fall water power on the river Dee was prepared for the Board of Agriculture and Fisheries, and dated April 16th, 1919. [Elec. Rev., May 30th, 1919, p. 647.] For the purpose of this scheme it is proposed to utilise the section of the river Dee between Llangollen and Erbistock, where there are facilities for the erection of 12 low-fall water-power stations, and the formation of dams and waterways to produce heads of water varying from 9 to 37 ft. Each installation would consist of two water turbines coupled to two d.c. generators in series, the installations being arranged on the Thury system, and the electricity generated at the installations transmitted to a central converting station where it would be converted to a.c., 3 phase, 50 periods, 440 V, and by step-up transformers to 33,000 V for main transmission. The 12 stations would provide 50,052,000 units per annum.

A description of five other proposed hydro-electric installations will probably be submitted by the North Wales Power Co. In the Vale of Clwyd there are water power resources and in a single instance the erection of a dam 50 ft. high, and the use of plant capable of developing 1,000 kW would generate approximately 3,000,000 units per annum, which would be sufficient for the requirements of the valley from Denbigh to Rhyl for some time. The existing overhead main transmission lines owned by the North Wales Power Co. total 70 miles in length, but the immediate requirements of the first period of development are 230 miles of line; second period, 73 miles; and third period, 50 miles, with 18 sub-stations on the transmission lines.

In conclusion, financial statistics, together with figures of the fuel cost and consumption of the existing undertakings in the district, are set out. The draft scheme is signed by Mr. S. E. Britton, city electrical engineer, and the town clerk, Chester.

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* Elec. Rev., July 23rd, 1920, p. 107.

† Elec. Rev., December 24th, 1920, p. 809, and January 7th, 1921, pp. 4 and 10.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Subter" Bell and Relay.

The Home Office requirements with regard to bells and bell circuits for use in mines are: (*a*) That the e.m.f. of the battery used in bare wire signalling must not exceed 25 volts; (*b*) That any bell or relay used for bare wire signalling must be capable of standing 25 volts without giving rise to a dangerous flash on the bare wires at the point of break; and (*c*) That even though the normal working pressure of the bell or relay may be low (say, 10 volts), it must still comply with condition (*b*). To fulfil these requirements Messrs. Sterling Telephone & Electric Co., Ltd., Telephone House, 210-212, Tottenham Court Road, W. 1, have produced their "Subter" bell and relay (figs. 1 and 2). The bell is fitted with parallel-wound coils, in a gas- and water-tight case with a broad machined joint. All live parts are carefully insulated from the case, and the cover is fitted by means of key-headed screws, which cannot be entirely removed, and which can be sealed by a wire. The "Subter" relay has a case similar to that of the bell, and the screws may be sealed in the same manner. Three standardised resistances (20, 100, and 500 ohms) are supplied, but special winding is provided for large orders if necessary.

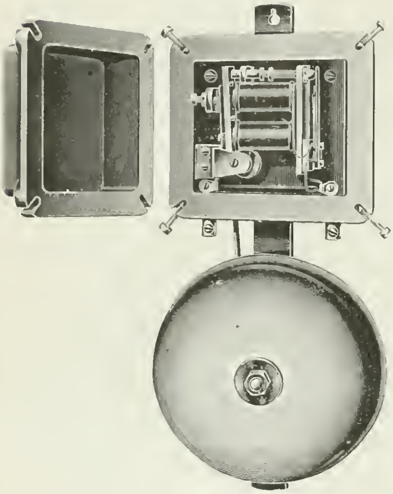
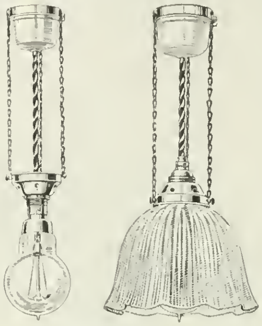


Fig. 1.—The "Subter" Safety Bell.



Figs. 3 and 4—A "Half-watt" Safety Cage.

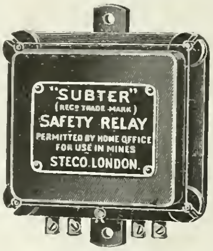


Fig. 2.—The "Subter" Safety Relay.

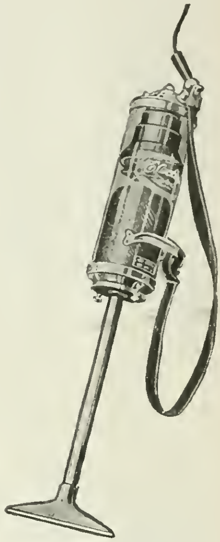
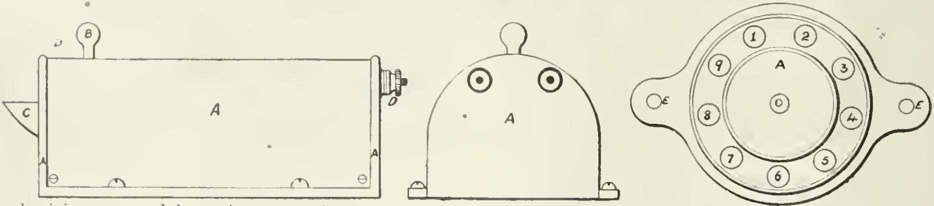


Fig. 7.—The "Electrolux" Suction Cleaner.



A, aluminium case and front plate; B, mechanical knob; C, brass tip; D, terminals; E, bolt holes. 1 to 9, press-buttons.

Figs. 5 and 6.—An Electrical Combination Latch.

A "Half-watt" Safety Cage.

To meet the growing demand, which has sprung up since the introduction of the "half-watt" type of lamp, for a means of supporting the fittings and reflectors which have become a part of the methods of illumination by these lamps, Mr. W. Broadbent, 11, Wellington Street, Moss Side, Manchester, has introduced a safety cage for attachment to existing ceiling roses. As will be seen from the illustrations (figs. 3 and 4), the device consists of a ceiling rose clamp, three chains, and a heat deflector fitting over the lamp-holder. In fixing, the screws of the ceiling rose are loosened and three lugs on the clamp are fitted between the wood block and base. The clamp is then closed and the ceiling rose screwed up. Fig. 3 shows the fitting applied to a lamp only, and fig. 4 illustrates the heat deflector reversed to fit a 2¼-in. share.

A Keyless Electro-mechanical Latch.

Messrs. Christie & Metcalfe, of 4, Verdun Terrace, Ballygomartin Road, Belfast, have devised an electro-mechanical latch and combination switch, which is illustrated in figs. 5 and 6. The latch is electrically operated by means of a specially designed combination switch, so that no keys are required. Connections, or combinations of connections, are made on the switch, and only those who know the "set," can operate the latch. Any desired combination can be "set" in a few seconds, and can be changed at pleasure without using the same set twice. A burglar alarm attachment can also be incorporated with this switch so that anyone who does not know the latch combination, on tampering with the switch, immediately gives the alarm. A series of these latches can be operated by one controlling or master switch, installed in any desired position. Both devices are neat in appearance, and have been thoroughly tested; they are made in various sizes, and to suit voltages from 100 to 500. For individual use, these appliances are suitable for hotels, private offices, strong rooms, store rooms, jewellery show cases, &c. Where a number of doors are required to be opened instantaneously, the latches are specially applicable. The inventors, from whom further particulars can be obtained, have applied for a patent.

The "Electrolux" Suction Cleaner.

A number of departures from the usual lines of electric vacuum cleaners are embodied in the "Electrolux" cleaner, sold by the "Z" Electric Lamp & Supplies Co., Ltd., 73, Newman Street, W. 1. This is a very compact device, as will be seen from the illustration (fig. 7). The dust-bag is inside the casing—a very convenient arrangement, and the motor is fitted at the top. When being used for purposes other than floor or carpet cleaning the container and motor can be slung by means of a strap across the shoulder, giving great adaptability and ease of employment.

The ⅙-h.p. motor has a normal speed of 8,000 r.p.m., giving a working suction equivalent to 16 in. water gauge. The "Electrolux" is manufactured in Stockholm and the "Z" Co. hold the agency for the British Empire.

Correction.—In our note on Messrs. Henley's distribution pillar, on p. 31 of our last issue, the example illustrated was inadvertently described as a "3-phase, 4-wire" type. This should have been "d.c., 3-wire."

REVIEWS.

Electric Switch and Controlling Gear. By C. C. Garrard, Ph.D., M.I.E.E., A.Am.I.E.E. Second edition. Pp. 654 +xxii; 529 figs. London: Benn Brothers. Price 25s. net.

Dr. Garrard needs no introduction to our readers, since for many years he has been recognised as one of the leading authorities on all matters relating to the control of electricity, and the success which has attended his book on switchgear is testified to by the early appearance of a second edition of the work.

In the preface to the new edition the author states that, while the book has been revised and enlarged to a certain extent, no considerable alteration has been made. This statement, while quite correct, does not adequately convey to the reader the great pains which have been taken to keep the book thoroughly up-to-date. On comparing the first edition with the one at present under notice, we find that many entirely new diagrams have been introduced, and in other cases diagrams of certain types of apparatus have been replaced by diagrams of newer or more interesting patterns. Improvements of this nature are noticeable throughout the work, but more particularly in the section dealing with the prevention of dangerous conditions of current and in that dealing with the starting and control of motors.

Perhaps the most noteworthy of the new sections of the book is that dealing with contactor types of gear for use in controlling motors working on heavy service. This section includes an account of the contactor itself (in which types for use on direct, alternating and high-pressure circuits are described), together with information concerning the relays necessary to ensure that the contactors are operated in the correct sequence and with the correct time intervals. It is a section dealing with a subject of increasing importance, and will doubtless be added to in future editions.

Rules and regulations (so far as they concern switchgear) issued by various associations formed an important part of the first edition, and these have been brought up to date and increased in number, the most noteworthy addition being concerned with regulations regarding the equipment of ships; references are also given to such of the publications of the British Engineering Standards Association as relate to the subject matter of the book.

The number of appliances described in the book is indeed legion, and one must feel a deep sympathy with the engineer of a large system called upon to decide the best mode of protection of his plant against the many possible sources of disturbance which may arise. He must look forward to the day when more experience has been gained and matters have become more standardised.

The book should be looked upon as a standard work, and no engineer concerned with the design, manufacture, installation, or operation of electrical plant can afford to dispense with its aid. The printing and diagrams are excellent, and, considering the bulk of the volume, the price is most moderate.

Tramway Motorman's Handbook. By W. S. Ibbetson, B.Sc., A.M.I.E.E. Pp. 208; 47 figs. London: E. & F. N. Spon, Ltd. Price 6s. 6d. net.

The author has made a praiseworthy endeavour to put a mental stepladder into the grasp of men who, almost universally, are trained (and evidently regarded) as machines. The control gear of the modern tramway car, elaborate as it is, does its complicated work by the mere turning of a handle.

Most tramway managers, and the majority of motormen, quite lose sight of the many and far-reaching economies in the use of power, but more particularly in the tremendously reduced maintenance costs of overhead line, of track-work, and, above all, of car equipment, which might be attained by intelligent and discriminating operators of that simple handle. The title chosen hardly denotes the scope of this little work, as repair men, and, indeed, all classes of practical tramway workers are catered for.

The first chapter is introductory, and explains the everyday terms used in electrical work; Ohm's Law is given, and examples of its use are shown. Definitions of the simpler mechanical units are also included. There is no use made of mathematics.

Chapter II describes briefly the "Distribution of Power," mainly by the single trolley-wire system; Chapter III deals with "Rolling Stock and Car Equipment," and, bearing in mind the scope of the book, covers the subject well. In Chapter IV a brief description of a tramway motor, treating its component parts and their uses separately, is given. Shunt, compound, and series motors are compared, and the advantages of the latter type for traction work stated.

Chapter V handles "Brakes and their Operation." The hand, air, and magnetically-operated types are, in turn, considered. An explanation of "regenerative control," and a large number of useful "don'ts," and "what-to-dos" are also included in this instructive chapter.

"The Controller" claims Chapter VI, and vies with the previous subject in elaboration. This is as it should be. A motorman's chief concern is the operation of controller and brake. Two standard controllers, of well-known makes, are illustrated, and complete connection diagrams given. The diagram on page 150, being full page, is clear enough, but that on page 158 will not be traced through by many, being entirely too small.

Chapter VII is devoted to "Faults." The author cogitates on the proper boundaries of a motorman's sphere in the realms of "trouble shooting," and his opinion is that a properly trained man will locate and remedy minor faults, thus saving much time, whereas the untrained type, "rushing in where angels fear to tread," will make more trouble still. However, this chapter will doubtless find many readers (and beneficiaries), who are repair-men, and the carefully tabulated lists of faults, their effects, location, and remedies, on overhead equipment, and every species of apparatus on a car, will no doubt be found of use in many a depôt.

A seven-page, carefully prepared, index completes the book.

There are a number of errors—some typographical. Paragraph 7: Final equation should be:—

$V = 12.5 \times 4$. Pressure $= 50$ volts.

Paragraph 22: The kilowatt-hour is described as "the energy transformed in a circuit. . . ." "Consumed" would be a more fitting word than "transformed."

Paragraphs 20 to 23 and 45: The author should make it perfectly clear that his formulæ and examples refer only to direct current work. Some of his readers *may* handle three-phase motors in repair shops.

Paragraph 33: The definition given of "torque," would describe better the "tractive effort of a car." Also torque expressed in "pound-feet," and the unit of work given as the "foot-pound" on the same page, are sure to lead to misconceptions. It should have been explained that torque is a twisting effort, and that a convenient unit is "a force of one pound-weight acting at right angles to a radius arm one foot in length."

Paragraph 126, page 74, third line: "Tapings" should evidently read "tappings."

There is a tendency throughout the book towards the use of loose phraseology. One example is the constant use of the word "auto," when "automatic switch" is spoken of. There is enough slovenliness in the use of technical terms without its being encouraged by writers, who are expected to know better, and who should remember that a great many of their readers will model their habits according to those of their favourite instructors.

Working Diagrams of Valve Amplifying Receiver Circuits. Arranged by H. W. Sullivan. Pp. 24; figs. 21. London: H. W. Sullivan. Price 1s. net.

Sullivan instruments have long been noted for their excellence of manufacture and finish. This applies no less to their wireless instruments for experimental work. Mr. H. W. Sullivan has now produced a brochure of working diagrams for use with the component wireless instruments produced by his firm. The booklet contains 21 excellently prepared drawings of single and multi-stage circuits for use as wireless receivers. In each drawing the condensers, inductances, and other component parts are numbered, and will be found in Mr. Sullivan's new catalogue of wireless instruments. Moreover, this enterprising firm provides a standard experimental valve receiver panel with all the necessary component parts fitted, so that by connecting up these parts in different ways nearly all the circuits in the booklet may be tried out, and many other additional circuits not actually given in the brochure. The list of items on the panel includes two variometer condensers, one reaction coupling coil, a series-parallel switch, filament rheostat, grid potentiometer, two iron-core valve transformers, two grid leaks, and two anode resistances, three valve holders, one radio-frequency inter-valve transformer, one variable tapping switch, blocking condensers, and other useful parts. Such a panel is ideal for experimental work and for use in schools, technical colleges, and other places where they teach and learn. Why no firm has previously had the push and go to place such an extremely useful arrangement on the market is almost beyond comprehension. Perhaps experimentalists have preferred "made-up" radio sets. There is no doubt that some wireless experimenters have no greater ambition than to turn the handles of a completed set, and simply listen to signals. Such men contribute nothing to the art and learn practically nothing themselves. Only by trying out innumerable circuits can they hope to gain the necessary experience in their subject. The man who buys a ready-made wireless set is no more entitled to be called an experimenter than a barrel-organ grinder—also a handle-turner is deserving of being called a composer. Anything which will encourage the experimentalist to learn the ins and outs of valve work is doing splendid service. There is absolutely no reason why inventions in radio-telegraphy and telephony should all be produced by a clique of professional men. Given a panel of instruments which can be connected in an infinite variety of ways, any experimentalist is capable of doing valuable work. Mr. Sullivan's combination of instruments is ideal for the purpose. Some experimental men, including some of the professional class, seem to prefer to use old coils and scrap pieces of roughly-made apparatus. Although such apparatus can be effectively used in skilled hands, yet time is always wasted, instruments are frequently damaged, and wrong or misleading results obtained. With a well-made set of component parts, the best results may be relied upon.

The diagrams in the brochure are beyond reproach from a technical point of view, and are essentially practical. They cover ordinary valve detector circuits, retroactive circuits, C.W. receivers, valve circuits using a crystal as detector, two-stage receivers, resistance amplifiers, and representative circuits employing up to three valves.

The booklet as a whole is a very commendable one, and reflects credit on its compiler. It is a praiseworthy attempt to make the "experimenter" experiment.—John Scott-Taggart.

Electric Lighting for Cycles and Motor Cycles. By Harold H. U. Cross. Pp. viii+124; figs. 50. London: E. and F. N. Spon, Ltd. Price 3s. 6d. net.

As the Cycle and Motor Show lately held at Olympia revealed, there can be no question as to the increasing popularity of electric lighting both for pedal and motor cycles, so that this new work—the author of which, Mr. Harold H. U. Cross, is well known in connection with handbooks of this kind—should enjoy a wide popularity. In accordance with its sub-title, "A Simply-written Handbook on the Construction, Maintenance, and Repair of Dry Batteries, Accumulators, and Dynamo Outfits," the little volume is couched in language which should be easily understood by the veriest novice in electrical matters, a series of 50 well-chosen illustrations assisting the reader to grasp the meaning of the text.

In the first chapter the author sets out the essential electrical facts in everyday terms, and once these are mastered by riders the remainder of the book should be easily assimilated. Thus the subsequent chapters deal with dry batteries, accumulators, and small dynamos, a number of the principal lighting outfits on the market being afterwards described. Briefly, it may be stated that the possession of a copy of the new work should enable the cyclist or motor cyclist whose machine is fitted with an electric lighting set to keep it in good working condition with a minimum of trouble, and enable him quickly to locate and remedy any small defects which may develop. The book should also prove useful to cycle and motor cycle traders who in their repair departments are likely to be called upon to carry out work in connection with such installations and fittings.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

36,321. "Measured service telephone systems." Automatic Telephone Manufacturing Co., C. Gillings, and R. Mercer. December 29th.

36,331. "Apparatus for testing magnetos." W. J. Hannah. December 29th.

36,357. "Safety device for electric incandescent lamps." K. A. Beckert. December 29th.

36,407. "Electro-magnetic mechanism." Automatic Telephone Manufacturing Co. December 29th. (U.S., September 7th.)

36,416. "Step-by-step electrical motors." A. P. Addison and H. G. A. Scott. December 29th.

36,432. "Electric cut-outs." P. H. Coales, C. C. Garrard, and A. H. Railing. December 30th.

36,441. "Sparking plug testers." H. L. Curzons. December 30th.

36,443. "Electric flash signs, &c." J. Sawle. December 30th.

36,448. "Jointing armoured electric cables." R. W. Blades and British Insulated & Helsby Cables, Ltd. December 30th.

36,449. "Electric furnace." R. R. Reed. December 30th. (U.S., March 27th.)

36,450. "Microphones." J. Gardner. December 30th.

36,474. "Electric, &c., switches." A. C. Day. December 30th. (Australia, January 15th.)

36,482. "Accumulator cells." A. H. R. Sharratt. December 30th.

36,488. "Protective device for direct-current electric motors." C. E. Fairburn. December 30th.

36,492. "Electric exploders." E. Cudney. December 30th.

36,499. "Dynamo-electric machinery." W. B. Sayers. December 30th.

36,503. "Apparatus for testing electrical machinery." Allmanna Svenska Elektriska Aktiebolaget and A. Yetterberg. December 30th.

36,505-6. "Electric fuses." Metropolitan-Vickers Electrical Co. December 30th. (U.S., January 12th.)

36,522. "Automatic cut-outs for electrically-heated appliances for boiling liquids, &c." E. W. Johnson. December 30th.

36,528. "Electric furnaces." A. Eimer. December 30th. (U.S., July 18th, 1914.)

36,540. "Windings for alternate-current dynamo-electric machines." F. Creedy. December 30th.

36,599. "Manufacture of electric cables." Callender's Cable & Construction Co. December 31st.

36,622. "Sparking plugs." S. Fisher. December 31st.

36,624. "Methods of protecting electric transmission or distribution systems." British Thomson-Houston Co. (General Electric Co.) and General Electric Co. December 31st.

36,626. "Current-collecting devices for dynamo-electric machines, &c." British Thomson-Houston Co. (General Electric Co.) and General Electric Co. December 31st.

36,630. "Radio-transmitting apparatus." Western Electric Co. December 31st. (U.S., December 31st, 1919.)

36,653. "Means for communicating between vehicles of electrically driven trains." J. Bethenod. December 31st. (France, January 3rd.)

36,666. "Electricity cable dividing boxes." South Wales Electrical Power Distribution Co. and A. Wisdom. December 31st.

36,668. "Primary electric batteries." O. Urbasch. December 31st. (Austria, December 28th, 1919.)

36,669. "Sparking plugs for explosion motors." F. E. Le Bissonnais. December 31st. (France, January 5th.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1914.

7,766. "Electrical conductors." Hochstadter. March 27th, 1914. (Convention date not granted.)

1919.

19,316. "Electro-deposited metals." C. P. Madsen. April 26th, 1919. (142,432.)

19,400. "Automatic telephone exchange systems." Western Electric Co. and G. Deakin. May 26th, 1919. (143,830.)

20,790. "Miners' electric safety lamps." Haslam & Stretton and T. Stretton. April 22nd, 1920. (154,967.)

21,441. "Wire-making machines." British Thomson-Houston Co. (General Electric Co.) September 1st, 1919. (154,977.)

21,449. "Method and apparatus for electric signalling through water, for example, between or with ships thereon." Q. C. A. Craufurd and L. O. Doughty-Wylie. September 1st, 1919. (154,978.)

21,594. "Valves used for wireless transmission." H. J. Round. September 3rd, 1919. (154,982.)

21,656. "Electric welding apparatus." British Thomson-Houston Co. (General Electric Co.) September 3rd, 1919. (154,985.)

21,685. "Electric control mechanisms." C. Weismann. August 10th, 1917. (132,265.)

22,074. "Cooling devices for electric transformers and the like apparatus." British Thomson-Houston Co. (General Electric Co.). September 8th, 1919. (155,017.)

22,798. "High-speed electric or other locomotives." British Thomson-Houston Co. and F. W. Carter. September 16th, 1919. (Addition to 128,106.) (155,038.)

23,149. "Sparking plugs." T. B. Broad. September 19th, 1919. (155,049.)

23,752. "High-frequency alternators." British Thomson-Houston Co. (General Electric Co.). September 26th, 1919. (155,061.)

24,718. "Galvanic batteries." O. Oldham, G. Oldham and J. Oldham. October 9th, 1919. (Cognate application 6,654/20.) (155,071.)

25,630. "Sparking plugs." H. S. Cooke. October 20th, 1919. (155,078.)

26,802. "Coin-freed pre-payment devices for telephone systems." Automatic Telephone Manufacturing Co. (Automatic Electric Co.). October 31st, 1919. (155,088.)

27,858. "Generation, transmission, and distribution of electricity." H. Hawkins, W. H. Hanstock, A. H. Higgs, and Ferranti, Ltd. November 11th, 1919. (155,095.)

28,534. "Sparking plugs." J. P. Reijnhout. November 18th, 1919. (155,100.)

32,791. "Electrolytic cells." I. H Levin. December 31st, 1919. (155,118.)

1920.

190. "Indicators or annunciators." Sterling Telephone & Electric Co. and F. G. Bell. January 2nd, 1920. (155,123.)

2,815. "Electric starting devices for internal-combustion engines." O. Imray (R. Bosch Akt.-Ges.). January 29th, 1920. (155,136.)

4,377. "Portable electric lamps." Compagnie Generale d'Electricite. May 27th, 1916. (138,929.)

4,863. "Insulating protectors for the ends of electric conductors." J. B. Hamilton. February 17th, 1920. (155,148.)

4,878. "Cross arms for supporting electric insulators." F. M. Simpson. February 17th, 1920. (155,149.)

6,359. "Electric couplings." H. A. Douglas. March 2nd, 1920. (155,155.)

11,935. "Electric switches." G. Gallo and F. Villarhoito. April 29th, 1919. (142,494.)

17,962. "Cut-out switch for electric polyphase alternating current circuits." V. Martinetto. October 15th, 1915. (145,690.)

A Safe Method of Synchronising.—To prevent mistakes when connecting a three-phase generator to another generator or system with which the first generator is to be synchronised a triple-pole, double-throw switch has been used by a correspondent of the *Electrical World* in conjunction with an induction motor for indicating direction of rotation. The switch is placed near the ends of the two lines which it is desired to connect together, and jumpers are run from the lines to the three blades of the switch. The induction motor is connected to the inside terminals of the switch. The switch is first thrown to the right and the direction of rotation of the motor is noted, and then it is thrown to the left. If the direction of rotation is not the same in both cases, two of the conductors of one line are interchanged at an auxiliary switch to make the directions of rotation identical. Then the oil switch at the first generator is opened and the auxiliary switch is closed. After this one phase of the generator line is synchronised with one phase of the line, after which the oil switch may be closed. The advantage of using this plan comes from the fact that the wires running from the double-throw switch to the two lines are left connected after the directions of rotation have been checked, thus preventing any chance of connecting the wrong wires of the two lines together.

THE

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UNEMPLOYMENT INSURANCE.

FOR some months past a number of employers and labour representatives have been meeting informally to discuss some of the more important problems which are pressing upon industry during this period of reconstruction, and they have come to the conclusion that the most urgent and serious of these problems is that of unemployment.

With a view to dealing with the matter more adequately than has yet been provided for under the National Unemployment Insurance Act, 1920, they have, with the aid of statistical and economic experts, drafted a scheme which they consider might be grafted upon the present Act and applied without delay.

A draft of the scheme has been sent to us anonymously in order that it may be discussed on its merits and without the names of the group being at present known, but we are assured that their credentials are unquestionable, and that the employers represent concerns having tens of thousands of workers and many millions of capital at stake. In one large works it has already been put into operation without State assistance.

It is suggested that the scheme should apply to all manual workers and to salaried workers, between the ages of 16 and 70, receiving not more than £400 a year, with the exemptions mentioned in the Act passed last year, the rate of benefit to be 50 per cent. of the average earnings, with 10 per cent. additional for a dependent wife and 5 per cent. for each dependent child under 16 up to a total of 75 per cent., but with a maximum of £5 per week, special provisions being made for the calculation of earnings in the case of seasonal or exceptional trades.

The benefits would be payable after three days' unemployment, and be limited to one week's benefit for every six weekly contributions, such benefits being payable for 26 weeks in any one year instead of for 15 as at present; the limitation of benefit to one week for every six contributions is a precaution against the work-shy, and it will be noted that in order to obtain the full benefit of 26 weeks the worker must have been employed at least part of each week during three years.

For the purpose of giving an immediate sense of security to workers, it is proposed that an adequate number of payments should be credited at the beginning, and although it is not mentioned in the scheme, if a credit should be given under this or a similar scheme, the credit might well bear some relation to the amount of employment which the insured person might be able to prove during some stated period prior to the credit being given.

The annual cost is estimated at about £56,500,000, exclusive of administration; the worker is to contribute £15,500,000 at the rate of one penny for every 10s. or part thereof of his earnings, the State to contribute £4,000,000 and the costs of administration, and the balance of £37,000,000 to be found by the employers by a levy of about 2 per cent. on the wages bill, the levy being increased or decreased in direct relation to a decreased or increased total contribution of workers.

In order that the scheme may be put into early operation it is proposed that the employers' contribution should be fixed for a term of five or seven years, the State retaining any surplus or making up any deficiency, and before the end of the term the Government Actuary would re-assess the employers' contribution for a further period based on the experience of the previous term.

The workers' contributions would be the same in all industries, but so soon as the necessary statistics were available the State would have power to vary employers' contributions in any industry according to the amount of unemployment in that industry. Contracting out would be permitted.

The underlying idea is to compel industry to create a wages equalisation fund, and to give employers an incentive to eliminate every removable cause of unemployment, and it is suggested that to alleviate suffering such a policy would be worth almost any cost, and that in practice it would be found to be as financially sound a policy as is a dividend equalisation fund.

We are informed that the scheme is meant to be an earnest attempt to solve a matter which is particularly urgent at the present time, and we are of the opinion that the scheme is worthy of consideration; whether it be put forth because of a deep consciousness of social obligations towards our fellow men or whether, as may be alleged by the cynic, it be from a desire of self-preservation in these days of industrial unrest, there can be no doubt that national good will result if the willing worker is relieved from the numbing fear of unemployment from causes over which he has, and can have, no personal control.

However much increased production may be urged by employers or by far-seeing labour leaders or be proved necessary by economists, the worker has a deep-rooted belief that the introduction of labour-saving machinery, the dilution of labour, or payment by results will render him or his fellows more liable to unemployment. The worker who is willing to place his utmost energies at the service of the community would not in an ideal State be at the mercy of trade fluctuations, whether they arose from exchange problems, change of fashion, seasonal employment, or any other cause which to-day may throw thousands of workers out of employment.

A scheme placed before us as this scheme is, with the backing of men who have given the matter serious and prolonged consideration, is worth inquiring into, and we shall be glad to open our columns for any of our readers who are willing to give their views on what in the first place is intended to bring early alleviation of a difficulty which is already assuming alarming proportions, and in the second to assure the workers upon whom the security and progress of our Empire so largely depend that honest and continuous labour will best assure them of freedom from the fear of unemployment.

Reconstitution of the National Council.

The employers' side of the District Industrial Councils for the electricity supply industry, in solemn conference assembled, has decided that a reconstitution of the National Council is advisable. Some of the District Councils, in fact, couch their sentiments in stronger terms, and say that it has *got to be done*. Anyhow, the employers' side is going to propose a radical refashioning. The supporters of the view, using a popular word, say the National Council must be democratised. The new National Council, which is due in May, is to be composed of 52 members—that is, of course, 26 for each side, employers and trade unions. Of the former 26, 13 are to be company representatives and 13 local authority representatives, so that each of the 13 District Councils will have two employers' representatives. As to election, the local authority representative is to be chosen directly by the District Council, and the nominee must be one of its own members. This means, of course, that the I.M.E.A., which at present holds the right of nomination, retires from the field. This proposition of reconstruction comes, we understand, mainly from the municipal side, the claim being that if the National Council is directly elected by the District Councils, the various local authority undertakings will more readily fall into line with the wages and other recommendations that are made. This, of course, among other arguments. As to the company representatives, some power (it is uncertain how much it will turn out to be) is left in the hands of the three associations—Power Companies Association, Provincial Committee, and London Conference. These bodies apparently are to nominate, but as there is a direction that one should be chosen from each District Council, the District Council concerned will probably claim to have some say in the matter. However, it ought not to be difficult to arrange such a detail amicably. The reconstitution presumably will necessitate a remodelling of the financial system. Up to the present, the expenses of the National Council have been met jointly by the four Employers' Associations; but with the altered scheme it looks as though the hat would have to be taken round the District Councils. Again, we think we are right in saying that the National Council at present pays no travelling or other expenses to its presumably affluent members; but it is very doubtful whether the whole of the 26 new members will be willing to put their hands into their pockets, or, shall we say delicately, be allowed to put their hands into the pockets of their individual undertakings. Hence a further prospective dip into the funds of the District Councils.

Now, as to the incidence of the re-arrangement, in the first place, it will facilitate the co-ordination of the work of the thirteen councils. On the employers' side, too, it will give machinery for formulating a common policy throughout the country on matters of principle or importance, as to the good of which there can be no two opinions. Also it will make the whole of the Whitley scheme as applied to this industry of a more homogeneous nature.

On the other hand, the new arrangement weakens any outside control. This, from the point of view of the ardent and progressive Whitleyite, may be welcomed. We have no doubt it is. But employers may be forgiven if they look somewhat askance at this new quasi-independence of the Councils. Certainly it gives the Councils a different complexion to unadulterated Whitleyism. The essence of the Whitley scheme is that all negotiations are between Employers' Associations and Trade Unions, whereas by this new proposal the Employers' Associations are, as Monsieur Beaucaire would say, "a 'leetle' in the background." Still, there is nothing to prevent an industry from departing from the formal type of council-scheme if it thinks fit.

There is one thing, the chairman will have a full team of horses to drive in this Council of 52. It may be true to say "the more the merrier," but certainly not the "handier" if work is to be got through—and it will require very skilful chairmanship to get as much done in the same time with a council of 52 as with one of 24.

As a last point, the Trade Unions have to agree. However, they ought to be able readily and also amiably to readjust their side, if the fraternal appellation with which they address each other stands for anything. Altogether there is likely to be much parleying and conferencing between now and hawthorn-tide, by which time this matter has to be settled, one way or the other.

The Bristol Inquiry.

The meeting held at Bristol with regard to the Lower Severn Electricity Scheme, and so soon adjourned, furnished one of two points worthy of consideration. In the first place the rule emerges that in all these "hearings" the promoters of the scheme should be represented by counsel. Then also the views expressed by the Chief Electricity Commissioner should afford, to everyone interested in any of the delimited areas, fruitful matter for cogitation. Sir John Snell most forcibly emphasised the necessity of every undertaker in the area realising that a Joint Electricity Authority scheme was essentially a voluntary and cooperative one; that the responsibility was laid upon every undertaking to do its best so to fit itself in with its neighbours as to make a joint scheme possible; that everyone obviously could not have everything he desired, but that by a judicious give and take, a reasonable arrangement ought to be attainable. He deprecated strongly (though in his own judicious and dignified terms) any disposition to stand aloof while other people took the trouble to prepare a scheme, and then to regard it as an "Aunt Sally" to shy at. As we understand the principle indicated at this hearing, it is that anyone who comes along with an objection must not expect much consideration unless he can satisfy the Commissioners that he has taken every step to get his contentions favourably considered by the promoters and has failed. Conversely, the promoters of a scheme must, on any debated point, show that they in their turn have given every opportunity to each undertaker to submit his individual requests and have duly considered them. The Chief Commissioner's tactful and guiding counsel ought certainly to bear good fruit in the interval which the adjournment has afforded—and if so, the delay is fully worth while. Certainly something of a chastened spirit seemed to show itself in some of the subsequent speeches.

The National Joint Board.

The action of undertakers generally has been anything but praiseworthy in respect of the National Joint Board. In few cases has the supply industry appeared in such an unfortunate light. Now, on top of this, a motion has been passed at an important meeting of representatives of the employers' side from all parts of the Kingdom, which seems to be decidedly ill-advised, considering the actual circumstances. Certainly it shows a lack of humour. This motion, as in the case of the National Joint Council, proposes that the National Joint Board be enlarged to 52 members, being 26 on the Trade-Union side and 26 on the employers' side. The idea is, of course, that there shall be two employer members from each of the 13 District Boards. But as the motion excludes dealings with commercial staffs, the Trade-Union side of the Board is limited to the Electrical Power Engineers' Association. This suggestion, therefore, implies that the E.P.E.A. is asked to send 26 representatives to the meetings of the National Joint Board. What the E.P.E.A. has to say in this matter we have not heard. The whole proposal, of course, is a reflection of the proposed reconstitution of the National Joint Council which we have dealt with above, and in previous issues.

I.E.E. Informal Meetings.

Next Monday the "informal meeting" of the Institution of Electrical Engineers will assume a dignity to which it has not hitherto aspired—it will be held at the Institution of Civil Engineers. The reason for this change of venue is that the subject of discussion is "Improving the Usefulness of the Institution," with the President in the chair, and it is anticipated that members will attend *en masse* to set forth their views on a matter offering such magnificent scope for the exercise of imagination.

In passing, we are asked to mention that light refreshments will be served at 5.30 p.m., and not, as usual on these occasions, after the discussion has been opened.

Undoubtedly the Institution has already made great strides during the past 10 years towards more amply fulfilling its mission. It has always been a leading characteristic of electrical engineers to aim at ever-increasing efficiency, and just as they revolutionised the design and construction of the steam engine in the early days to make it approach their ideals more closely, so they are moulding the Institution to suit their needs. Doubtless there are still many ways in which the Institution can be of service to its members; we shall hear some of them next Monday, but we would remind the innovators that only those proposals which do not involve additional expense have much prospect of fulfilment under existing conditions.

Whilst on this subject, we venture again to recall the President's telling quotation from Bacon: "I hold every man a debtor to his profession, from the which as men of course do seek to receive countenance and profit, so ought they of duty to endeavour themselves by way of amends to be a help and ornament thereto." We have just heard a member, in the presence of many others, describe the Institution as a "wash-out." In the name and interest of many of our readers who are members of that body, we deprecate the use of such expressions; so long as a man is a member of it or of any other professional society, we conceive it to be his duty to uphold it in public, and to reserve his complaints or grievances for the appropriate occasion. It is another example of the present tendency to talk of rights rather than duties. If that had been the spirit of our warriors in the great struggle, we should have had few "rights" left by this time. Let us all remember that we should individually give as well as take; it is only by service that we can succeed in benefiting our fellow-men.

Electrical Development.

To initiate and successfully establish a new institution, embracing a whole industry, is a gigantic undertaking nowadays, when there are in existence so many rival interests competing for the attention of the individual. The fact that the British Electrical Development Association (Inc.), was developed from the small beginnings of the Heating and Cooking Committee of the Institution of Electrical Engineers, and in 19 months was able to present to the first annual general meeting a report which proved that it had in that short period "grown up" and was a fully-fledged incorporated association, with a long and weighty roll of membership and—still more noteworthy—a record of excellent achievement, speaks volumes for the ability, energy, and driving force of its originators; it augurs well for the future also, and thanks to the fortunate choice of a director full of "push and go," backed up by an executive committee of first-class men of affairs, it is safe to prophesy for the newcomer a career of distinguished usefulness to the electrical industries. It should be noted that "E.D.A." does not work only for the supply undertakings; its activities are of direct benefit to manufacturers and contractors as well, and we do not hesitate to class the consumer also among its beneficiaries—for surely a man who through the agency of the Association, directly or indirectly, has been induced to share in the comfort and convenience of the electrical way of doing things is better off than when he was in outer darkness?

But are all the benefits thus derived from the work of the Association to be pocketed, so to say, without the courtesy of acknowledgment, let alone reciprocation? One good turn deserves another, and we therefore urge those firms which have not hitherto given tangible support to the Association to mend their ways, and to become members of it while the new year is still young. Let them remember that if its efforts are so cordially appreciated as we know they are, in these early days of its existence, they will be vastly more fruitful in later years, when things settle down to something approaching the normal. The field open to electrical development is almost inconceivably immense; we have only scratched the fringe of it as yet. The public are waiting and willing to be educated in electrical lore—"E.D.A." is to be the teacher, and now is the time to equip it for its onerous duties. We therefore strongly commend to the notice of our readers the merits of this Association as a profitable investment for the moderate subscription which will help not only the subscriber but all other members of and workers in the electrical industry. At the recent annual meeting the members of the Association, who already number over 400, were furnished with a report on the work done during the preceding 18 months, and if any reader wishes confirmation of our remarks, we advise him to apply to the Director, Mr. J. W. Beauchamp, for a copy of it.

THE GREAT WEST-SEA BUBBLE.

Government Engineering Up-to-Date.

By A TAX-PAYER.

At the end of November last the taxpaying section of the public was thrilled by a communication sent to the daily and technical Press which proved that the Ministry of Transport was going to give some value for its ever-increasing salary list, and that the nation was to be presented with a "Christmas Gift" in the way of a scheme of power for almost nothing.

In the "old wicked world" before millions were tossed about like jugglers' paraphernalia, the value of a scheme, whether public or private, was, in sober matter-of-fact circles, judged largely by the way in which it was brought forward, careful and definite calculations and estimates being a *sine qua non;* and it was remembered that usually "good wine needs no bush." Nowadays, when anyone questions the idea that several quarts can be got out of one pint pot, or that unlimited wages or salaries can be obtained from a limited revenue, he is called a reactionary of the worst type; and one hopelessly out of sympathy with the times. Anyone, therefore, who opposes "power from the moon" will be denounced as a lunatic.

Unfortunately two and two continue to make four, although many friends of progress believe with Mr. Lenin that mathematics are "undemocratic," so that the value of a scheme in these days is measured mainly by its attractiveness to the man in the street. In pre-war days, judging by the way this scheme was puffed, it would have been looked upon as a "ramp" worthy of a company promoter of the "Hooley" era. The first and second "puffs" emanated from the Transport Ministry; strange to say, the first was not signed, not even by the Electricity Commissioners; but a news agency, whilst circulating a photograph of a wash drawing with a notice that the same could be reproduced for a nominal fee, "gave away" the names of the "three distinguished engineers" who were alleged to be responsible for it; and it is to be hoped that these "water power experts" were not overcome with modest departmental blushes at such an unwarranted breach of Whitehall confidence. If these gentlemen were actually responsible for the issue of this first "puff" they would be well advised in their own interest to join the staff of some "wild cat" company promoter, or a patent medicine proprietor, where such phrases as "light, purity and power," "the keen vision of the Press," and the "beautiful and romantic Valley of the Wye" would be fully appreciated.

When discussing the feasibility of the project for a storage reservoir, the following statement was made: "Some years ago such a project would have been quite impracticable of execution, owing to the low efficiency and high cost of the pumping plant which could then have been installed. Wonderful developments, however, have taken place in the evolution of the centrifugal pump, and centrifugal pumps of great size have now been designed which will raise water hundreds of feet with high efficiency." We do not know if such a statement can have been that of the alleged "distinguished engineers" of the Transport Ministry, or the muddled views of some hired "literary gent," but anyhow, outside the "civil engineering branch" it is well known that there have been no material improvements in centrifugal pumps during the last ten years, and that makers have been willing to produce almost any size for mining, dock, and irrigation work; and as far as price is concerned, since the war, this has probably gone up four to five times. Other statements of a similar value are made in the circular; it is said, moreover, that "the attractions of the scheme above outlined would appear to be limitless"; the question is whether the attractions are greater for Ministry hangers-on or for the "public that pays."

After the public had been treated to the first instalment of "ground bait," it was followed up by "corroborative detail" from a second Transport Ministry circular, the items of which should please any first-year student who has got hold of an electrical machinery maker's catalogue for the first time; hundreds of this and scores of that would be so nice to talk about. No sooner had the public begun to talk about rotary converters and pumps than the Board of Trade, not to be out-done, produced a 2d. masterpiece at an estimated cost to the Government (so we are told) of £19 for printing. After the two sets of fireworks it was like a semi-damp squib, part of which banged and the rest fizzled; it was nearly as amusing as the two circulars. The public, thirsty for information, is told at the end of the first section that the committee considers it "desirable to place our conclusions upon record at once," then, like a pictorial puzzle in a Christmas cracker, the reader is apparently asked to find a conclusion in the remainder of the report; judging by the vague terms used there does not seem to be one. It must be an important document, as the names of the distinguished committeemen are given twice; paper, as is well known, costs nothing to Government departments. Perhaps owing to the ignorance of water-power development by the bulk of the distinguished members of the committee, a sub-committee of two was appointed, Sir Philip Dawson and Prof. Gibson. Perhaps these two gentlemen walked along the Severn estuary like the walrus and the carpenter, "hand in hand," and discussed the suitability of the quantities of sand as a site for miles of power house, or perhaps even as a Disposal Board dump; at any rate, the epoch-marking report is presumably one of the results.

One sentence in the report is delightful: "We have been strongly impressed by the extravagant ideas current in the popular mind as to the availability of tidal energy"; it is doubtful, judging by the remarkable variation in the estimates of available power, whether this remark is intended as a sly hit at the "Civil Engineering Branch" of the Transport Ministry or not. While the first circular hints at ½d. a unit, the more cautious B.o.T. Committee, headed by a rival expert, pointed out that it could not get definite estimates of cost from manufacturers and designers, and that "no useful purpose would be served by endeavouring to give in this report any estimate of the cost of the scheme"; but later it says that investigations support the view that energy can be generated at a favourable rate. As capital charges are one of the largest items in power cost for such a scheme, the value of the report can be judged by this illuminating remark; perhaps it was decided that the "Civil Engineering Branch" should be let down gently. This report is remarkable for the information that this galaxy of talented committeemen (including two super-experts) has not been able to give; perhaps the report has been arranged to form the basis of a suitable road for retreat, if after examination, worthy of the name, the scheme proves hopeless. It would appear that the only people who have given much study to a Severn scheme are three gentlemen whose names appear in small print at the foot of the first page; it is not unusual, however, in Government departments to annex the work of others with scant acknowledgment.

From the practical point of view, before the war, coal power stations could compete in most cases with normal water-power stations, except where coal was very dear; that is to say, coal plus wages and interest charges was often equivalent to the usually higher interest charges on water-power plus the wages, transmission costs, and other incidentals. Quite recently Mr. A. T. Smith, of the Castner-Kellner Alkali Co., said that before the war, with Lancashire coal, his company was able to produce power more cheaply than was possible at Niagara. No doubt, with pre-war capital charges, existing water power is in a more favourable position than it was, but with existing capital charges for new work the thing seems to be the other way; if capital charges have risen more than the price of coal, the situation regarding water power, and especially tidal power, is less favourable than it was.

The three reports are delightfully vague regarding capital cost and interest charges, but at present on these factors tidal schemes must stand or fall; nobody says that power cannot be generated. No amount of pretty talk and fashionable "eyewash" will prevent the proverbial "brick" coming through the gold foil if the scheme is not sound economically. The capital cost of works and machinery has gone up four to six times, and the interest on Government-guaranteed securities has about doubled, therefore interest charges must be reckoned as eight to twelve times those required in pre-war times; coal has gone up three to four times in most places. After allowing for the smaller capital cost of a steam power station, especially with, say, 25,000-kW sets, as against, say, 1,500-kW low-speed water turbine sets with gearing and d.c. generators, rotaries, and other stand-by plant, things begin to look a little uncomfortable. It is exceedingly difficult to-day to get heavy manual outdoor work carried out efficiently, even by able-bodied unemployed, as has been shown in iron ore mines and in reclamation work on the East Coast. If machinery has to be used in large quantities, then the politically attractive unemployment relief idea largely falls to the ground. The capital cost, energy losses, and salaries bill for miles of low-speed turbines with silty water, the d.c. generating sets and gearing, the rotaries, step-up transformers, and the capital cost and low efficiency ot the storage system capable of dealing with the maximum demand must make a "poor show" when capital charges are honestly allotted. No comparison has been given regarding the cost of power generated from steam in the Wye district with duff coal or inferior fuel.

If the scheme seems sufficiently attractive from the political point of view, and that is the main thing that counts nowadays, the matter will be settled by the party Whips after a report, perhaps by a conveniently packed Commission, and not by impartial engineers of world-wide experience of actual water-power development. From beginning to end the whole scheme opens the door for log-rolling and chicanery; the original pamphlet, with its gush and political hints, indicates that very definitely. If the capital cost of the electrical branch comes out too high, millions will be debited to the wonderful dock scheme (as illustrated), to the motor road, or to the quadruple rail connection to carry the Welsh coal, or as a last resort, to the industrial Garden of Eden. If the scheme begins to fall flat, then opposition will be called lack of sympathy for the (unemployable section of the) unemployed.

It should be noted that with electric traction from, say, Patchway to Newport, the traffic through the Severn Tunnel could be largely increased; that a new bridge near Berkeley, or even a reconstructed Severn Bridge would carry motor traffic from places east of Swindon to South Wales by a fairly direct route, and that if the traffic from Devon and Somerset to South Wales is so great, it is remarkable that more ferry traffic does not take place.

Given honest dock labour, existing ports could carry much more traffic than they do; without the reconstruction of the Severn navigation and connecting canals, large barges of the Continental type could not reach the Midlands. No doubt, however, such prizes from the Geddes "Christmas tree" will be dangled at the critical moment before the gullible public.

No real estimates of capital cost are given in any of the three papers, although in the first, presumably by pure intuition, the cost of energy generated is stated to be something over ½d. a unit, the available power being there stated as half a million with a peak load of a million horse-power. In these days other people's money is mere dross, especially when handled through mushroom syndicates, and to the modern type of Government post-war official, details and estimates are superfluous, for obvious reasons.

In the old days, when a rank swindle was to be promoted it was usual to give some figures (even if conveniently "faked"), and lists of other companies and schemes were given which, more often than not, for reasons naturally undisclosed, were not comparable with the scheme to be "puffed." In the first inspired Severn puff a list of large water-power installations was given, no mention being made that none of these were tidal schemes, and it was not stated that in capital cost a waterfall plant was not comparable with any tidal plant, full use being made of the now fashionable economic "*suggestio falsi*," although in the committee's report, which the general public is not likely to read, the absence of existing tidal schemes is pointed out.

It should be noted that there is nothing new about the study of tidal schemes; something like two hundred patents have been taken out at home and abroad, and the reason why nothing was done before the war, when an honest day's work was conceivable, and Government money was available at about 3 per cent., and money for sound independent schemes at about 4 to 5 per cent., was that such a scheme could not be made to pay even in places where coal cost 30s. a ton or more. It should be pointed out, however, that at that time the nation had not available the services of the Transport Ministry with its "distinguished engineers," or the Water-power Committee of specialists, the simultaneous assistance of the Central News, or the creative ability of the engineering artists on the staff of the *Daily Mail*, let alone the "taxpayer's joy," the Government Wire-pulling and Publicity Staff "Unlimited."

The French Government, which has at its disposal some of the most distinguished water-power engineers in Europe, has not filled the popular Press of Paris with company promoters' "tosh" first, and then begun to look into such minor details as capital cost afterwards, but has voted a sum of money for experiments on tidal turbines and tidal schemes, and the question is being examined by engineers whose names carry some weight in connection with water power. Such methods would naturally not appeal to those whose existence in Government employ has to be justified by advertisement; the French Government should send over to Whitehall to learn how to do these things properly. It is interesting to note that most schemes of tidal power abroad are based on double reservoirs and not on the single dam system.

In the past Government interference has been little less than disastrous to the electrical industry, and if the way in which the Severn scheme has been put forward is to be taken as a guide for the future, the less Whitehall interferes the better; if the scheme is sound, men of action will be found to carry it through; if it requires Government fireworks to make it popular, it ought to be left alone.

Until a comparatively high-speed, variable-head turbine with a constant speed, or a simple reliable generator producing three-phase current with a constant periodicity with a variable speed is invented, it is very little use talking about a Severn scheme, especially as long as interest on money remains at its present level, and labour refuses, even with periodical bribes, to do an honest day's work. There are few schemes in which engineering and finance are so completely intertwined as a tidal power proposition, and judging by the way it has been "boosted," for ulterior motives, one is entitled to say that "fools rush in where angels fear to tread." A mixed scheme in which a railway, a roadway, a dock, an electricity supply, and unemployment are mixed up should be handled only by men of absolute impartiality with a reputation for large general engineering and hydraulic power schemes; and apart from a grant for independent study, no more advertising "stunts" should be allowed until figures and plans are produced and published which will bear investigation.

THE ELECTROLYTIC STERILISING OF WATER.

[COMMUNICATED.]

It is interesting to note the keen go-ahead methods of our Colonies. Towards the end of the war period, a large Colonial dairy, having seen an account of the electrolytic sterilising of water, telegraphed without further parley for a plant to be sent out, which was the forerunner of many similar installations. In this country there is a much larger field for water sterilising, yet it remains practically untouched.

There are many systems to choose from, but the electrolyser has strong claims for favourable consideration. Bleaching-powder solution and chlorine gas have been employed with success, but they impart a nauseous taste to the water, calling for a further dechlorinating process, which is unnecessary where the type of electrolyser which produces neutral hypochlorite is employed. The hypochlorites are essentially unstable, particularly so when neutral, and for this reason they are eminently suited to the sterilisation of drinking water, as any slight excess employed—and it is necessary, for complete sterilisation, to employ an excess—which does not combine with organic matter is quickly decomposed by sunlight into hydrochloric acid and oxygen ; there is then no free chlorine left to impart an unpleasant taste to the water. The amount of hydrochloric acid in the water is negligible ; the total quantity of hypochlorous acid employed is only 0·5 part per million, and by far the larger portion of this combines with organic matter, leaving probably only 1 part in 10 millions to be decomposed.

The importance of pure water in industry is not always readily recognised, particularly where it is fairly clean ; yet water which is charged with peaty or vegetable matter is known to be a fruitful cause of pitting and corrosion in boilers. Water drawn from reservoirs where weeds flourish is unfit for humidifying rooms where manufacturing processes are carried on, as it is apt to impart an unpleasant odour to the air ; such water is also unfit for making tea, or drinking generally. Where there are weeds there will be snails, and other organisms ; the snails get into the pipes and under valve seatings, the weeds are drawn into the pipes and choke them. The transparent eggs have been known to produce strange markings on cloth which is being finished, and mildew spores carried by water cause trouble in the material under treatment, and in the woodwork of the establishment.

Water which is clear and free from odour, is often seriously contaminated, and is the means of spreading epidemics ; cattle drinking it apparently do not suffer, but cows convey the diseases in their milk. Fluke in sheep is liable to be conveyed by water, hence the farmer, quite as much as the manufacturer, has every reason to examine the purity of his water supply. Electrolysers can be profitably employed wherever there is a few horse-power to spare, as rough coarse salt, the other requisite, is always available. Skilled supervision is not demanded : ordinary steady workmen as a rule are perfectly capable of attending to the plant.

There are many other uses to which this harmless sterilising agent may be put. For example, a little of the liquor added to the water employed in washing bacon assists in removing the slime and rancid flavour ; it also prevents fish from becoming tainted so soon in hot weather, and this process is preferable to some of the methods employed.

The electrolyser is largely employed in laundries, the liquor used being an excellent bleaching agent, which does not injure the clothes, and removes the odious smell of perspiration which remains as the result of imperfect rinsing. In hospitals it sterilises infected clothing, and the liquor is used for flushing drains, replacing expensive disinfectants. For bleaching cotton and linen, it rivals the old grass bleach, and it is also the most suitable medium for bleaching cotton-wool, surgical gauze, &c.

THE FARADAY SOCIETY.

The Atomic Theory and the Structure of Iron.

A paper presented to the Faraday Society at the December meeting by Prof. E. D. CAMPBELL, of the University of Michigan, on "A Force Field Dissociation Theory of Solution Applied to some Properties of Steel," led to an interesting discussion on atomic structure generally. The paper was presented and the discussion initiated by Dr. A. E. OXLEY, who has in recent years put forward suggestive ideas on the structure of the atom which physicists will have to take seriously into consideration.

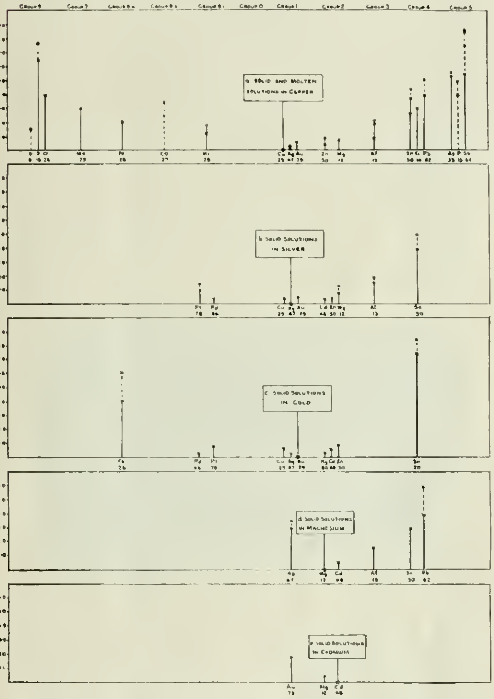
The central idea of Prof. Campbell's paper is that steel is a solid solution of carbides in iron, and that there is no essential difference between a liquid solution and a solid solntion. He considers that the use of the latter term is largely to blame for the unnecessary obscurity that has arisen as regards the constitution of alloys, while a subsidiary cause has been the difference in the mode of expressing the composition of alloys and of ordinary solutions. In the former case percentage by weight has been the vogue; in the latter the far more scientific procedure has been adopted of molecular or atomic concentration per unit volume. The transformation from one to the other is a simple process, and Prof. Campbell redraws a portion of the ordinary iron-carbon diagram with composition expressed in milligram atoms per centimetre cube. It is not, however, the Arrhenius dissociation theory which Prof. Campbell adopts for ordinary solutions and applies to the case of steel—he considers that entirely untenable for a solvent that is not a dielectric but a conductor. (He overlooks the fact that this constitutes a genuine difference between an aqueous solution and an alloy.) Instead, a theory first put forward in 1915 independently by Prof. E. C. C. Baly in this country and Prof. Campbell himself in America is described, and shown to be closely applicable to the case of steel and capable of explaining its properties, and in particular the effect of the alloying constituent on its electrical resistivity. This so-called "Force-Field Dissociation Theory" postulates that in a molecule the electromagnetic field of force associated with the constituent atoms is normally closed in combination in the molecule. In solution, however, the force field is more or less opened out by the solvent, to a degree depending on concentration and on the composition of solvent and solute. It is to the field of force thus set up outside the molecule of solute that the reactivity of ions is due, and not to electric charges as in the Arrhenius theory. It is the products of ionic dissociation of carbides in solution which react when a p.d. is set up in steel, and electronic motion of electricity is converted into atomic or molecular motion of sensible heat, while conductance of the electric current takes place through the solvent iron. Thus the products of ionic dissociation in a metallic solution are capable of reacting with electrical energy just as truly as are the ions in an aqueous solution, but the result of the reactivity is electrical resistance in the former case and conductance in the latter case; the reversal of the phenomena being solely due to the solvent being a conductor in one case and in the other a dielectric.

Dr. OXLEY, in commenting on Prof. Campbell's theory, agreed that a stray electromagnetic field would exist outside but close up to an atom or molecule that on the whole was electrically neutral, but he did not think that force field was competent to account for the phenomena of solution—Arrhenius's dissociated ions were required in addition. That he thought was proved by the evidence for the lattice structure of crystals which the well-known work of the Braggs had led up to. On the other hand, the phenomena of diamagnetism and paramagnetism did require that in an atom there should reside something which acted as a unit of magnetism, a magneton, as well as the electron unit of electricity. Thus, the Rutherford-Bohr "solar system" atom, which admirably explained spectral phenomena, failed utterly to account for the diamagnetic or paramagnetic properties of matter. Dr. Oxley then outlined his own modification of Langmuir's cubic atom theory, which imagined that the nucleus and electrons were arranged in a sort of cubic formation, the electrons being at the corners of the cube. This theory had been brilliantly successful in explaining chemical affinity and many physico-chemical properties of matter. It was only necessary—Dr. Oxley suggested—to suppose that the electrons instead of being fixed rotated in tiny orbits round their central positions, or were themselves little vortices or rings, to have the required unit of magnetism, and it could easily be seen how the magnetic properties of matter would fall into the scheme. Unfortunately, to work out this theory completely and quantitatively presented formidable mathematical difficulties at present.

The all too short remainder of the evening was given to the hearing of a very excellent and suggestive paper bearing on the same subject by Mr. A. L. NORBURY, entitled "The Electrical Resistivity of Dilute Metallic Solutions." It is of interest to note in passing that Mr. Norbury *pace* Prof. Campbell strongly advocated the retention of the term and the idea of solid solution—to distinguish it from the liquid or molten metallic solution. The starting-point of Mr. Norbury's conception of metallic solid solutions—or alloys—is the well-known fact that a small quantity of impurity in solid solution in a metal causes a large increase in the electrical resistivity of a pure metal. With enormous industry Mr. Norbury has collected all existing data in this connection and plotting resistivity against composition expressed in terms of atomic concentration (in this he yields to Prof. Campbell's requirements) he has arrived at relationships of very great interest.

Dealing for the moment with individual alloys, we find a broad distinction between those in which the constituents are mutually insoluble and those in which continuous solid solutions are formed. In the former case each crystal grain may be regarded as a separate conductor. In so far as the arrangement of grains tends to be in the nature of conductors arranged in parallel the *conductivity* is a linear function of the composition; in so far as they tend to be arranged in series the *resistivity* is a linear function of the composition. In the latter case the initial additions of solute normally cause a linear increase in the resistivity of the metallic solvent. Cold work and variations in grain size have little effect on the resistivity of pure metals. In the case of binary alloys the grain size has an increasingly large influence, as the number of atoms forming the crystal boundaries becomes comparable with the total number of atoms present.

The most important section of the paper dealt with the effects of various elements in the resistivities of iron, nickel, palladium, platinum, copper, silver, gold, magnesium, cadmium, sodium and potassium. The generalisation arrived at will be best appreciated by reference to the accompanying figure. The results should really be plotted in three dimensions, the dimension not indicated being that showing the vertical arrangement of the elements in the Periodic Table. In order, however, that the vertical positions may be more readily imagined, the atomic numbers are written in under each of the solute elements.



The Atomic Effects of Various Elements on the Electrical Resistivities of Copper, Silver, Gold, Magnesium and Cadmium.

(The uprights indicate: Increase in the Resistivity of the pure Solvent (in microhms per centimetre cube) due to the Presence in Solution of 1.0 Atomic per cent. Added Element. Solid Solutions thus x, Molten Solutions thus * at 1100°—1400°.)

It will be noted that the atomic effects of the solutes are plotted against the positions in the Periodic Table, and the remarkable result is brought out, that the atomic effect of a solute on the resistivity of a metallic solvent is large or small according as the solute is far from or near the solvent in the Periodic Table. Many other interesting relationships can be deduced, but for the discussion of these reference must be made to the full text of Mr. Norbury's paper. They all bear on the generalisation that the atomic resistivity effects of various elements as solutes in solid solution in a metal are large or small according as the solute differs from or resembles the solvent in some atomic property.

Various atomic properties were examined in an endeavour to find which of them would explain the results. Atomic volumes, intrinsic pressures, electrical resistivities, thermo-electric properties and decomposition potentials failed to do so. It is suggested that the results may be explained by assuming that the relative atomic effects are small when there is little electrical attraction between the atoms of solute and solvent, and large as this attraction becomes greater.

If one atom of solute in a very dilute solid solution is pictured, and if, for example, the face-centred cube lattice is assumed, it is known from the work of W. H. and W. L. Bragg that this atom of solute is surrounded by twelve equidistant atoms of solvent. It is thought that the solute atom will not be attached, providing the solution is sufficiently dilute, to any one of the twelve surrounding atoms in particular, although there may be strong "affinity" forces at work tending to cause such combination.

The above non-formation of inter-metallic compounds will, however, only occur in very dilute solutions. As the solutions become more concentrated some of the atoms of solute will tend to "combine with" (that is to say, a transference or regrouping of electrons will take place) definite atoms of solvent to form inter-metallic compounds. It is noteworthy that the useful alloys, those with good mechanical qualities, do not contain intermetallic compounds, but consist purely of solid solution.

The generally accepted view on metallic conduction is that metals conduct an electric current by means of their "free" electrons. It seems in accordance, therefore, with the above view to explain the relatively enormous effects produced on a metallic conductor by the introduction of a few foreign atoms, by assuming that the increased resistivity is due to the solute atoms exerting restraining forces on the electrons of the neighbouring atoms of the solvent and vice versa.

To take an actual case, the fact that the addition of 1.0 atomic per cent. arsenic sends the specific resistivity of copper up by four or five microhms (this effect is apparently almost equally great near absolute zero where the resistivity of pure copper approaches 0.0) makes it seem very probable that each arsenic atom is exerting a very considerable influence on the resistivity of a large number of the surrounding copper atoms. It is thought that it would be difficult to explain such a relatively large influence unless it is assumed that the electrons in a large number of the copper atoms are being affected.

We are glad to learn that Mr. Norbury is continuing his excellent work, and is carrying out experiments which will enable him to fill up some of the gaps in existing data. He will then be in a position to put his views to a strict quantitative test, and thus help to throw more light on phenomena that are not only of great theoretical interest but bear closely on matters of technical importance.

THE PHYSICAL SOCIETY'S EXHIBITION.

(*Continued from page 40.*)

Messrs. Siemens Bros. & Co., Ltd., showed about half a dozen instruments which included different patterns of temperature indicators; a suspended-coil temperature recorder, fitted with a continuous chart roll driven by clockwork, and suitable for use with thermo-couples or resistance thermometers; and a locomotive pyrometer for measuring the temperature of superheated steam.

Messrs. Newton & Co. exhibited a selection of optical lanterns for educational purposes, which although not new have been remodelled. Arc lanterns were demonstrated which are suitable for ordinary work as well as open-stage, vertical, and opaque projection. Various attachments were also shown by the use of which the lantern can be adapted for use with a low-power projection microscope, polariscope, micro-polariscope, and spectroscope. The "Episcope" was specially constructed for the projection of opaque objects, such as diagrams, maps, and small natural objects. In the lantern shown a drawing up to 27 in. wide and of indefinite length could be placed in position, the actual field of projection being about 11 in. square. An attachment was provided so that ordinary slides could be used as well, and two high-c.p. gasfilled lamps supply the light.

Messrs. Chance Brothers & Co., Ltd., demonstrated certain properties of ultra-violet light, isolated by the use of their special glass, particularly with reference to the effect on the eye, and the protection from the rays which may be afforded by Crookes and certain coloured glass. The subject is of special significance in connection with the protection of operators performing electric welding. A sample of "Daylight" glass was shown, which is claimed to give a daylight effect when used in conjunction with gasfilled tungsten lamps. Another interesting exhibit was the glassware of high thermal endurance; it was demonstrated that water can be squirted on to this glass when the latter is heated to a high temperature, without causing any injurious effects whatever.

Messrs. Creed & Co., Ltd., demonstrated the reception and automatic printing of wireless messages in Roman characters. Mr. F. G. Creed's ingenious method is the only one that has been adapted to print wireless messages. The system consists of a combination of existing Creed printing telegraph apparatus working in conjunction with groups of thermionic valves The message is first translated into the Morse code by perforating a strip of paper in a keyboard device so contrived that each key punches the strip, by means of a solenoid operated mechanism, with the Morse equivalent of the letter in question. The strip is fed to the transmitter which sends out Morse dots and dashes, the latter actuating a transmitting contact maker. Several sizes of transmitter have been developed, including one which is worked by an electro-pneumatic relay and which is capable of dealing with as much as 300 kW; it has eight sets of contacts each breaking under an air blast. Reception is by thermionic valve, and the incoming messages are amplified considerably by means of valves in cascade. Current impulses are thus supplied to the relay magnet of a Creed receiving perforator of the same type as those used in line telegraphy and operated by compressed air; the working speed may be up to 200 words per minute. This is an interesting device, but an electrically-driven pattern is now being produced on a mechanical principle which is stated to be simpler, more compact, and which will dispense with the use of compressed air. The strip from the receiving perforator, still in the Morse code and the exact counterpart of that used at the transmitting station, is next fed to the Creed printer for translation into Roman characters. This is a purely mechanical device, and forms an automatic typewriter controlled entirely by the position of the holes in the perforated strip; the working speed is 120 words per minute, and it is a remarkable piece of apparatus. The whole apparatus is driven by an electric motor, so that no external source of compressed air is required. An improved form of printer has also been developed which does not employ compressed air, is more compact, and has a higher printing speed, but it has not yet been adapted to wireless reception. The Creed system of wireless reception, using compressed air, is capable of dealing with a transmission speed of 180 words per minute. This speed is in excess of that of the printer, but the improved printer will be able to keep pace with the receiver and deal with a 50 per cent. increase in transmission speed.

The Cambridge & Paul Instrument Co., Ltd., besides other instruments, included in its exhibit a Rosenhain inverse rate recalescence curve tracer (fig. 4), which was designed to allow of the semi-automatic plotting of "inverse rate" heating and cooling curves. In such curves the quantity plotted is the time taken by the specimen to heat or cool through successive equal temperature intervals, and the use of this instrument does away with the laborious plotting by hand of the time intervals obtained by the use of an ordinary chronograph. The recorder consists of a revolving drum, carrying a chart, over which the recording pen moves at a definite rate. At the end of each time interval, when the observer taps a key, the pen marks the chart, indicating its position, and is immediately afterwards returned to zero, while the drum is simultaneously advanced one step. After a short period of rest, introduced in order that the times of the forward movements of the pen shall not be altered by the varying times taken by the pen in returning to rest after long or short deflections, the pen once again moves forward at a steady rate until its progress is stopped by the observer again tapping the key at the end of the next temperature interval. Curves are obtained on an open scale, the rate of travel of the pen being usually 3 mm. per second. A two-speed arrangement is, however, provided, to reduce the speed of the pen to one-quarter of this when the pen has reached the middle of the drum. This is necessary on account of the fact that long arrests in the heating or cooling process may occur, and during these the pen at the normal rate of travel would be carried a greater distance than the width of the drum.

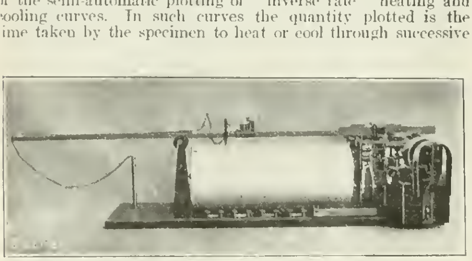


Fig. 4. The Rosenhain Plotting Chronograph.

The details of the driving mechanism are as follows: Two vertical spindles, each carrying small disks, are revolved in opposite directions at constant speeds, the speed in one case being more than ten times that in the other, of which the periphery moves 3 mm. per second. Running on guides between these two disks is a light wooden bar, carrying the pen, below which is the drum. Normally, the bar is held by a spring against the slowly moving disk, and the pen travels outwards over the surface of the drum at the rate of 3 mm. per second. When, however, the tapping key is pressed, an electro-magnet is excited which overcomes the tension of the spring and presses the bar against the quickly moving disk, causing it to return at high speed to the zero position. In order to provide the period of rest referred to above, the electric magnet, being once excited, is caused to remain in action for a definite period before the pen arm is allowed to start on its return journey. The two-speed arrangement is secured by mounting a second driving disk of smaller diameter on the same spindle as the first. The wooden bar is so shaped that for a distance equal to half the width of the drum it bears against the large disk, but after that the bearing is upon the small disk, with a corresponding reduction in the speed of travel.

The machine running recorder exhibited was designed for Messrs. J. & A. D. Grimond, Ltd., Dundee, for recording the number and duration of stoppages of 50 textile machines. Each machine is connected up to the instrument in such a way that when the machine stops an electrical circuit is completed to contacts in the instrument, each of the 50 machines being connected to one of the 50 contact studs arranged in a circle, as seen in fig. 5. A rotating switch runs over the 50 contact studs, being driven by a small electric motor of $\frac{1}{8}$ h.p., and so geared that it passes over all the contacts once in six seconds. The records are made on a continuous paper chart, passing over a brass cylinder, by means of an inked roller carried at the end of an arm swinging across the surface of the chart. A cam on the main spindle which carries the rotating switch causes the recording arm to swing completely across the paper from right to left as the switch passes across the 50 contacts, and returns the arm to the extreme right-hand position before the switch again starts to travel across the contacts. If none of the contacts is energised, *i.e.*, if all the machines are in operation, the inked roller does not touch the chart, but when the circuit is completed by the stoppage of one of the machines, an electro-magnet on the recording arm is energised, causing the inked roller to be momentarily pulled downwards and mark the chart. If this contact is still closed when the switch next passes the corresponding contact stud, the roller will be once more pressed on to the chart, which is moved forward a short distance after each revolution of the contact switch. Consequently a series of marks, forming a straight black line on the chart, is made during the whole time any machine is out of operation.

The instantaneous photometer shown was designed for the Admiralty in conjunction with the staff of H.M.S. *Vernon* for measuring the instantaneous candle power of an electric lamp when it is lighted up or going out. The comparison is always made with a similar lamp, which has been previously calibrated with varying currents in an ordinary photometer. The lamp to be measured is placed in an upper box and the comparison lamp in a lower box; the comparison lamp is then run steadily with different currents below and up to its normal current. The insides of the boxes are painted white, and the two lamps illuminate slits covered with opal glass. Disregarding the effect of the shutter for the moment, light from these two slits passes through two cylindrical prisms with vertical axes to a double prism with horizontal axis in the eyepiece, and the light then passes in two nearly parallel beams to the eye. The latter prism is observed through an ordinary eyepiece, so that the observer sees two adjacent rectangular fields, the upper illuminated by the lower comparison lamp, and the lower by the lamp under test. The revolving shutter carries another pair of slits. Light only reaches the eye when the two pairs of slits come into line with the eyepiece, so that the eye only perceives flashes lasting about 0.001 second. The two revolving slits are independently adjustable on both sides so that the two flashes can be made simultaneous and of equal duration. To avoid carrying the obscuring screen completely round, a second shutter obscures the lamps when the revolving slits are far away from their operating position, the secondary shutter being opened by the revolving slits in good time before the slits themselves come into action. The revolving shutter also carries a cam which operates the switch controlling the lamp under test. The contacts are carried on a large wheel under the revolving slit. By rotating this wheel the position of the contacts is moved so that the cam lights up or, alternatively, switches off the lamp at a varying interval before the shutters open. As the motor revolving the shutter and cam is fitted with a centrifugal governor, the speed of revolution is constant at 30 r.p.m., and the wheel carrying the contacts can be calibrated accurately in units of time. One half of the wheel is calibrated with white

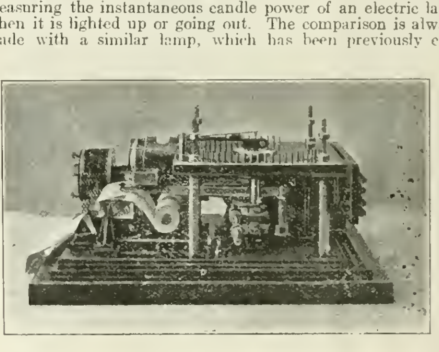


Fig. 5.—Machine Running Recorder.

figures in hundredths of a second, from 0 to 1 second, representing intervals of time after lighting up, and the other half of the wheel is similarly calibrated in red to represent intervals of time after switching off.

Other instruments shown were totally-enclosed pyrometer indicators, a McGregor-Morris anemometer (Elec. Rev., September 10th, 1920, p. 345), a "Cambridge" thread recorder, a six-string galvanometer, an electrical CO_2 indicator (Shakespear patent), &c.

The Cox-Cavendish Electrical Co., Ltd., exhibited X-ray equipment for the routine examination of materials of low density by means of a conveyor band which is made to pass beneath the screen. A new X-ray plate was also shown by the use of which it is claimed that exposures may be reduced to 1/25th of the normal.

Messrs. Cuthbert Andrews's exhibit consisted of a show case containing a number of modern X-ray tubes of British manufacture, together with protective devices, such as aprons, gloves, masks, &c. There were also shown electrodes for use in high-frequency treatment, and an improved Walter pattern of penetrometer for estimating the penetration of X-ray tubes; a practical demonstration of the making of small pieces of bench-blown glassware was given.

The Foster Instrument Co.—Everything on this firm's stand was shown working. A portable pyrometer indicator of "Resilia" construction, was mounted upon a "bumping" stand to demonstrate its robustness; it was calibrated for a Hoskin's alloy thermocouple outfit. A special spring mounting was utilised in the millivoltmeter shown to provide a very open scale, allowing fine readings without the errors possibly introduced by set-up zeros; the readings msy be made with ease to 0.2 per cent. of the scale. The instrument, which was fitted with an enclosed rotary switch and a lamp for illumination, was mounted on a swivel bracket and calibrated as an indicator for platinum-platinum-rhodium thermo couples. Various other pyrometric outfits and accessories were shown in addition to a Humfrey autographic notched bar and an Eden-Foster repeated impact testing machines.

Messrs. Crompton & Co., Ltd., claim special advantages for Robertson's combination bridge and potentiometer, which was designed for educational laboratories to meet the double purpose of an ordinary four-gap slide-wire bridge and a simple form of potentiometer; the list of experiments which can be carried out by means of the apparatus is extensive. The stroboscopic vibrator that wss demonstrated consisted of an electrically-maintained tuning fork of large size, which was arranged to periodically admit light to the eye or to the body in motion. It can be driven by energy derived from two storage cells, and can be started by gradually turning the regulating screw until the platinum contacts touch, and the amplitude of the vibrator can be adjusted by the same screw. Each limb of the fork is surmounted by an aluminium vane in which slits are cut; by means of two thin slits, each equal to the amplitude of the arms, placed directly opposite when the fork is at rest, slit vision can be obtained giving glimpse frequencies of 12,000 per minute. By means of the second slit, which is normally covered by the edge of the vane, but which is periodically uncovered when the vibrator is in action, edge frequencies of 6,000 per minute can be obtained. The firm's low-voltage potentiometer for pyrometry has several novel features, the chief of which is that the standard resistance coils are made of manganin, and all the connecting studs for contacts of copper, thus ensuring freedom from thermo-electric forces within the instrument itself. The range is up to 20 mV, but a change-over switch is provided for converting the instrument into a standard potentiometer with a range up to 2 volts. The Kelvin bridge shown had both variable ratios and variable standard. Variation is obtained by means of switches under glass, and the coils and slide are inside the box, but can be inspected by removing the sliding bottom.

Messrs. Everett, Edgcumbe & Co., Ltd.—This exhibit, although not as large as we have known it in past years, nevertheless showed a wide range of measuring instruments, from the 2-in. dwarf pattern for X-ray and medical requirements to the 18-in. illuminated-dial sector for use in large power stations. The "Metrohm" insulation testing set, incorporating a self-contained hand generator, has a particularly long and open scale, and the "resistance metrohm" or direct-reading ohmmeter can be supplied for any range of resistance. Other exhibits included frequency meters of the moving-iron and resonance types, rotary synchronisers, relays, graphic recording instruments, and measuring instruments of various patterns. The "rotary" pattern of power-factor meter is particularly suitable in cases where the flow of power is liable to change its direction, and the precision with which the reed is picked out in the vibration tachometer, which is based on the principle that the speed of a rotating machine is determined by the vibration of a tuned reed resonating with the periodic vibration of the machine, is remarkable. The "Luxometer" hand photometer, by means of which candle power, illumination, brightness, and window efficiencies can be measured seems likely to be of considerable assistance in connection with factory lighting. It is claimed that the instrument affords a reliable guide to the efficiency of daylight illumination.

The Weston Electrical Instrument Co., Ltd., exhibited pivoted moving-coil and dynamometer types of laboratory instruments with an accuracy, it was claimed, of at least 1/10 of 1 per cent. either in d.c. or a.c. circuits of any frequency up to 133 cycles per second. Portable precision current and potential transformers were shown for use with the standard testing and measuring instruments; the latter are said to have a normal accuracy of ¼ per cent. of the full scale reading. Other exhibits comprised pyro milli-voltmeters for use in connection with thermo couples, and sensitive pivoted moving-coil micro-ammeters, in addition to various patterns of d.c. and a.c. switchboard instruments, and thermo ammeters and galvanometers for radio frequencies. The miniature precision d.c. instruments showed exceptional mechanical construction and finish; the moving system weighs only about 5 grains, and the pointers used are made of specially drawn aluminium tubing which has a wall thickness of under 0.001 in. The tail of the pointer is 0.01 in. in diameter, and is threaded with 500 threads to the inch, so as to carry the small balance weights which are used for the accurate balancing of the movement.

The Zenith Manufacturing Co. showed a range of standard resistances of various types, and tandem projector-arc resistances arranged to work two arcs alternately and maintain the load constant on the generator. Magnetic rectifiers were shown in operation; they are suitable for rectifying either one or both halves of the complete a.c. cycle, and the latest pattern is fitted with a device which ensures that the charging current will flow in the correct direction independently of the way in which the accumulator cells are connected as regards polarity.

The Concordia Electric Wire Co., Ltd., had a show case containing wire suitable for a variety of uses and covered with different substances. Samples of nickel-chrome wire and ribbon such as is used in the manufacture of elements for heating and cooking apparatus were also on view.

(To be concluded.)

THE GERMAN ELECTRICAL AND STEEL COMBINATION.

The shareholders in the two German electrical companies which are entering into a community of interests with coal and steel companies—the Gelsenkirchen Colliery Co. and the Deutsch-Luxemburg Mining & Ironworks Co.—have now approved the terms of the agreement of the proposed association. At the meeting of the Schuckert-Electricity Co., on December 28th, the method of pooling the net profits was explained. It was stated, for instance, that the Gelsenkirchen Co., the Deutsch-Luxemburg Co., and Siemens & Halske Co. would each receive 100 parts of the profits, while the Schuckert Co. would participate to the extent of 45 parts. The meeting decided to issue 6 per cent. preference shares for 70,000,000 marks.

The speech delivered by Herr C. F. von Siemens at the meeting of the Siemens & Halske Co., on December 28th, of which an abstract is given below, should be premised by an explanation of the terms used with reference to vertical and horizontal communities of interests. The latter are associations of interests of firms producing the same or similar classes of products, while the former comprise amalgamations or interconnections of works whose products complement each other, and lead from raw materials up to highly finished manufactures. The meeting sanctioned an increase in the share capital by 4,000,000 marks to 130,000,000 marks, and the issue of 6 per cent. preference shares for 130,000,000 marks.

Herr von Siemens's Views.

Herr C. F. von Siemens, dealing first with the advantages expected from a close co-operation between various branches of industry, stated that the solution of coming years and the distant future was represented by the highest technical development of material taking into consideration that its final object was the maximum economic utilisation. In such technical progress would also be found the economic forces which would render it possible again to take up the contest in the markets of the world, and combinations must take place for that purpose. It would, however, be impossible to decide in general whether the vertical or the horizontal structure was the more correct. The company had reached the conviction that in the present case, and without falling into the errors of a fixed mould, the principle of the vertical combination must be adopted, as it was necessary in present times, both for the producer of raw materials and of semi-finished products, to occupy himself more fully with their conversion into manufactures. At present, when intelligence and valuable human labour only remained in their possession, they must take care that the little material they could derive from the soil was placed on the world's markets only in a highly improved or finished condition embodying a lot of labour. It would be impossible for the Germans to create a world monopoly. At the most they could build up artificial monopolies in the country, but only in certain cases would these obtain a better utilisation of the material, and thereby a cheapening of the final product. A combination in common progressive work between individual vertical members of industrial life was no monopoly and no restriction of any kind whatever; it sought for its superiority in free competition at home and abroad solely in technical and economic perfection. An inland monopoly would only receive an incentive to progress when it had to fight against other foreign monopolies in the world's markets.

Coming to consider the essential points of the agreement forming the community of interests, Herr von Siemens explained that unceasing co-operation could only be guaranteed when an internal economic unit had been created which worked solely according to technical and economic points of view, and excluded separate financial interests. As a consequence the fundamental tendency of the agreement was that all the companies could only have a common economic object; and precautions had also been taken that separate advantages could not be created through a dissolution. The common economic interests would be formally watched over by a head organisation bearing the name of the Siemens-Rhine-Elbe-Schuckert Union, which would be specially concerned with the guiding lines for the general business policy and the financial measures. In the first place, consideration had been given to the necessity of leaving freedom of action to the individual members, and therefore the feeling of responsibility of their managers was fully maintained. The internal co-operation was to be attained by an interchange of directors between the companies. As to the question of the distribution of profits, the chairman stated that precise values could not be determined in present times owing to the continually changing values. It had, however, been agreed that each partner should have the same share in the financial proceeds with the exception of the Schuckert Co., which as a result of being a smaller undertaking, would receive 0.45 of one share instead of a full share.

The chairman proceeded to state that the community of interests conferred an enlarged security on the shareholders, as the risk was divided in a double respect, namely, according to professional and territorial points of view. If political difficulties arose in one part of the country which hindered an economic conduct of business, it could probably be assumed that this would not be the case in other districts, and the industry would be maintained at least in some parts of the community. Financial economic advantages would result from the better distribution of the stocks of raw materials and of semi-finished products. There was no intention of obtaining the requirements of one undertaking exclusively from the others. The mutual requisitions of materials in the best case would only form a small part of the total production of the individual members, but the agreement ensured the procuring of raw materials in times of extreme scarcity. In conclusion, the chairman expressed the hope that through this close connection between the old Mark, Rhineland, and South Germany, a new bond would be formed between important parts of the country, which would show the world that the Germans were united and wished always to remain united.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Handy Concrete Mixer.

Labour is such an important item in present-day building costs that it pays to use machinery even on a comparatively minor operation. That this is being recognised is proved by the popularity of small concrete mixers, which are being successfully used under circumstances which would have been considered impossible a few years ago. The Westminster Electric Supply Corporation, Ltd., has recently purchased a Jaeger concrete mixer for use on the building and street works which the company has frequently to carry out; the Corporation undertakes its own contracting, and the accompanying illustration shows the mixer in use on the reconstruction of the boiler house at Eccleston Place, where certain steam-raising plant is being removed to make way for transformer chambers —this being part of the scheme for converting the old steam generating station at Eccleston Place into a sub-station. It is anticipated that the mixer will be of considerable use in connection with the foundations for new machines, and for concreting in the long runs of trench work required for mains extensions.

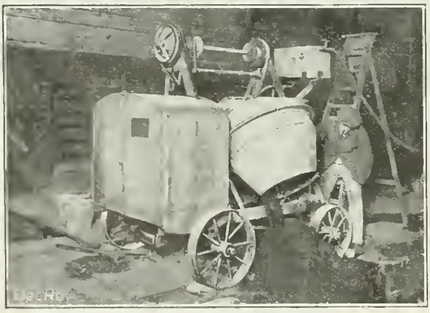


Fig. 1.—Jaeger Concrete Mixer in Use.

The Jaeger concrete mixer referred to, which is supplied by Messrs. Millars' Timber and Trading Co., Ltd., of Pinners' Hall, E.C.2, is, on account of the ease with which it can be moved from one job to another, particularly adapted for such work as that undertaken by the large electricity undertakings, where, as a general rule, and especially as regards work carried out in public thoroughfares, speed is essential.

A Mercury Circuit Breaker.

The Absolute Con-Tac-Tor Co., of Chicago, has placed on the market a hermetically sealed circuit-breaking device which can be used as a switch or to make and break an electric circuit rapidly. The contactor (fig. 2) consists of a glass tube containing a certain quantity of mercury, an inert gas to prevent oxidation or combustion, and two central electrodes with a gap between. The electrodes are connected to outside brass caps at each end of the tube. The simplest type of these contactors is operated by being tilted so that the mercury makes and breaks the circuit between the electrodes.

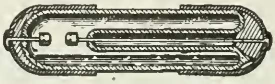


Fig. 2.—A Mercury Circuit Breaker.

In the relay form of construction the necessity of tilting is eliminated by the use of a hollow iron cylinder which is lined with an inner sleeve of porcelain. The gap between the electrodes is inside the iron cylinder, which is actuated by a magnetic coil around the glass tube.—*Electrical World.*

The Wickman Screw Gauge.

The Wickman adjustable thread snap gauge claims to effectively and rapidly gauge screws, and is worthy of study inasmuch as the advantages claimed for it are numerous. Fig. 3 illustrates the gauge, which is supplied by Messrs. Alfred Herbert, Ltd., of Coventry, and which has been developed from the plain adjustable snap gauge. The anvils supplied with the gauge are threaded according to the various pitches which it may be required to gauge, and the front set of anvils has what is known as a "full form" shape, viz., the anvils represent a perfect thread of the particular pitch

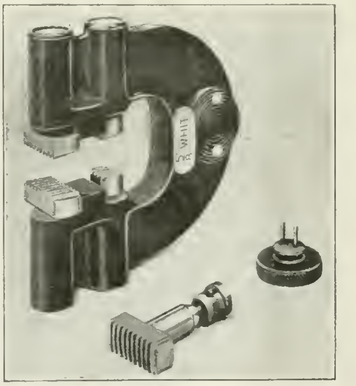


Fig. 3.—Wickman Screw Gauge.

they are required to gauge. As diameters are adjustable, these anvils have only to be correct in form of thread and pitch. The second set of anvils is cleared on the major and core of the thread, so that they only test the effective diameter or flank of the thread to be gauged. This feature overcomes one of the chief faults of the ring gauge, viz., the passing of screws with threads which are too thin for mechanical strength. By adjusting these "no-go" effective anvils below standard size to some predetermined amount, it is possible to set the limit on the thinning, or decrease of effective diameter below which the "no-go" anvils will pass over the work, and so reject it. If the work also fails to pass the first set of anvils, the operator can hold the gauge up to the light, with the work between the anvils, and see exactly what element of the thread to be gauged is in error. With a weekly inspection of the gauges, there never need be an error, it is claimed, greater than .0002 between the set-up gauge and the hardened ground standard. The gauge is sealed by means of lead seals pressed into position by a special press which can be locked. This press indents the users' monogram in the lead seals, and it is impossible to remove it without detection. The adjusting screw is underneath the locking screw, which in turn is under the lead seal, so that no screw or pin is exposed, effectually preventing any possibility of tampering therewith.

An Opal Glass Gasfilled Lamp.

As has been the case with a great many more inventions, the gasfilled lamp has been badly abused, at any rate as regards its smaller sizes, by being employed without any sort of diffusing device to relieve the eye-straining glare. In there circumstances we are pleased to hear from The Edison Swan Electric Co., Ltd., of Ponders End, Middlesex, that it has placed a lamp (fig. 4) on the market to remedy this rather serious fault. This lamp, called the "Fullolite," is made of opal glass, giving perfect diffusion of light. The surface of the globe is smooth, and the dust-collecting defects of sand-blasted or acid-treated glass do not appear. The new lamps are manufactured in all standard voltages and ratings up to 200 watts.

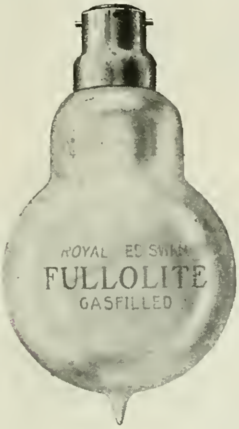


Fig. 4.—The "Fullolite" Gasfilled Lamp.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Home Lighting Economies.

Has not your correspondent "E. R." turned down Voltman's suggestion somewhat reproachfully?

I have had this system in successful operation in my house for at least five or six years, during which the only attention I have found necessary is the occasional topping-up of the 4-volt accumulator. I use 6-volt steering-pillar lamps, and my 60 ampere-hour cell is not only in circuit with the whole house lighting, but also with my heating circuit.

My use of the cell being practically continuous (for back hall and landing lights, which are, of course, only intended to render "darkness visible"), I find that I never require to use the change-over switch provided for cutting the cell in and out of charge.

In addition to operating small lights, as above, and for cupboards, &c., I also run my clock, and see no reason why I should not operate the bells, except that the wiring for them is imbedded in the plaster, and appears to be of inferior insulation. I have found the cell useful for a safety lamp on my iron circuit controlled by a d.p. switch, one pole on the power main and the other on the cell. This was the only apparent solution to repeated failures of shunted lamps, and some warning is essential with electric irons.

I have been careful to insert the cell and connections in the neutral wire, so that ordinarily they would not be subject to any potential difference much above earth, and in the unlikely event of rise of pressure on this otherwise neutral wire, the fuses on the cell connections would be blown before any weakness on them could let a dangerous current pass. The cell itself stands in the usual insulated tray, and is not subject to the open-circuit supply voltage, being permanently in the neutral wire.

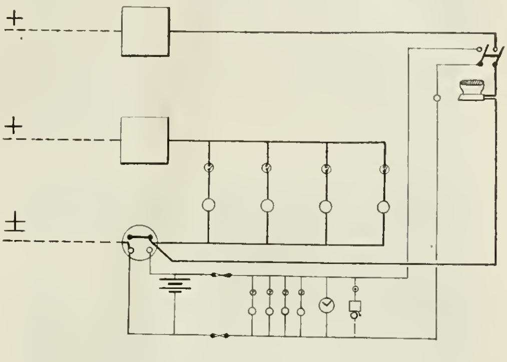


Diagram of Connections.

W. H. R.

I was interested in "Voltman's" suggestion for the economical illumination of inaccessible places and dark recesses, but more particularly in "E.R.'s" comments in your issue of January 7th, with which I in part agree and in part disagree.

"Voltman's" suggestion is quite sound in principle if properly carried out. It is a scheme of which I have made use for several years now with success.

I will take "E. R.'s" points in the order in which they come. The argument that the flexible and miniature switches and lamp holders usually associated with 4- or 6-volt lamps are quite unsuitable for connection to a 230-volt circuit does not apply in most cases, as almost invariably one of the mains is at zero potential, or nearly so, in relation to earth, and it is naturally on this main that the cells are put in series with the full voltage lamps so as to be on charge whenever a big lamp is in use. This is necessarily the case where a three-wire system of distribution is used, as is usual for d.c. work. Under these circumstances the low-voltage circuit will *never* be alive to the full pressure of the supply; as "E. R." states, the only pressure existing on or between any of the wires will be a matter of a few volts.

It is true that if accumulator cells of the acid type are used for this purpose, the system is not safe, unless under constant supervision, as there would be some small danger, as "E. R." states, of the cells going dry. This danger, however, is one that would not often occur, as it takes a long time for cells to go dry. A more obvious danger is that occurring from corroded terminals. If the circuit through the cells gets broken by corrosion or otherwise, then there is danger of an arc occurring and a fire being started, especially if the cells are of celluloid, and no doubt fires have been caused in this way.

In my own arrangement I make use of alkaline cells in which the connections are solid steel bolted, and there is no possibility whatever of the connection being broken if correctly carried out. There is also very much less topping up required with these cells, especially if the small lights take about as much current as the big lights put in.

I find that the system on these lines is quite automatic in action, the voltage of the cells rising just at the time when it is wanted to light the small lamps. On my system the small lamps are in pantries, lavatories, small bedrooms, and bed-reading lamps, and are mainly required after the full-voltage lamps have been on for some little time. The system can be, and has been absolutely left for two months or more without any trouble of the kind that "E. R." mentions. Occasional replacement of small lamps is required, as would be expected.

Regarding also the idea of running lamps in series, I may say that I have in addition a system of running five 50-volt, 10-watt lamps in series for lighting landings, passages, and hall, which is also very satisfactory.

E. Fowler Clark.

Derby.
January 17th, 1921.

Shop Displays.

I have been interested in the correspondence of Mr. Marshall Carr, "Retailer," and others, and would suggest that instead of asking why things are not done, they should ask themselves: "What are they doing?" and whether they are not in a large measure responsible for the present state of affairs?

The E.C.A. has done, and is doing, good work, and could do more if every contractor was loyal to the Association; but its efforts are crippled by the outside contractor, who, instead of joining with others in an association, prefers to do as he likes.

The trade unions have a nasty name for this class of man. I suggest that instead of writing futile letters they should join the nearest branch of the Contractors' Association.

Their enthusiasm and assistance will be welcomed.

One Who Knows.

January 12th, 1921.

I note that Mr. Tate, the secretary of the N.F.E.A., has "had his attention drawn" to my previous letter in your valuable columns. The prominence given to this letter by you has brought me numerous letters, all of which agree with my views contained therein.

I do not propose to follow Mr. Tate's example in mud throwing, or to take up your space unnecessarily.

My so-called personal grievances are, it is quite evident, general grievances, and what Mr. Tate is satisfied to term "vague charges", are in fact clear, inasmuch as I say distinctly: The N.F.E.A. as at present constituted has proved itself wholly incapable of dealing with problems all-important to the majority of its members, whilst pandering and legislating to the benefit of a possible minority, which is made up of those who formulate the legislature, pass it in committee, and push it through.

I repudiate Mr. Tate's statement that I or my firm thanked the solicitors for their so-called help, and it must be evident to your readers that the matter in question, viz.: Supply company's charges to consumers for service mains, cannot be of any financial interest to us, and only in endeavouring to protect the public are we concerned. With all deference we submitted this to the E.C.A., which refused to take it up, and advised us to deal direct with its solicitors; this we did, and paid their costs ourselves, and at the same time put numerous clients in communication, all of whom, including ourselves, got no satisfaction. Perhaps Mr. Tate will obtain the letters of thanks from our clients and allow you to publish them.

The last paragraph of Mr. Tate's letter is wholly misleading; suffice it to say that the management of funds received by the N.F.E.A. under the cable makers' agreement is on a par with the unbusiness-like methods they adopt.

The subsidy fund contribution has not been paid, as this is our only means of protest.

In conclusion, not being hypocrites, we cannot practise loyalty as suggested by Mr. Tate to an Association which is beneficial only to those who run it, but suggest to Mr. Tate that the first step towards loyalty would be from the Association to its members.

Watson Marsh & Co. (Hampstead), Ltd.,
M. Cohen,
Managing Director.

Hampstead.
January 17th, 1921.

Cost of Living in Tanganyika Territory.

Could you possibly give me any idea of the general conditions prevailing in Tanganyika Territory, Africa, in the central station line, also any information regarding cost of living, &c.? If you happen to have any information regarding those things I should be obliged for it.

Q.

January 12th, 1921.

[Correspondence on this subject is invited.—Eds. Elec. Rev.]

The Life of Metallic-filament Lamps.

As your correspondent "Dudlux" remarks, it is high time that a protest was raised against the great inferiority of the metal-filament lamps at present being supplied to the British market. All the various makes seem to be far below their pre-war or even "wartime" quality, as regards both life and candle power.

Our experience during the last few months is that fully 20 per cent. of the "vacuum type" fail prematurely, and quite 40 per cent. of the "gasfilled" break down almost immediately. Although the makers are generous in replacing these defective lamps, there is no doubt that the bad quality of electric lamps is doing the electrical world much harm, owing to annoyance caused to consumers and consequent loss of faith in electricity as an illuminant.

During the war there was perhaps a legitimate excuse for the lamp makers, as raw material of the correct kind was difficult to obtain, but surely two years of peace should be sufficient for them to put their house in order.

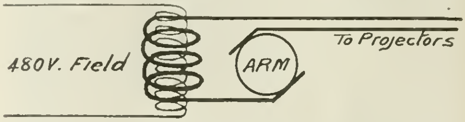
If the lamp makers were to devote more money and attention to perfecting their products, instead of to huge advertising schemes, prices would fall, as the cost of replacing the present number of defective lamps must be enormous.

Norman Aish.

Bournemouth.
January 15th, 1921.

A Generator Problem.

Referring to Mr. Robinson's and Mr. Besley's letters of the 8th inst. on the above subject, probably the following sketch will be of some assistance.



This is a 4-pole machine, and has no interpole coils, so I should not say that the compound is actually the interpole winding.

Wireman.

January 15th, 1921.

A Curious Phenomenon.

The correspondence *re* "A Curious Phenomenon" brings to mind an incident which happened during the early days of the war.

I was then a wireless operator stationed at Rosyth Naval Base; our wireless room was lighted by means of acetylene gas. I noticed that whenever the key was depressed the flame grew smaller, and that as long as the key was depressed the flame remained small. The spark was uncovered, and in the same room as the gas light.

There may be some explanation to be found in the fact that electric waves and light waves travel at the same speed.

Jacraigie.

Huddersfield.
January 15th, 1921.

Underground Tie Lines.

I notice that in the discussion at Glasgow on Mr. Woodhouse's paper Mr. N. C. Bridge is reported as having said that he thought there was no advantage to be gained in power transfer lines, because, first, the line might not be used except once in a way for a period of a year, and secondly, the amount of generating plant necessary for the passage of the energy through the tie line must be kept available at both stations.

It is true that for both stations to get the full advantage of the tie line the obligation must be reciprocatory, but this does not necessarily involve that the smaller station should always have the requisite amount of power lying idle, because it does not follow that the time of the year at which the other station requires the power will necessarily coincide with the maximum demand on the smaller station.

The point, however, which I would like to emphasise is that if tie lines of this nature are being considered, and if the standing charge on these tie lines is worked out in terms of so much per unit, the figure necessarily comes very high, because the total number of units passed over the tie line is so low. If, however, the standing charge on the tie line is divided by the total number of units supplied by the generating station, and not by those supplied over the tie line, a comparison is then obtained in terms of per unit with the total costs of the said generating station; and without going now into details, I believe, for example, that it will be found that on a tie line 30 miles long, and capable of transmitting 30 per cent. of the output of the generating station, or, say, 30,000 kVA, the cost of the tie line would not add more than 3 per cent. to the cost of the unit as turned out by the generating station.

If this be so—and I believe it is capable of demonstration—then surely that is a much smaller handicap on the generating station than even the normal fluctuation in the price of coal or wages, and may be looked upon as of the nature of an insurance, in return for which one may save the whole of the generating plant from being seriously overloaded for a period, it may be, of some months, resulting no doubt in a considerable shortening of its ultimate life; or, alternatively, one may take on 3 per cent. additional consumers (and thus pay for the insurance) without appreciably diminishing the 30,000 kVA required to be available. What one would really do would, of course, be to put in the tie line for 33,000 kVA, so as to get the 30,000 kVA after the 3,000 kVA for the new consumers had been deducted.

Where transformers of the suitable pressure already exist at both stations, the supply and running of the cables should surely be a work involving *greatly* shorter periods of time to carry out than the putting down of new generating plant, and affording great opportunities for the utilisation of rough labour, which in the present state of the country's finances would seem to be a good investment.

A. M. Taylor,
Hon. Major.

Birmingham.
January 14th, 1921.

Freemasons' Lodges for Engineers, London Area.

Having noted Mr. V. Delebecque's remarks concerning Freemasons' Lodges for engineers, I should be pleased to hear if there are any such lodges in London.

I shall be pleased if all those interested will communicate with me.

E. Boulter.

Harrow-on-the-Hill.
January 17th, 1921.

[In London the Telephone and Kelvin Lodges are restricted to electrical engineers, and in Middlesex the Electric Lodge, meeting at Hampton Court, is mainly electrical. Other London engineering Lodges are the Vulcan, Archimedean, Hardware, and Junior Engineers.—Eds. Elec. Rev.]

[Many letters have been received too late for insertion.—Eds. Elec. Rev.]

LEGAL.

Theft of Lamps.

Thomas Harrison, a labourer, was charged at Rotherham recently with having stolen electric lamps valued at £2 10s. from Messrs. Steel, Peech & Tozer, Ltd., and Messrs. W. Cooke & Co., Ltd. It was stated that the accused was employed by a contractor carrying out work on the Templeboro' extensions. The lamps had been taken from the stores of the firms concerned, access having been obtained by means of skeleton keys. Previous convictions were proved, and the prisoner was sentenced by the Bench to three months' imprisonment with hard labour.

Bedser *v.* Evans.

At Bishop's Stortford, an action was brought by Mr. P. H. Bedser, electrical engineer, to recover from Mr. E. A. Evans, rope maker, the sum of £76 19s. 2d. for electrical work which had been executed and materials supplied. According to a report in the local Press, counsel stated that in August last the defendant, who had premises next door to the kinema, of which Mr. E. E. Smith was proprietor, was desirous of installing electric light and taking the power from the engine at the kinema. Plaintiff told the defendant that the cost would be approximately from £70 to £80, and particularly if Mr. Smith's employé helped with the wiring. It was important for the order to be accepted that it should have been given at once, but owing to the cost of materials the defendant did not proceed further with the matter at that time. When the plaintiff came to do the work he charged fair and reasonable prices, and his original bill included an amount which he thought Mr. Smith would expect for allowing his man to assist in the work for the defendant; but he understood Mr. Smith said that he did not want anything out of it. An amended bill was sent in in April for £125; the defendant paid £50 on account, and it was for the balance that the plaintiff now sued. The case was heard at length, a good deal of technical evidence being given as to the installation of the electric light and the price of the materials which were used, and subsequently a private consultation between the parties took place. A settlement was arrived at, with judgment for the plaintiff for £50, in addition to the sum already paid into Court, such amount to include costs.

Apprentice's Appeal Dismissed.

The Court of Session, Edinburgh, on January 15th, disposed of a stated case in an arbitration under the Workmen's Compensation Act between an apprentice electrician of Shotts and the Baton Colliery Co., Ltd., Shotts. In the lower Court the Sheriff refused to grant the lad compensation because it was held that severe burns which he received on his hands through contact with a live wire were incurred while doing work which was outside the sphere of his employment. The lad appealed against this finding. The Court of Session affirmed the decision of the lower Court, holding that he had added a peril to those imposed upon him by his contract of service, and dismissed the appeal.

BUSINESS NOTES.

Company Liquidation.—High Temperature Generators, Ltd.—Winding-up voluntarily. Liquidator, Mr. F. Morse, 1 and 2, Great Winchester Street, E.C.

Trade Announcements.—The Sunderland Forge and Engineering Co., Ltd., announces that the new address of its Belfast branch is Sydenham Road Works (off Queen's Road), Belfast. Telephone: No. 5036. Telegrams: "Marr," Belfast.

Messrs. Hogan & Wardrop, of 2, Gresham Buildings, Basinghall Street, E.C., the London and District representatives of the Midland Electric Manufacturing Co., Ltd., inform us that their agency has been extended to cover the whole of the South-Eastern Coast from the Wash, and the Southern Coast to Chichester.

Messrs. Wallis-Jones & Dent, consulting engineers (Mr. R. J. Wallis-Jones, M.Inst.C.E., M.I.E.E.), have removed to their new offices at Adams House, 23, Old Queen Street, Westminster, London, S.W. 1. Telephone: Victoria 8070. Telegrams: "Alteration," Victoria, London.

On and after the 31st inst. the London offices of the Parsons Marine Steam Turbine Co., Ltd., and C. A. Parsons & Co., Ltd., will be at 56, Victoria Street, S.W. 1.

Lead.—Messrs. James Forster & Co. state that the following particulars of lead supplies for 1920 disclose how much we have been dependent during the year on Government stock, and the abnormal supply of chemical scrap lead from dismantled war plant:—

Board of Trade Returns.

	Imports. Tons.	Exports. Tons.	Left for home absorption. Tons.	
January	5,888	4,679	1,209	
February	8,598	5,611	2,987	
March	13,600	7,527	6,073	
April	10,436	4,910	5,526	
May	14,568	3,317	11,251	
June	9,343	3,680	5,663	First half 32,709
July	12,587	3,960	8,627	
August	14,767	5,107	9,660	
September... ...	16,872	8,866	8,006	
October	16,128	7,083	9,045	
November	17,279	3,934	13,345	
December	22,784	3,099	19,685	Second half 68,368
	162,850	61,773	101,077	
January 1st.—Stocks in Government stores		54,975		
December 31st.—Stocks in Government and public warehouses ...		19,045	35,930	
Total for home absorption ...			137,007	

The imports from Australia amounted to 59,987 tons, or 37 per cent. of our total imports, and owing to the strike at Broken Hill were entirely from stock. There is now no stock in Australia therefore for the time being this source of supply is cut off. From Spain we received 58,149 tons. An additional source of supply last year, which is also exhausted, was obtained from the dismantling of chemical plant erected by the Government during the war, which accounted for several thousands of tons.

Messrs. G. Cawson & Co. report:—Lead is coming forward very slowly, and there is very little lead on the market except a few second-hand parcels. It rather looks as if this position may be maintained, as there is very little lead afloat for this country. Were it not for the general slackness of trade the position would seem to warrant an improvement in price. Consumers have been making some small purchases to cover actual requirements, but are not operating by any means freely. Should the financial position become easier, and trade be thereby encouraged, this position may perhaps change.

Bankruptcy Annulled.—At the Leeds Bankruptcy Court, on January 11th, Oswald Carr, formerly in business as an electrician, at Oak Works, Headingley, Leeds, applied for the annulment of his bankruptcy, which took place in 1911, he having paid his debts in full. Mr. W. H. Clark, solicitor, on behalf of Carr, stated that debtor had obtained work on the West Coast of Africa, and had been able to make sufficient money to liquidate his debts. He was now on holiday in this country. Mr. J. W. Gillespie (Registrar) granted the application, and commented upon the debtor's creditable action.

Catalogues and Lists.—Lamlok, Ltd., 36, Rusthall Avenue, Chiswick, W. 4.—A blotter advertising "Lamlok" electric lamp locking rings, lampholders, and adjustable cord grips.

The Aqua Electric Heater Co., 168, Regent Street, W. 1.—A leaflet illustrating, by means of a cut-away drawing, the construction of the "Aqua" instantaneous electric water-heater, delivering hot or cold water from the same tap.

The Hart Accumulator Co., Ltd., Marshgate Lane, Stratford, E. 15.—Leaflet illustrating and describing "M-E" type ignition batteries; priced. Also a folder giving the various sizes of "Hart" batteries suitable for replacing the existing batteries on American cars imported into this country.

The Electric Construction Co., Ltd., Dashwood House, 9, New Broad Street, E.C. 2. Two well-produced booklets dealing with the "E.C.C." small house lighting sets. One is an illustrated specification of the plant, giving prices; the other contains a number of hints on starting and running, with diagrams and illustrations.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—A showcard (19 in. × 4½ in.) advertising the "Magnet" pedestal electric heater, and depicting a lady in an evening gown bathed in the heater's cheerful rays.

L. G. Hawkins & Co., 116, Charing Cross Road, W.C. 2.—Booklet No. 665, dealing with "Universal" electric grills and portable ranges, and giving a large number of recipes which may be prepared with these appliances.

The Edison Swan Electric Co., Ltd., Ponders End, Middlesex.—Pages 101, 102, 107, 108, 111, 112, 113, 114, 115 and 116 of new instruments list, illustrating and describing moving coil switchboard type instruments, including voltmeters, ammeters and horsepower meters.

International Film Traders (Alfred Lyons & Co., Ltd.), 5, Denmark Street, Charing Cross Road, W.C 2.—Seven illustrated and priced leaflets dealing with kinematograph outfits, electrical instruments, motors, carbons, switches, fuses and other kinema accessories.

Gent & Co., Ltd., Faraday Works, Leicester.—Postcard (No. 44), dealing with iron-cased electric bells of various sizes for both a.c. and d.c. Priced.

Alfred Herbert, Ltd., Coventry.—A souvenir brochure giving a number of views of the company's works. The illustrations are very clear, and disclose a wide range of operations.

C. A. Vandervell & Co., Ltd., Acton, W. 3.—Folder "L." A well-illustrated price list of various types of electric horn for use on automobiles.

J. & W. B. Smith, Ltd., 15-23, Farringdon Road, E.C. 1.—Catalogue No. 143. An excellent example of publicity matter consisting of 223 pages of illustrations of artistic electrical fittings and glassware, including chandeliers, pendants, statuettes, table standards, crystal fittings, bowl fittings, Holophane reflectors, ships' fittings, &c.

E. P. Allam & Co., 107-109, Gray's Inn Road, W C. 1.—Monthly Stock List, No. 5, of d.c. electric motors for sale or hire.

The London Telephone (New System) Co., Ltd., Donington House, Norfolk Street, Strand, W.C. 2.—A folder illustrating an interconnecting 'phone system, and embodying an application-card for a demonstration.

The Lanston Monotype Corporation, Ltd., 43 and 44, Fetter Lane, E.C. 4.—"The Monotype Recorder," containing advertisements of printing machines, &c., sold by the company as well as two or three interesting notes on the "monotype" and some users.

Austin Walters & Son, Gaythorn Electric Works, Little Peter Street, Manchester.—A profusely illustrated leaflet describing tandem resistances for kinematograph work and theatre light "dimmers."

Calendars.—Messrs. Smith & Co., electrical and mechanical engineers, 17, West Tower Street, Carlisle, have issued a calendar bearing a picture of an "old salt" telling "A Likely Story."

Messrs. C. Purden, Ltd., mill and factory furnishers, Lancaster Street, Birmingham, have sent us a charming three-quarter length picture of a lady. The monthly date-slips are printed in bold figures.

In sending us a calendar adorned with a handsome picture of the "Incoming Tide," reminiscent of St. Bees, Messrs. Fredk. Hodgson & Co., Ltd., quote their motto:—"Satisfied clients by thorough work make lasting reputation."

Messrs J. Culkin & Co., electrical engineers, 1b, Skinner Lane, Leeds, have forwarded a calendar bearing a picture entitled "The Path of Dreams," portraying a lady seated upon a terrace gazing pensively at the sea in which the "sun's declining rays" are reflected.

Mr John D. Mackenzie, 155a, St. Vincent Street, Glasgow, has sent us a calendar with bold-figured monthly sheets. Against each date is a small space for memoranda.

Messrs. W. T. Henley's Telegraph Works Co., Ltd., inform us they have a number of refills left suitable for use in the calendar which they issued last year, and if any of their customers have retained the last year's calendar and would care for a refill, they will be pleased to forward one on request.

For Sale.—Messrs. L. Farmer & Sons inform us that the auction sale on February 8th and following days, of electrical equipment and stores lying at Woolwich Arsenal and Dockyard will, for the convenience of purchasers, be held at the Commercial Sale Rooms, 30, Mincing Lane, E.C.

By direction of the Disposal Board, Ministry of Munitions, Messrs. G. N. Nixon & Co. will sell by auction, on February 1st and following days, at the R.A.O. Depôts, Park Lane, Aintree, and Burscough, near Liverpool, a quantity of electrical material and equipment, comprising motor-generator sets, electric lighting plant, batteries, switchboards, &c.; Warrington Corporation Electricity Department has for disposal five Babcock & Wilcox water-tube boilers, coal bunkers, delivery shoots and coal conveyer; West Bromwich Corporation has for disposal two Babcock & Wilcox boilers with Foster superheaters, &c., two Weir feed pumps; the plant and machinery section of the Disposal Board has for sale by public tender, 150,000 inert cells, by Siemens & Halske, lying at Wood Lane, Shepherd's Bush, and Richborough; Messrs. Geering & Colyer have been instructed by the Disposal Board to offer by auction, on February 3rd and 4th, at Earl's Court Exhibition, and at the C.S.D. No. 5, Wood Lane, Shepherd's Bush, a quantity of machine tools, railway material and electrical equipment. For particulars see our advertisement pages to-day.

Proposed New Works Department.—It is announced that the Treasury has been asked to sanction the creation of a works department at the Office of Works. For a start it is proposed to spend £28,000 on plant and £4,000 a year on additional staff. The manager is to receive £900 a year plus bonus.—*The Builder.*

Socials.—The officials and members of the Mains Department of the Southport Corporation Electricity Department held their annual social gathering on January 12th. Dinner was followed by an excellent musical and humorous programme. The proceedings throughout were of a highly enjoyable character.

On Friday evening, the 7th inst., the London Office staff of Messrs. Boving & Co., Ltd., and Electro-Metals, Ltd., together with their friends, were entertained to dinner at the Holborn Restaurant by their directors, this being followed by a musical programme and dancing.

On January 15th the staff of the Foster Engineering Co., Ltd., held a fancy-dress dance and social at Wimbledon. Over 100 guests were present, and the costumes were original and varied to a degree. The dance music was ably supplied by Mr. C. B. Jone (piano) and Mrs. Moxan (violin). A waltz selection was given by the "Wimbledon Juvenile Orchestra," under the able direction of Mrs. Moxan. Mr. "Dick" Williams admirably filled the post of M.C. during the evening. The party broke up at 11.45, with the singing of "Auld Lang Syne" and the National Anthem.

On January 5th the second of a series of socials was held in the Bristol showrooms of the Edison Swan Electric Co., Ltd., under the chairmanship of Mr. Fifield. A varied programme of songs, dialogues, recitations, and a conjuring display made the evening a complete success.

Book Notices.—"Lockwood's Builder's, Architect's, Contractor's and Engineer's Price Book for 1921." (429 pp. and supplement, 284 pp.) London: Crosby Lockwood & Son. Price 7s. 6d. net.—The preface to the present edition of this work includes a set of diagrams showing the rise in the costs of wages and materials since 1914. Among the new features is the form of building contract and schedule of conditions issued by the Institute of British Architects, and the supplement consisting of the London Building Act, 1894, and amending Acts has been brought up to date by notes on recent decisions in the Courts. The general index has been transferred to the front of the volume for ease of reference.

"*Journal* of the Institution of Electrical Engineers." Vol. LVIII, No. 295, September, 1920; and index to Vol. LVIII. London: E. & F. N. Spon, Ltd. Price 10s. 6d.—This issue contains the following papers: "Thermal Efficiency of the Generation and Use of Gas and Electricity," by Sir Dugald Clerk; "Permanent Magnets in Theory and Practice," by Mr. S. Evershed; "Electric Railway Contact Systems," by Sir P. Dawson; "Application of the Electric Locomotive to Main Line Traction on Railways," by Lt.-Col. H. E. O'Brien; "Contract Prices," by Capt. W. P. Digby; and "Use of Vacuum Tubes for Wireless Transmission and Reception," by Mr. J. Scott Taggart.

"The Inventors' Annual Review," a record of progress and achievements (22 pp.). London: The Inventors' Union. Price 1s. net.—This new publication covers a wide field embracing every department of invention and discovery. The Severn barrage scheme is dealt with at some length, and the aims and objects of the Inventors' Union are set out. An article advocating an "All-Empire" scheme of patent protection, also appears.

"The Callender Kay Poles for Power Transmission Lines" (78 pp). London: Callender's Cable and Construction Co., Ltd. Price 5s.—This is a well illustrated brochure describing the design, construction, and erection of an improved means of supporting aerial transmission lines and distributing their weight. The towers were introduced in 1912, but the war retarded their development. The illustrations are very clear and instructive. A large photographic reproduction is given of four spans of a line erected for the South Wales E.P.D. Co. between some of the South Wales hills.

"*The Electrical Engineer's Diary*, 1921." Thirteenth edition. London: S. Davis & Co. Price 10s. 6d. The additions to the latest issue of this invaluable work include articles on mercury arc rectifiers, a comparison of old and new cable standards, fault localisation, insulation tests, vulcanised rubber cables, centrifugal fans, portable electric tools, automatic telephone systems, electric hot-plate efficiencies, vacuum cleaners, and extracts from the I.E.E. regulations for the electrical equipment of ships. Perhaps the most important innovation is the introduction of a section dealing with electric vehicles and trucks, in which are given comparisons of various types, costs of operation, descriptions of accumulators, and a great amount of other information. We are interested to note that the objectionable term, "half-watt," in connection with lighting has given place to the more truthful adjective, "gasfilled."

For the convenience of those who wish to carry the Diary about with them an edition in limp covers has been prepared from which the ruled memoranda pages have been omitted. An interesting point about this publication is that, although it has increased twelvefold in size since its first appearance, the present price is only four times that of the original.

"Factory Administration and Costs Accounts." By E. T. Elbourne. Pp. xx + 811. London: Longmans, Green & Co. Price 45s. net.

"The Theory of Direct-Current Dynamos and Motors." By J. Case. Pp. xiii + 196; 120 figs. Cambridge: W. Heffer & Sons, Ltd. Price 15s. net.

"Lubricating and Allied Oils." By E. A. Evans. Pp. xv + 128, 25 illustrations. London: Chapman & Hall. Price 9s. 6d. net.

Copper Prices.—Messrs. F. Smith & Co. report January 18th:—Electrolytic bars, sheets, wire rods and H.C. wire, no change.

Messrs. James & Shakespeare report January 19th:—Copper bars (best selected), sheets and rods, £127, £3 decrease; English pig lead, £25, 20s. decrease on last week's prices.

American Inventors and the Peace Treaty.—American inventors, it is said, are losing their patent rights abroad through the failure of the United States to ratify the Peace Treaty.—*The Times.*

A Transformation Scene.—Recently the Bute Saw Mills, Luton, were changed over from *batswing gas burners* to electric lighting, with "Mazdalux" intensive reflectors and Mazda gas-filled lamps, giving an illumination of six foot-candles with an expenditure of 0·65 to 0·7 watt per square foot. We are not surprised to learn that this drastic change has exerted a beneficial influence on the comfort and output of the workers, though we were astonished to hear of the survival of the open gas-flame in a large workshop, containing moving machinery, so far into the 20th century. The Illuminating Engineers' Department of the British Thomson-Houston Co. was responsible for the scheme.

Electricity Supply Rifle League.—The results of the final (December) matches were as follows:—Shoreditch, 573—City Co., 565; City Co., 574—St. James's, 553; Metropolitan, 583—Central, 561; Central, 562—St. James's, 546; Metropolitan, 575—St. James's, 518. Shoreditch are the winners of the shield and medals for 1920, with a total of 26 points; the Metropolitan team were the "runners up," with 24. Hampstead and Poplar had to drop out early in the season owing to their inability to raise teams.

Taxation of Vehicles.—A contributor to *Motor Transport* says that electric vehicle owners can congratulate themselves on the fact that the weight of these vehicles taken into consideration in the new vehicle taxation scheme is the weight without batteries. In this way the chassis weight of most electrics is about the same as that of a petrol or a steam vehicle of equal carrying capacity. The tax will, therefore, fall practically equally on each. Taking the figures for a two-ton electric chassis, the average weight appears to be just over the two-ton limit, and, therefore, the tax will be £25; if the weight of the battery were included, the amount payable would be £28. By using strong but lighter materials in both chassis and body, makers may be able to keep their two-ton vehicles within the limits of the £21 tax.

B.T.H. Dinner.—The foremen of the switchgear works of the British Thomson-Houston Co., Ltd., held their first dinner in the Duke's Room at the Holborn Restaurant on New Year's night, when a company of about 50, including a few members of the office staff, sat down to an excellent repast. The chair was taken by the manager, Capt. C. R. Acklom, R.N., C.B., C.B.E., supported by Mr. A. Cresswell as vice-chairman. Mr. H. Trencham (chief engineer), in proposing "The Chairman," complimented Capt. Acklom (who has been but a short time at Willesden) on the thoroughly capable manner in which he had assumed command. The manager suitably replied. During the evening a most enjoyable entertainment was given, under the direction of Mr. Albert Nelson, who is a member of the staff of the Willesden works. A feature of the programme was the fine singing of Mr. Frederick Shaw, of the Royal Opera, Covent Garden, whose exquisite tenor voice was greatly appreciated by all.

Motor Cycle Lighting.—In the recent London-Exeter 24-hours' continuous run reliability trials for motor cycles, the only 2½-h.p. machine to receive a Gold Medal was a Metro-Tyler, driven by J. S. Bennett. This motor-cycle was in one respect unique, *i.e.*, unlike many other competing cycles, it depended for lighting its front and rear lamps entirely upon a combined magneto and lighting set, which was a B.T.H. "Sparklight," and which for 15 hours on the outward, and for 5 hours on the return journey, gave perfect lighting, the accumulators being as fully charged at the end as at the beginning of the journey. The B.T.H. "Sparklight" set uses the idle half of the voltage wave generated in the low-pressure winding of a single cylinder magneto—and usually wasted—for charging the battery or supplying the lights. The above performance speaks well for the reliability of these sets.

Industrial Questions.—On Wednesday evening, at a meeting of the Industrial League and Council, held at the Caxton Hall, Sir George Paish lectured on "World Finance." Next Wednesday, 26th inst., "Unemployment: the Best Means of Dealing With It," will be the subject of an address by Mr. E. W. Petter. The lectures, under the auspices of the Industrial League, will continue to be held regularly each Wednesday evening at Caxton Hall, until March 30th, and among the subjects to be dealt with are:—"Some Factors in Present-day Industry," by Prof. A. W. Kirkaldy, M.A.; "Payment by Results," Mr. E. J. P. Benn; "Control of Industry," Mr. H. H. Elvin; "Health in Industry," Dr. E. Halford Ross; "Scientific Management as a Factor in Production," Mr. A. R. Stelling; "The Ex-Service Man and his Reinstatement in Industry," Mr. C. Latham; "Some Obligations of Industry to Labour," Mr. T. W. Casey, M.P.; "Works Committees and their Functions," Mr. Robert Young, M.P.; "Industry and its Relation to Finance," Mr. H. G. Williams, M.Sc., &c.

South Wales Wages Reduction.—The South Wales copper workers have agreed, says the *Evening News*, to accept a 5 per cent. reduction in wages. It was stated that unless the men accepted the proposal the works would have to be closed down.

Metal Prices, 1920.—Messrs. The Metal Information Bureau, 7, East India Avenue, E.C. 3, have sent us a copy of their "Metal Chart" for 1920, which shows very clearly the official day-by-day average prices of copper, tin, spelter and lead for the past 12 months. The remarkable fluctuations in tin and copper make the chart of more than ordinary interest and utility.

Dangerous Processes.—The Home Secretary has certified the following processes incidental to the manufacture of india-rubber, and of india-rubber goods, to be dangerous:—(*a*) Vulcanising by means of the process known as the cold cure process; (*b*) any other process involving the use of carbon bisulphide, sulphur chloride, carbon-chlorine compounds, or benzol; (*c*) any process involving the use of lead or lead compounds.—*The Times.*

The Shut-down at Ilford.—The following official statement has been issued by the Electrical Power Engineers' Association:—

On December 11th the National Joint Board officially requested the Ministry of Labour to bring pressure on those undertakings which had refused to accept the Schedule and Conditions, and the E.P.E.A. agreed with the Ministry to deal with these undertakings in groups according to the District Areas.

In District Area No. 10 (Greater London) there were 53 undertakings, of which only four were defaulting—Hackney, Hornsey, Finchley, and Ilford. A meeting of representatives of these four undertakings and the E.P.E.A. was held in December, and the undertakings were given 10 days in which to decide to pay. Hackney, Hornsey, and Finchley complied, but Ilford agreed to accept the Schedule and Conditions in their entirety for six months only, and also circularised other Councils to support it in repudiating the Schedule at the end of six months.

The E.P.E.A. notified the Ministry of Labour that this qualified agreement would not be accepted, as the Association would not give preferential terms to undertakings merely because they held out to the end.

The Ilford Councillors explained to the Ministry that their resolution was not intended to mean what it said. They said that the intention of the Council was to accept the Schedule, and at the end of six months they intended to review the situation, but the Schedule would continue to be paid at the end of the six months unless they passed a resolution to cancel it.

The E.P.E.A. intimated to the Ministry that if the resolution intimating acceptance had no time-limit incorporated in it, so that it was not more favourable to Ilford than to the other undertakings which had accepted, they would exempt Ilford from the strike, and the Ilford councillors promised the Ministry to call a special meeting the next week to alter the wording of the offending resolution, and to make it say what they had all along intended it to say.

At the next Ilford Council meeting, however, by 9 votes to 7, the previous wording was confirmed, and the E.P.E.A. gave its final warning—24 hours' notice.

It seems that Ilford Council had just previously only partly paid a recommendation of the Industrial Council to its workmen, and had refused to arbitrate on the claim of the clerical staff for the Civil Service Award. These other workers were, therefore, anxious to press their claims at the same time as the E.P.E.A. In the case of Ilford, the E.P.E.A. claims are a very small part of the price which the Council will have to pay now to get a settlement, and other undertakings will probably think very seriously before driving the E.P.E.A. members into a strike.

It is reported that the Ilford District Council remains obdurate; on January 17th it was even proposed to dismiss all employés of the Council who were on strike, and to fill their places, giving a pledge that those engaged should be retained in service so long as they proved themselves competent. But Sir David Shackleton, on behalf of the Ministry of Labour, induced the Council to defer decision, and to send a deputation to interview Dr. Macnamara. It will not be forgotten that the Southampton Town Council pledged its honour to retain in employment members of the E.P.E.A. who enabled it to carry on supply during a strike last year, and within a few days it shamelessly broke its pledge, to its lasting dishonour. What value will any honest man, then, attach to the pledge of a local authority?

It appears that the strike embraces not only the technical staff of the electricity works, but also the administrative and clerical staff of the Council and the non-trading manual workers; these three parties have joined hands to enforce the adoption of the awards of three distinct Whitley Councils, which have been generally accepted by other local authorities. Ilford Urban District Council is clearly "recalcitrant."

An Imperial Patent System.—The unfair exploitation of inventors was the subject of discussion at the first meeting of the recently-incorporated Institute of Patentees, held on January 12th. Sir Harry S. Foster, the president, said that one of the objects of the Institute was to persuade the various Legislatures within the Empire to adopt a system of Imperial Letters Patent. The present necessity of taking out a separate patent in each of the Dominions involved great expense, and in some cases great hardship on the inventor.—*Morning Post.*

Electricity Supply Wages Award.—According to the *Daily Herald*, the National Joint Industrial Council for the Electricity Supply Industry has agreed to put in operation the award for No. 10 Area, which was recently accepted by a ballot vote of the workpeople concerned. The award will give increases ranging from 3s. to 12s. 3d. per week, and it is to be retrospective, to September 1st, 1920. The National Council, while agreeing to put the award in operation, states that it does not agree with the principle involved. An application has been made to No. 9 Area Council for similar rates to those awarded by No. 10 Area Council, and was to be considered in London on Tuesday last.

New Commercial Agreement between Canada and France.—Canada has concluded a commercial agreement with France under which a minimum Canadian Customs tariff will be put into effect in exchange for a minimum French tariff on almost the whole list of articles included in the last commercial treaty with an extensive list of articles not previously included. The agreement also provides for a fixed percentage tariff on certain other articles, some of which were included in the last Convention at minimum rates. The agreement remains in force until a more permanent agreement is negotiated and is subject to cancellation at four months' notice.—*Reuter's Trade Service* (Ottawa).

Selling Benjamin Industrial Illumination. — The Benjamin Electric, Ltd., is conducting a well-planned advertising campaign, which is designed to raise the standard of industrial illumination throughout the country, by bringing home to the works owner, the architect, and the consulting engineer, in a convincing manner, the necessity of correct practice, and its importance as a factor in increasing production. A striking series of full-page advertisements has been prepared, which does not include illustrations of the many types of fittings that the Benjamin Electric, Ltd., manufactures; these advertisements are designed to sell "better illumination," rather than any particular type of reflector, and will appear in the Press of the following industries, quite apart from the general advertising in the electrical trade papers:—Mechanical engineering works, iron and steel foundries, paper mills, shoe and leather factories, textile mills, shipbuilding and shipping. In addition to these Press advertisements, over 52,000 letters (enclosing reprints of the advertisements) and folders are to be distributed through the post to owners of works and factories in all industries, and also to consulting engineers, architects, &c. Special letters and printed matter are being sent to those concerned with the sale and installation of Benjamin reflectors, including electrical contractors throughout the country, and the sales engineers on the staffs of the wholesale distributing firms. It is considered that the campaign will form one of the most effective sales helps to the dealer and contractor yet launched by any manufacturer. The ground will be thoroughly prepared by the advertisements and messages to the users referred to above, which are intended to eliminate what is perhaps the greatest difficulty of the salesman—that of getting the "prospect" interested. We are informed that considerably over 250,000 pieces of printed matter have had to be produced and collated for this campaign; the amount of detail work involved in a scheme of this magnitude can be readily imagined. We think that for the initiation and execution of a scheme of this nature and magnitude, which obviously will benefit not only the firm itself, but also the electricity supply undertakers, manufacturers, contractors, and last but not least important, the consumers, the Benjamin Electric, Ltd., deserves the cordial thanks of the whole industry.

A Celluloid Bill.—According to the *Birmingham Post*, already protests are being registered against the provisions of a Bill the London County Council intends to promote in the new Session to regulate the sale and storage of celluloid. The Celluloid Act of 1915 is proposed to be so amended as to provide that warehouses and shops in which articles containing 10 per cent. or more (by weight) of celluloid are kept or stored in such quantities that the weight of celluloid exceeds in the aggregate 112 lb., shall be included within the statutory definition of a celluloid stores, thus becoming registerable, and having to adopt certain precautions against fire. At present the storage of celluloid articles on wholesale or retail shop premises is entirely free from regulation; but the difficulty is to estimate the percentage of celluloid present in a given manufactured article, and in many cases it is asserted the amount is so small as to be a negligible quantity as far as fire risks are concerned.

The Cable-Makers' Association.—We are asked to state that, in accordance with a rearrangement of the organisation of the Cable-Makers' Association, Mr. Llewelyn B. Atkinson, M.I.E.E., who took up the secretaryship of the Association during the war, will in future act and sign as Director. The secretary in future will be Mr. W. G. Stiles, F.C.I.S., who has been assistant secretary for some time past.

American Plant for Japan.—The Nippon Electric Power Co., of Osaka, Japan, has given the contract for the supply of overhead transmission cables and sundries, for a service of 140 miles, to the Blaw-Knox Co., of Pittsburg, Pa., U.S.A., says the *Financier*.

Industrial Administration.—We have received a copy of the first number of *The Journal of Industrial Administration* (January, 1s. 6d.) It is edited by Mr. E. T. Elbourne, and contains a report of addresses and discussions before the Institute of Industrial Administration at Westminster, and in the general notes we observe particulars of two instructional courses which have been arranged by the management, dealing with Production Estimating and Production Costing.

A North Sea Ferry.—On January 12th a conference was held between delegations of Swedish and British business men to discuss the establishment of a ferry between this country and Sweden. Mr. Ahlberg, who holds a high position in the Swedish State Railways, indicated some of the advantages attendant upon such a scheme. The ferry ship, designed by Mr. Hok, would be constructed to carry a load of 500 tons in trucks. It was suggested that there should be four of these placed in service; the journey to and from Sweden would take four days.

Industrial Depression.—In the Special January Number of *The British Trade Review*, Mr. F. G. Kellaway, P.C., M.P., head of the Department of Overseas Trade, contributes an article tracing to-day's commercial depression to its origins in the war period, and exhorting British producers and traders the world over to realise that "courage is the need of the moment." Elsewhere it is shown that conditions all over the world are much the same at present; most countries find it difficult, it is remarked, to sustain the progress made in the "boom" at its height a year ago. Commerce is now organised to such a pitch that the prosperity or failure of any of the great trading powers has immediate effects on the condition of the rest.

LIGHTING AND POWER NOTES.

Abersychan.—Electricity Supply.—The Urban District Council is applying to the Electricity Commissioners for powers to generate and supply electricity in the Urban District of Abersychan, and to sell electric fittings, apparatus, &c., and to open showrooms, &c.

Belfast.—Extensions Needed.—In a report to the City Council, Messrs. Preece, Cardew & Rider stated that the probable maximum demand for the coming winter would be 21,740 kW, and this would increase to 28,240 kW in 1922. The present safe maximum combined output of the East Bridge Street and Harbour stations was 19,000 kW. A deduction of 500 kW would have to be made from this total for the working of auxiliary plant. Provision had been made for the installation of a 12,500-kW set at the Harbour station, but further extensions would have to be considered within the next 18 months. It was estimated that the total cost of completing the first section of the Harbour station and a sub-station with necessary feeders and distributors for the Ballymacarret district would be £361,800. The minutes of the Electricity Committee embodying the report were adopted.

Birkdale.—Price Increase.—The Electricity Supply Co. has signified its intention of raising its charges to the same level as those of the Southport Corporation. Birkdale is a part of the borough of Southport.

Birmingham.—The Case for Extensions.—The City Council, last week, adopted the recommendation of the Finance Committee, and deferred the question of proceeding with the second scheme for the enlargement of Nechells generating station owing to financial stringency. Mr. E. P. Beale, the chairman of the Electricity Supply Committee, made a strong appeal to the Council not to hinder the work of the department. He pointed out that the whole of the plant was working at its fullest capacity, and that there was no spare plant of any kind to take the load of any machine that might break down. The supply of power was so short that they had had to buy bulk supplies from the Dunlop Rubber Co. to the extent of 12,000 h.p., and from the Shropshire, &c., Electric Co. to the extent of 4,000 h.p. Many manufacturers had been placed on short supply, with the result that hours of work had had to be curtailed. The department was unable to take over any new business, and there were now between 3,000 and 4,000 applications for energy for power or lighting. Some of these people had been waiting for supplies for several years. Mr. Beale contended that a plentiful supply of power was absolutely vital to a manufacturing city like Birmingham, and the expenditure proposed would be wholly productive. Alderman Williams, chairman of the Finance Committee, expressed the hope that within a year it might be possible to finance the undertaking, but at present it was out of the question.

Blackpool. — Loan Sanctioned. — The Council has received permission from the Electricity Commissioners to borrow the sum of £30,000 for additional plant and extension of the power-station buildings.

Bo'ness.—Extensions.—The Town Council is applying for permission to extend the electricity works and to install a 1,000-kW turbo-generator and a new boiler, at an estimated cost of £45,000.

Carmarthen.—Cost of Street Lighting.—The Town Council, on Wednesday, considered a letter from the manager of the Carmarthen Electric Light Co., asking the Council for sanction to a further increase of 50 per cent. on the charge for public lighting. An increase of 20 per cent. had already been granted. The company urged that it had to bear an increased cost of over 200 per cent. above the pre-war level. The Council refused the application.

Clones (Co. Monaghan).— Public Lighting.— The Urban Council received a bill for £70 10s. for the last quarter's public lighting by the local electric lighting company. During a discussion it was asserted that the lighting was "too strong," and representations are being made to the company on this subject.

Continental. — Denmark. — The Gudenaa-Central, at Tange, in Central Jutland, was to be officially inaugurated on January 8th. This new hydro-electric power station, which is the largest of its kind in Denmark, has six turbines which drive three generators and can develop 6 000 h p. The fall is 9·5 metres. The power station was built by Hampman, Kierulff and Saxild; the Swiss firm, Brown & Boveri, supplied the electrical distribution plant; the turbines were made by a Swedish firm, while the generators were manufactured by a Danish company, A/S Titan. A high-pressure cable leads direct to Aarhus, where a large new transformer station has been built. A similar cable connects Skive with the power station. Power is generated at 10,000 V, which is then transformed to 50,000 V, at which pressure it is conveyed to Aarhus and Skive. The total cost of the new works is estimated at 10 million kronen.—*Reuter's Trade Service* (Copenhagen).

Belgium.—Out of the 53 concessions for the supply of electrical energy for lighting and power purposes in Flanders held by the company, the Société des Centrales Electriques des Flandres is at present supplying 40, the total number of consumers being 12,700. The power station at Langerbrugge has at present a capacity of 10,600 kW, but this will shortly be increased by the addition of a new 6,600-kW turbo-generator. In addition, arrangements have been made to increase the capacity of the plant to 24,000 kW, as soon as this becomes necessary. The high pressure (12,000 V) distribution system has been increased by 40 miles, and now extends to nearly 140 miles, while in addition there are 156 miles of low-pressure mains and 100 transformer stations with a total capacity of 14 000 kVA.

Cuba.—Sale of German Stations.—The Electric Light and Power Investments Co., of Berlin, which owns three small electricity supply works in Cuba, is in negotiation for the sale of two of the works, and the transaction has so far proceeded that the transfer will be effected at a profit in dollars.

Dundalk.—Need for Extensions.—In submitting three alternative schemes for the augmentation of the municipal generating plant, Mr. Spalding, the engineer and manager, states that at certain peak load periods the output of the station has been 14 per cent. in excess of its generating capacity—the difference being met by the storage batteries. The following are the suggested schemes :—(*a*) Extensions comprising one 500-h p. steam engine with boiler, chimney, economiser and accessories ; (*b*) one 500-h.p. gas engine with producer plant and accessories ; (*c*) one 300-h.p. Diesel engine and accessories. Mr. Spalding recommends Scheme (*c*), which although engendering a higher capital cost than the others, will prove more economical in working. His second choice falls on Scheme (*a*).

Electricity Districts.—South Wales.—The latest date for the receipt of representations regarding the South Wales Electricity District has been altered to October 31st, 1921, instead of April 30th.

North Wales and Chester.—The Electricity Commissioners will hold a local inquiry at the Assembly Room, Town Hall, Llandudno, on February 15th, 1921, at 10.30 a.m. and following days, with reference to the area to be included in the above-named district, and the schemes which have been submitted by the North Wales Power and Traction Co., Ltd., and the Corporation of Chester for the formation of a Joint Electricity Authority. Copies of the respective schemes may be obtained from the North Wales Power and Traction Co., Ltd., Clark Street, Dolgarrog, North Wales, at a cost of 5s. each, and from Mr. J. H Dickson, Town Hall, Chester, at a cost of 3s. 6d. each.

Falmouth.—Proposed Price Increase.—The Town Council is again protesting against an application of the local electricity supply company for permission to increase its charges from 7d. to 1s. 2d. per unit. The existence of a four years' street-lighting agreement has been brought to the notice of the Ministry of Transport.

Frinton. — Proposed Price Increase.—The Urban District Council is lodging an objection to the application of the Frinton Electric Light and Power Co. for permission to increase its maximum charge from 9d. to 1s. 2d.

Gillingham (Kent).—Loan.—The Town Council is applying for sanction to a loan of £10,000 to cover expenditure on mains for the ensuing two years, and an overdrawal of accounts in this connection.

Halstead (Essex).—Electricity Supply Company.—A limited liability company, with a capital of £12,000, has been formed with the object of supplying electric lighting and power to the town.

Harrogate.—Loan.—The Town Council is applying for the sanction of the Electricity Commissioners to the borrowing of £6,390 for the installation of a new condensing plant at the electricity works.

Llandaff.—Loan Sanctioned.—The Llandaff and Dinas Powis Rural District Council, Cardiff, has received sanction from the Electricity Commissioners to borrow £3,782 in connection with the electrical undertaking.

Lyme Regis. — Purchase of Undertaking.—The Town Council on January 11th decided to exercise the option of purchasing the electricity supply undertaking for £4,250, subject to safeguards as to the loan being forthcoming. Mr. H. T. Tilley, who was engaged as valuer, estimated the installation to be worth £3,869. The prices given in the report for the existing generating plant, meters, poles, &c., were those which he would expect to be obtained at the present time, but the figures for the overhead and underground cables were what he considered them to be worth as an installation. Considerable outlay would have to be made in the near future. The approximate outlay necessary to install a new generating set, cables, &c., now required, would be £5,895.

Newport (Mon.).—Extension of Supply.—The Corporation is applying to the Electricity Commissioners for powers to extend the area of supply of electricity to include the parishes of Bettws, Duffryn, Malpas, and St. Woolos, the urban district of Caerleon, and the parishes of Christchurch and Nash, all in the county of Monmouth.

New Zealand.—Lake Coleridge.—For the financial year ended March 31st, 1920, the load on the Lake Coleridge, N.Z., power house increased from 5,900 kW to 7,066 kW, the stated plant capacity being 6,000 kW. The capital outlay increased during the year from £403,157 to £422,076, the increase being mainly in making provision for a new generator of 4,000 h p. now being installed. The revenue for the year was £45,831, and expenses as follows :—Working expenses, £17,759 ; interest, £16,863 ; depreciation and reserve, £7,624 ; total, £42,246. The result of the year's operation is thus a net profit of £3,585 towards reducing the deficit on the four previous years' working. The revenue for the previous year was £37,324, and the expenses £40,159, the deficit being £2,835. The deficit in 1915-16 was £17,649 ; in 1916-17, £11 956, and in 1917-18, £4,241. The output for the year from the power house was over 33,000,000 units.—*Commonwealth Engineer.*

Slaithwaite.—Electricity Supply.—The Huddersfield Corporation is applying to the Electricity Commissioners, under the Electricity Supply Acts, for an order authorising it to supply electricity for all public and private purposes within the urban district of Slaithwaite.

Torquay.—Interview with Commissioners.—At a recent meeting of the Town Council a report was received from the deputation which interviewed the Electricity Commissioners in November last. The deputation pointed out that to raise the sum of £250 000 necessary for the suggested erection of a power station at Newton Abbot, was at the present time impossible, unless assistance was obtained from the Government. Failing that, it might be possible to induce a private company to carry out the scheme. Sir John Snell, in reply, stated that the erection of a new station in the area was very necessary. The Commissioners had no funds for the subsidisation of schemes, and he knew of no company that would be likely, or willing, to take over Torquay's obligations. In any case, it would cost a company more to raise the necessary capital, which would engender higher charges for electricity. If, however, the Council still favoured recourse to a private company, Sir John recommended approaching the Urban Electric Supply Co., now supplying part of the area.

The engineer was instructed to report upon the suitability or otherwise of the Medical Baths site for a power station, and also to ascertain from the company supplying Newton Abbot if it would be prepared to enter into a contract for a bulk supply from the Newton Abbot station when erected.

Tredegar.—Lighting Order.—The Council was recently reminded that the provisions of the clause in the Tredegar Parliamentary Bill relating to electricity had to be carried out within a period of two years, and that the proposed scheme had to be presented for approval within six months. It was decided to frame a scheme for submission immediately.

Truro.—Lighting Order.—The Electricity Commissioners have written to the City Council asking what steps have been taken in the carrying out of the provisions of the Electric Lighting Order granted in 1913. The question was referred to the Finance Committee.

Walsall.—Condensing Water Supply.—The Town Council proposes that, subject to the approval of the Board of Trade and the Electricity Commissioners, an agreement be entered into with the Birmingham Canal Navigations, under which the Corporation will pump canal water from one level of the canal to another, sufficient to meet the company's requirements, and utilise the water for condensing purposes at the Corporation generating station. The company will be relieved of certain pumping work now carried out by it, and is to pay the Corporation £3,000 per annum. The scheme involves a capital outlay of £21,000, of which amount £14,000 is included in £119,500 which the Corporation is authorised to expend in the completion of the generating station. —*Birmingham Post.*

Walton-on-Thames.—Proposed Price Increase.—The Urban District Council has decided to oppose the application of the Urban Electric Supply Co. for sanction to further increase charges for electricity.

Warrington. — Overloaded Plant. — The Electricity Committee finds itself unable to meet fully the demands of its consumers. The Ministry of Transport has sanctioned the purchase of two 6,000-kW turbo-generator sets (three were authorised by the Council), but delivery is not expected until the beginning of next year.

Warwick.—Inquiry.—On January 11th, an inquiry was held by the Ministry of Transport into the application of the Warwick and Leamington Electrical Co. for permission to increase its charges. The town clerk said that it was unfair to fix prices for five years at a time when the cost of production was at a maximum. He also asked for an adjournment of the inquiry, complaining that he had received none of the data upon which the proposed increased prices were based. A fortnight's postponement was agreed to.

West Hartlepool.—The Corporation is applying to the Electricity Commissioners for a special order to extend the area of supply of electricity to include part of the parish of Stranton in the Rural District of Hartlepool.

TRAMWAY AND RAILWAY NOTES.

Australia.—Melbourne.—Although the profit from the tramway system is stated to be "infinitesimal," the Tramway Board has decided not to increase the fares. The Melbourne system will therefore still be one of the cheapest, if not the cheapest, for travellers in the whole world.

Bradford.—Protest against Railless Cars.—The proposed substitution of railless traction in place of the present rail traction on the Idle and Thackley routes has raised a storm of protest from residents in that district, and opportunity is to be afforded them for protesting before any decision to effect a change is made.

Chile.—Railway Electrification.—Provision is to be made in the new loan of £7,775,000 in gold by the Government of Chile for the electrification of the State railways, the purchase of new equipment, and the operating deficits for the past three years. —*Financial News*.

Continental.—Sweden.—The question of the electrification of the Swedish State railways, and particularly of the line between Stockholm and Gothenborg, appears to have entered upon a new stage since the return from the United States of Mr. Granholm, general manager, and Mr. Ojverholm, principal of the electrical department of the State railways. It was decided some time ago to adopt the single-phase system, as used on the frontier railway, for the projected conversion of the Stockholm-Gothenborg line, and a sum of 75,000,000 kronen was voted by Parliament for the purpose. Before these decisions were reached the Special Committee which investigated the problem of electric railway working suggested that firms representing the direct-current system should also be permitted to submit offers, but the Railway Administration rejected this recommendation on the ground that a postponement of a decision as to the choice of a system would only aggravate and confuse a problem which was already difficult, without obtaining any counterbalancing advantages. The working of the direct-current system in the United States, however, has created a favourable impression on the general manager and the electrical engineer, and it is now assumed that the question of the system to be adopted will undergo re-examination. In discussing the question, a Swedish newspaper suggests the possibility of the direct-current system being decided upon as possessing great advantages, and that in this event it would be impossible for Swedish firms to deliver the plant on account of the lack of that experience in this direction which would permit of their successfully competing with foreign rivals, and the Americans in particular. It would not be good economy in these times of scarcity of money, the newspaper remarks, to borrow 75,000,000 kronen, of which a considerable amount would cross the Atlantic ; and it is, therefore, suggested that the most appropriate course to adopt would be to postpone the whole question, while in the meantime Swedish firms would be able to render themselves capable of rescuing for Swedish industry a Government order of great economic and national importance. Two or three days after this expression of opinion the Allmänna Svenska Co. announced that the company was fully equipped and competent to co-operate in the electrification of the railways, and that the question had already been discussed with representatives of the United States General Electric Co., who launched the direct-current system. It was added that it would be of advantage for the Swedish company to co-operate with the American company in the matter, although an agreement had not been entered into for the purpose.

Germany.—The electric tramway system in Berlin, which was formerly owned by a company that paid dividends of up to 8 per cent. per annum, and which was acquired by the municipal authorities a few years ago, now shows a deficit of 74,000,000 marks. Despite constant increases in the fares it has been found impossible to balance income and expenditure, and the adverse balance is growing month by month.

Italy.—The *Morning Post* states that a violent scene occurred at the sitting of the Rome Municipal Council on January 13th, when a number of disabled ex-soldiers, armed with sticks, invaded the Council chamber and endeavoured to compel the concession of free tickets on the municipal tramways. The system is already overcrowded and working at a loss, but a compromise was reached by which all wounded ex-soldiers are to be allowed to travel free until Feb. 28th. During the interval a mixed Commission is to investigate the matter. Similar demands have been advanced in Milan. The Roman car fares have been nearly trebled, the lowest fare being 40 centesimi.

France.—A scheme has been submitted for approval to the Conseil Général du Departement de la Savoie for the complete electrification of the tramways of the Department. Four networks are in contemplation. The first is the Chamberg network, comprising 26 lines ; the second network is constituted by the Albertville to Beaufort-sur-Doron line ; the third and fourth networks embrace seven lines, at present partially served by electric trolley cars. The networks will be served by a conduit system, and the total length of the lines projected is 200 km., the estimated cost being about 80,000,000 fr.

Durham County. — Transport Scheme. — Durham County Council, on January 12th, decided to proceed with its county transport scheme, in connection with which a Bill has already been deposited in Parliament to empower the Council to construct and work tramways and to provide trolley vehicles, motor omnibuses, &c. The scheme is estimated to cost £1,631,473, of which £847,122 is for the construction of tramways and tramroads, £397,770 for the provision of electrical equipment for tramways and trolley vehicles, £120,000 for the provision of tramway rolling stock, and £143,000 for provision of trolley vehicles. Sir A. M. Palmer, in opposing the scheme, said the opposition was so great from all quarters of the county, from landowners, coalowners, local authorities, and others, that he did not think Parliament would pass the Bill. He agreed that the days of tramways were gone, and if the Council wanted anything of the kind, it should operate motor-buses. The Council went into Committee to hear the opinion of experts before coming to its decision. As the majority in favour was not a majority of the whole Council, it is expected a further meeting of the Council will have to be held to consider the matter.

Liverpool. — Proposed Purchase. — The City Council has accepted a recommendation of the Tramways, Electric Power, and Lighting Committee that, subject to the necessary power being obtained, the Corporation should acquire from the St. Helens Corporation the section of the line between Brook Bridge and Moss Street, Prescot, being Tramway No. 1, authorised by the St. Helens Corporation Act, 1898. with the right to make use of the lines between Moss Street and the King's Arms, Prescot, including the loop line and the triangle, at a price of £8,000.

New Zealand.—New Plymouth.—The municipality is purchasing new cars, &c., at a cost of £22,500. A proposal to extend the present system and to introduce railless cars, which would have cost £43,500, was defeated.

Rate-Relieving Tramways.—Comparative Figures.—A useful, as well as interesting, return has been compiled by the borough treasurer of Preston, showing the extent to which the rates of various municipalities have been relieved by municipal enterprise, tramways, &c. Bootle and Wallasey head the list with 1s. 11d. from the tramways, &c. ; Liverpool, 6½d. ; Manchester, 11d. ; Birmingham ¾d. ; Leeds, 1s. 9½d ; Birkenhead, 3½d. ; Chester, 5¼d. ; St. Helens, ½d. ; Southport, 4d. ; Warrington, 11¼d. ; Wigan, 1d. ; and Widnes, 1¾d.

Shipley. — Power Rate Increased. — The Council, having applied for an increase in the rate of payment for electricity used on tramways leased to the Bradford Corporation, has been informed that the present rate of payment will be increased by ½d. per unit on the recommendation of the Bradford Tramways Committee. The increase is retrospective to October 1st last.

TELEGRAPH AND TELEPHONE NOTES.

Cable Delays.—The delay to which the whole of the cable traffic from the East has been subject is attributed by the *Daily Mail* to the fact that on Christmas Day a fishing trawler fouled its anchor in several of the Eastern Telegraph Co.'s cables lying off the Portuguese coast.

Storm Damage.—It was announced by the General Post Office, on Tuesday last, that there would be telegraphic delay to France, Germany, and Switzerland, owing to the storm during the early part of the week. Communication between different parts of England and also with and in Ireland was also made difficult.

China.—New Wireless Stations.—The American Federal Wireless Telegraph Co., of San Francisco, has signed a contract to erect powerful main wireless stations at Shanghai, Peking and Harbin at a cost of $1,200,000. It will be a joint Chino-American operation to be controlled by the Ministry of Communications : after 10 years the system will revert to China.—*Reuter's Trade Service* (Peking).

France.—Wireless Society.—There has been formed at Paris a society for those interested in wireless telegraphy, under the title of the Radio-Club de France. Its objects are to popularise wireless telegraphy by every means of propaganda, and in particular by setting up research laboratories at its offices, and also in the principal centres ; likewise, workshops, reading rooms, and library. Other objects are stated to be visits to stations and laboratories, maintaining relations with like associations abroad, assistance to inventors and research workers, obtaining of situations, and affording pecuniary assistance to members in difficulties. Its offices are at 95, Rue de Monceau, Paris.

Italy.—Telegram Surcharges.—As from January 15th, the surcharge on telegrams to and from Italy was increased to 300 per cent., says *The Times*.

Japan.—New Wireless Station.—The wireless station at Tomioka was opened on January 11th. It is the most powerful station in the Orient, and is receiving messages direct from New York and other big world stations. Experiments in sending messages have proved very successful, and the station will commence dispatching about February 1st.—*Reuter's Trade Service* (Tokio).

Sweden.—Telegraphic Communication with Russia.—The Great Northern Telegraphic Co., of Copenhagen, is negotiating with the Government of Sweden and the Russian Soviet Government with a view to the resumption of telegraphic communication between Stockholm and Petrograd. At present the only connection which exists is the wireless one which Prof. Lomonosov has with Moscow. The company's property in Petrograd has been respected, and both it and the Swedish Telegraph Administration are prepared to resume communication at any moment. The company's Asiatic and Siberian service was maintained during the years of war with few exceptions in the case of connections with Irkutsk and Vladivostock, where transitory interruptions took place. But the connection between Europe and the East of Asia *via* Russia has been entirely at a standstill, and the company in later years has been compelled to maintain communication with its East Asiatic service through English cables *via* India. Now the intention is to re-establish the connection between European Russia and Eastern Asia at the same time as the recommencement of the service in Russia.—*Financier*.

U.S.A.—Wireless Press Facilities.—The American Publishers' Committee has sent a representative to this country for the purpose of urging the need of improved facilities for the transmission of news between Great Britain and the United States. According to *The Times*, Mr. Joseph B. Pierson, chairman of the committee, who is now in London, says that the committee was organised by the cable-using newspapers and Press associations of the United States for the purpose of securing better transmission service for news dispatches to and from all other parts of the world, but chiefly with England and France. The committee has the support of the leading officials of the Government at Washington, which has placed the extensive high-power wireless facilities of the United States Navy at its service. It is using those facilities to the extent of several thousand words daily, particularly in the Far East, and there are adequate facilities for increasing wireless messages between England and America as soon as England increases its wireless stations. It is for the purpose, Mr. Pierson says, of establishing better facilities, that the American Publishers' Committee has sent its representative to England. "Better facilities are possible, and, in fact, are in operation between France and America. The committee has the energetic co-operation of the Newspaper Proprietors' Association of London, and hopes to secure the sympathetic consideration of the British Post Office. We are asking that England should develop wireless facilities to work with American stations, and that the cables be cleared for certain short definite periods in the night and in the day for the swift transmission of news under organised management of the newspapers and news associations." Mr. Illingworth, Postmaster-General, agreed to receive a deputation from representative Press organisations last Wednesday on the subject of telegraphic communication by cable and wireless.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Aberdeen.—February 21st. Corporation Waterworks Department. Electrically-driven pumping machinery. Specifications, £5 (returnable), from Water Engineer's Office, 41½, Union Street, Aberdeen.

February 21st. Electricity Department. Temporary and permanent coal conveyors and shutes in connection with the reconstruction of the boiler house at Ferryhill. (See this issue.)

Australia.—South Australia.—P.M.G.'s Department. March 2nd. Telephone parts, Schedules 558 and 559; telegraph and telephone material, Schedule 560. (January 7th.)

Melbourne.—March 2nd and 9th. Victorian Railways. Reactances and condensers (for power signalling), electric crabs and equipment for cranes. Copies of the specifications can be seen at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W. 1.

March 31st. Electricity Commissioners. Plant for the Morwell power scheme. Telephone wire and pin-type insulators. (January 14th.)

Adelaide.—February 23rd. P.M.G.'s Department. Electric lamps, as per Schedule 561. (See this issue.)

Sydney.—March 21st. P.M.G.'s Department. Telephone and telegraph apparatus, testing instruments and switchboard parts, Schedule 814. (See this issue.)

Perth, W.A.—March 29th. P.M.G.'s Department. Telegraph accumulators, Schedule 333. (See this issue.)

Belgium.—February 1st. Municipal Council, Antwerp. Rotary converters with switchboard, for No. 77 Wharf of the Bassin Canal. Specification in French can be seen at the Inquiry Room of the Department of Overseas Trade, 35, Old Queen Street, S.W. 1.

February 3rd. Municipal authorities of Molenbeek-Saint-Jean, near Brussels. Supply of the necessary electricity meters required in connection with the local electricity supply undertaking. Particulars may be obtained from the Hotel Communal, Molenbeek-Saint-Jean, Brussels.

February 11th. Municipal authorities of Tirlement. Electricity supply in the town; (1) the supply of electrical energy; (2) the establishment of a distribution system; and (3) the concession for the supply of electrical energy for lighting and power purposes. Specification from the Secretariat Communal, Tirlement, on payment of 30 fr. The municipal authorities will decide as to the scheme to be adopted after the tenders have been opened.

The Belgian State Railway authorities, at La Salle Madeleine, Brussels, are about to invite tenders for the supply of a large quantity of miscellaneous material in connection with the electric lighting of trains.

Chester-le-Street. — January 25th. Urban District Council. Wiring 512 houses, feeder cables, overhead mains, equipment for sub-station. (January 14th.)

Edinburgh.—January 24th. Electricity Supply Department. Circulating water pipes and valves for the Portobello generating station, Specification No. 30. (January 7th.)

France.—Paris.—February 17th. The supply and installation of a multiple commutator table at the Central Telephonic Bureau in the Boulevard Raspail. Particulars from the Direction de l'Exploitation Téléphonique, 4e Bureau, 103, Rue de Grenelle, Paris.

Great Yarmouth.—February 11th. Electricity Department. Supply and erection of h.p. switchgear. (See this issue.)

Haiti.—*Le Moniteur*, the official journal of the Republic, publishes details of a contract between the Haitian Government and a firm at Jacmel for the erection of a hydro-electric plant in Port-au-Prince. There is to be one generating station and one sub-station, the former being provided with two 100-kW sets, comprising a Pelton wheel driving a three-phase 42-cycle, 600-V alternator, with the necessary switchgear and accessories. The power is to be conveyed to the sub-station by an overhead line at 8,000 V, and the consumers' voltage is to be 220. Applications for the name of the firm in Jacmel should be addressed to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1, quoting 2619/FL/PN.

Halifax. — February 3rd. Electricity Department. Twelve months' supply of stores, including electric lighting fittings and accessories, cables, v.i.r., and phosphor bronze, telephone wire, e.h.p. and l.p. cables, meters, &c. (January 7th.)

Keighley. — January 24th. Corporation. Electricity Department. Construction of 6,600-V overhead line to Easeburn. (January 14th.)

London.—Hammersmith. — January 26th. Electricity Department. Single and three-phase transformers. (January 14th.)

Paddington.—January 24th. G.W.R. stores, including telegraph instruments, electrical apparatus, electric wire and cable, &c. (January 14th.)

L.C.C.—January 31st. Electric wiring installation at the Bethnal Green Weights and Measures Office and Coroner's Court, comprising about 87 switch points and 89 lighting points. (January 14th.)

H.M. Office of Works. February 1st. Six months' supply of switches, fuses and fuseboards. (See this issue.)

Lurgan.—January 29th. Urban District Council. Four-core l.p. lead-covered and armoured cables. (January 14th.)

Manchester. — January 26th. Electricity Committee. Direct-current switchgear for Dickinson Street generating station. Mr. F. E. Hughes, secretary, Electricity Department, Town Hall.

February 14th. Electricity Department. 33,000-V trunk feeder, pilot and telephone cables. (See this issue.)

Middlesbrough.—February 9th. Corporation. Double line of tramways from Albert Road to Linthorpe Road. Particulars from Mr. S. E. Burgess, Borough Engineer, Municipal Buildings.

New Zealand. — Wellington. — March 1st. Public Works Tender Board. Seven 4,000-kVA single-phase transformers, with accessories, for Lake Coleridge electric power scheme. Copy of the specifications can be seen up to January 20th at the Department of Overseas Trade, Room 48, 35, Old Queen Street, S.W. 1.

Rosyth.—January 30th. Electric lighting work at Park Road School. Deposit, £1 1s. Mr. R. H. Motion, architect, Union Bank Chambers, Dunfermline.

South Africa. — Pretoria.—March 10th. Municipal Council. One 20-ton overhead crane, six boilers (350-lb. working pressure), three 3,000-kW steam turbo-generators with condensing plant, five 750-kW converters. Further particulars can be obtained from Mr. T. C. Wolley-Dod, general manager, electric lighting department. Specifications (five guineas) from the town clerk.

Durban.—January 26th. Corporation. Supply of telephone cable, paper sleeves, concrete pipes, and various telephone and miscellaneous accessories and materials.

February 16th. One 1,000-kW rotary converter with transformers and switchgear. Specifications of the above may be consulted on application to the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

Uruguay.—Monte Video. — May 29th. State Power House. Single and three-phase meters. Copy of the specification (in Spanish), conditions of tender and a list of spares to be provided (also of a similar call for tenders for 500 d.c. meters for the provinces), can be seen at the Department of Overseas Trade (Room 48), 35, Old Queen Street, S.W.1.

CLOSED.

Belgium.—Eight tenders were submitted to the Municipal Authorities of Ixelles, Brussels, last week, for the supply and erection of a steam turbine and alternator at the local electricity generating station. Four of the tenders came from Belgian firms, one of which quoted for either Belgian, Swiss or French plant, two quotations came from French firms, one from Brown, Boveri and Co, of Baden, Switzerland, and one from the Swedish Turbine Works (Ljungström), of Finspong, Sweden. The prices quoted ranged from 850,000 francs to 1,525,000 francs.

Glossop.—Town Council. Accepted :—

Aerial feeders, for electric lighting, on three sites, £325.—J. Swainson & Co

Leigh.—Town Council. Accepted :—

One 2,500 kW turbo-alternator, £18,694.—Fraser & Chalmers Engineering Works.
E.h.t. and l.t. switchgear, £2,420.—Ferguson, Pailin, Ltd.
One 500-kW La Cour converter, £4,070.—Bruce Peebles & Co.

Sunderland.—Corporation. Accepted :—

Spare parts for A.E.G. turbine.—J. Howden & Co., Ltd.
Spare parts for coal conveyor.—Babcock & Wilcox, Ltd.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, January 21st. At the Institution, Storey's Gate, S.W. At 6 p.m. Paper on "The Mechanical Loading of Ships," by Mr. H. J. Smith.

Junior Institution of Engineers.—Friday, January 21st. At the Caxton Hall, Westminster, S.W. At 8 p.m. Lecturette on "Motor Yachts," by Mr. B. H. Joy.

Salford Technical and Engineering Association.—Saturday, January 22nd, at the Royal Technical College. At 7 p.m. Presidential address by Mr. J. Morris. Musical social evening.

Institution of Electrical Engineers.—Informal Meeting.—Monday, January 24th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Discussion on improving the usefulness of the Institution.

Thursday, January 27th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Paper on "Temperature Limits of Large Alternators," by Mr. G. A. Juhlin.

North-Eastern Centre—Monday, January 24th. At the Mining Institute, Westgate Road, Newcastle-on-Tyne. At 7.15 p.m. Paper on "Some Economic Aspects of e.h.t. Distribution by Underground Cables," by Mr. R. O. Kapp.

North-Midland Centre.—Tuesday, January 25th. At the Hotel Metropole, Leeds. At 7 p.m. Paper on "The Distribution of Electricity," by Mr. W. B. Woodhouse.

South-Midland Centre (Students' Section).—Tuesday, January 25th. At the Birmingham University. At 7.30 p.m. Paper on "Thermionic Valves," by Mr. J. A. Cooper.

Manchester Wireless Society.—Wednesday, January 26th. At 7.30 p.m. At the Albion Hotel, Manchester.

Royal Society of Arts.—Wednesday, January 26th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "The Origin and Development of the Research Associations established by the Department of Scientific and Industrial Research," by Mr. A. Abbott.

Belfast Association of Engineers.—Thursday, January 27th. At the Municipal Technical Institute. At 6.45 p.m. Paper on "The Mechanical Handling and Conveying of Materials," by Mr. R. P. Terry.

Chelmsford Engineering Society.—Thursday, January 27th. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Electric Winders for Collieries," by Mr. C. S. Buyers.

Liverpool Engineering Society.—Thursday, January 27th. At the Exchange Hotel, Liverpool. At 7 p.m. Annual dinner.

Edinburgh Electrical Society.—Friday, January 28th. At the Philosophical Institute. At 8 p.m. Papers on "Electrical Wonders in Guernsey," by Mr. E. C. Catford.

Physical Society of London.—Friday, January 28th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary meeting.

Association of Engineers-in-Charge.—Saturday, January 29th. At St. Bride's Institute, Bride Lane, E.C. At 7 p.m. Discussion on "The Association and its Future Activities." To be opened by Mr. A. E. Penn.

Manchester Association of Engineers.—Saturday, January 29th. At the Memorial Hall, Albert Square. At 7 p.m. Paper on "Cast Iron *v.* Semi-Steel," by Mr. E. Wheeler.

NOTES.

The "Electrical Review" Index.—The Index to Vol. LXXXVII of the ELECTRICAL REVIEW, which will shortly be printed, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 6d., post free. Any reader or advertiser, at home or abroad, who requires a copy for binding or for other purposes, is asked to make early application therefor to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

Freemasonry.—The next regular meeting of the Kelvin Lodge will be held at Mark Masons Hall, Great Queen Street, London, W.C. 2., on Friday, 28th inst., at 4 p.m.

Electricity on Board Airships.—Commenting upon the passenger airships, R. 36 and R. 37, which are being built for the Civil Aviation Department of the Air Ministry, the *Daily Chronicle* states that electric cooking apparatus is to be installed, in addition to many other details to cater for the comfort and convenience of passengers.

Edison on the After-Life.—An interview with Thomas Edison, the inventor, is published in the current issue of the *London Magazine*. Although Edison does not express any definite views as to the persistence of conscious life after death, it seems clear that he regards the subject as worth careful investigation. The apparatus he is perfecting, if successful in enabling the people of this world and the spirits of the next world to communicate with each other, will cause, he says, "a tremendous sensation." Whatever Edison may have concluded as to the after-life, he is very definite as to whether the earth and its life exists simply as a result of an accident. He says:—"I can no more doubt the existence of an Intelligence that is running things than I do the existence of myself."—*The Times.*

Appointments Vacant.—Telegraph engineers (£480) for the Nigerian Government; draughtsman (£6) (temporary) for the Wimbledon Corporation electricity department; plumber-jointer for the Corporation of Salford electricity department; plumber-jointers for the Burnley Borough Council electricity department. See our advertisement pages to-day.

Norwegian Rustless Steel.—*Berlingske Tidende* learns from Christiania that the Norsk Electro-Kemisk Aktieselskab, whose works are at Tyase, has long been experimenting with a special ferro-chrome alloy, produced electrically, which will not rust, and which is not affected by most acids. The process of production is said to be so cheap that the new steel will not cost more than other kinds. The company contemplates the establishment of works for the production of the new steel.—*Reuter's Trade Service* (Copenhagen).

The Engineers' Club for London.—On Monday last Mr. Edmund L. Hill was the guest of the Batti-Wallahs' Society at luncheon at the Holborn Restaurant, and delivered an interesting and inspiring address on the Engineers' Club for London, of which he is the hon. secretary *pro tem.* Referring to his intimate acquaintance with the Manchester Engineers' Club (of which he was one of the founders and hon. secretary), Mr. Hill mentioned that Mr. H. T. Wilkinson had played a leading part in setting on foot the movement in London. At Manchester the proposal had met with a good deal of hostile criticism, and some 18 months' hard work was required to establish the Club, but it was a huge success; it had 850 members, and a long waiting list, and had a building fund of £50,000. In London the amount of adverse criticism that had been received was practically negligible. The scope of the Club should be wide, including industries allied to engineering, and both the commercial and technical sides; it would be designed not only for London, but also for members from the Provinces and the Oversea Dominions throughout the Empire. There was a possibility of securing a temporary home for the Club, in which event a start might be made by midsummer. In order to improve the "load factor" members should use it to the full; they must provide a service so cheap and efficient that members could not do without it, including ample bedroom accommodation and really good food. With regard to the all-important question of finance, Mr. Hill gave a long list of the eminent gentlemen who had promised to serve on the preliminary Organising Committee, and would have to consider this subject; he deprecated the adoption of a high entrance fee, which would keep out young engineers, but thought that an annual subscription of 10 or 12 guineas would be necessary. The service of the Club must be perfect in all respects. Such an institution was an ideal worth working for—and it would involve a great deal of hard work, to provide a fitting and abiding home for the noblest profession in the world.

The chairman, Mr. W. E. Warrilow, drew attention to Mr. Hill's great work in connection with the Federation of British Industries. Mr. Wansbrough, president of the Cable Makers' Association, proposing a vote of thanks to Mr. Hill, said that no one was better fitted than he to start the Club, and Mr. Dixon, seconding, said it was a disgrace to London that it had no real meeting place for engineers. The vote was accorded with enthusiasm and musical honours, and Mr. Hill, in acknowledging it, pointed out that the movement was not due to himself alone, but to a number of promoters.

A New German Electric Car.—The *Motor* states that a new electric motor-car is being manufactured at the rate of 100 per month by a Berlin firm. The price of the car complete is 14,000 marks—at present exchange rates, about £56.

Detecting Faults in Coils.—In our issue of January 14th, page 52, we described a method for the detection of short circuits in motor armature coils outside the motor. A correspondent asks whether any of our readers can give a description of a similar apparatus for the motor coils already in position in stators and rotors. 110-V single-phase current is available on site.

The Ilford Shut Down.—As we go to press, we learn that at 6 p.m. on January 19th a conference was held between the Council and the Ministry of Labour (represented by Dr. Macnamara, Sir David Shackleton and Mr. H. F. Wilson). Following this conference, certain proposals were placed before a full meeting of the Council, when it was agreed to adopt the E.P.E.A. Schedule immediately, at the same time calling upon the Ministry of Labour to form a Board of Appeal to which recommendations for the revision of the terms of the Schedule might be submitted.

This decision was arrived at shortly after 8 p.m. and in less than half-an-hour normal work was resumed at the electricity works.

The Stoke Newington Contracts.—The Borough Council has decided to lodge an appeal against the recent decision of the Court in the matter of pre-war contracts with the North Metropolitan E.P.S. Co.

Swedish Enterprise in Russia.—According to the Swedish newspapers, the Vice-President of the Russian Supreme Economic Council has just declared that among the concessions in course of preparation is one for the Allmänna Svenska Elektriska A.B. of Västerås, which is invited to start the construction of turbines and other plant at the company's former works at Jaroslaw. On inquiry made at the office of the Swedish company, Mr. Linden, manager of the company, is reported to have confirmed the report that negotiations for this purpose have been opened, although they are in a preliminary stage. The proposal has been initiated by the Russian authorities, and the conditions put forward correspond with those fixed generally by the Soviet Government for all possible foreign concessions in Russia. In addition to the Allmänna Co., the L. M. Ericsson Telephone Co. and the Swedish Ball Bearings Co. are in negotiation with the Soviet authorities in the matter of concessions; and the latter are also said to be proposing to grant concessions to Americans and Germans for the establishment of tanning, dye and leather works, also concessions to English firms.

A First-Aid Appliance.—A giant eye-magnet for the removal of fragments of metal from injured eyes has been installed in the operating theatre of Preston Royal Infirmary. The instrument was designed by Mr. J. F. Simpson, tramway engineer, with the assistance of Mr. G. J. Gibbs, consulting electrical engineer. The cost has been defrayed by workmen engaged in the metal trades of the district.

Fatalities.—A youth of 16, named Leslie Harrison, of Handsworth, Birmingham, was recently killed whilst engaged at the works of Messrs. J. Grove & Sons, of Hales Owen. He was in the employ of the Staffordshire, Shropshire, and Worcestershire Electric Power Co., and was sent to do work in a cubicle, and he was warned that there were live wires in it. A cry was heard, and Harrison was found bending over the wires. His work had been completed, and the foreman stated at the inquest, at which a verdict of "Accidental death" was returned, that he thought that the lad returned to the box to have another look at it before it was inspected.

An inquest was held at West Leigh, on January 14th, on John Boardman (21), of First Avenue, Hindley, who, while passing along the colliery railway line, saw an electric cable fusing, and setting fire to one of the poles. Boardman went over the hedge, and a few minutes later a companion heard a scream, and saw flames shoot into the air. Boardman was found unconscious, and he died three minutes later. The fingers of his left hand were almost burnt through. A verdict of "Death from misadventure" was returned.—*Liverpool Post.*

A New Wireless Station at Northolt.—We have received some interesting particulars of a new wireless station which is being erected by the Post Office at Northolt, which is quite close to London, lying half-way between Uxbridge and Harrow. The aerial system will consist of a triangular network, each side of which will be 650 ft. in length. and the aerial will be supported by three Elwell wooden lattice towers, each 446 ft. in height. The earth system will consist of a network of copper strip connected to metal plates buried at the bottom of the excavations made to receive the stay wire anchorages, and the tower and building foundations. The transmitting equipment, both primary and secondary. will be Elwell-Poulsen arc generators fitted with remote control. The decision to install these arc generators was reached after alternative tenders had been obtained for valves and alternators. In the near future a valve set employing the latest practice in valves, viz., the high-power Mullard silica valves, will also be installed. When this has been done, comparative tests will be made to ascertain which system is the more economical and reliable in commercial operation. The specification calls for a minimum output of 50 A in the aerial, and arrangements are being made for the emission of a single wave when transmitting, and the complete suppression of radiation when spacing, instead of the usual de-tuning. It is believed that this will be the first arc station of any size to operate commercially on this principle. Many advantages are gained by being able to stop radiating when spacing, such as the saving in power, and the freedom from jamming which will result. Although the output to the aerial is quite considerable, the station will be operated directly from the Central Telegraph Office, London, at a speed of about 60 words per minute, but provision has been made for the use of high-speed signalling at more than 100 words per minute. The contract for the whole of the wireless equipment and masts has been placed in the hands of Mr. C. F. Elwell, who is at present also completing the two Imperial wireless stations at Oxford and Cairo. We published a fully illustrated description of the Elwell apparatus in our issue of April 2nd, 1920. The object of the new station is to give direct working to Central Europe, and the rates per word will be the same as the existing telegraph rates. The service should be vastly superior, however, as the use of lines passing through many different foreign countries will be eliminated.

Supply Company and Juvenile Employé.—The Plympton Electric Supply Co., South Devon, was summoned at Plympton Petty Sessions on Monday for two offences under the Factory Acts. One related to the unlawful employment of a young person on Sundays, and the second charge was that of employing him without procuring the requisite medical certificate. Mr. Joseph Owner, Inspector of Factories, told the Court that the Act laid it down quite clearly that an employer who employed any person under 16 years of age, must, within seven days of that employment, obtain from a surgeon in the district, a certificate of the physical fitness of the employé Defendants had been served with a notice in which that requirement appeared. A boy named Gill, who had been employed by the defendants for 15 months, had never been examined by a doctor, and no attempt had been made to get a medical certificate. The boy was also employed on alternate Sundays from 4 p.m. to 11 p.m., and it would be far better were a man employed to do the work. A fine of 10s. in respect of each summons was imposed.

Educational.—The curriculum of the "day continuation schools" under the Education Act, 1918, which commenced on January 10th, includes mathematics and science, as well as "practical subjects," such as mechanical drawing and workshop construction.

The Second Congress of the Universities of the Empire is to be held at Oxford early in July. Among the many important questions selected for discussion are "The Universities and Research," "The Universities and the Teaching of Civics, Politics and Social Economics," and "The Universities and Secondary Education."

German Lamp Production.—It is stated that the production of wire filament lamps in Germany in the financial year 1919-20 amounted to 59,520,000, of which 13,370,000 were for export markets, and, consequently, not liable to the tax on lamps. The number of carbon-filament lamps made was 4,680,000; incandescent gas mantles, 48,030,000, of which 3,760,000 were for export; and arc lamp carbons, 1,090,000 kg., of which 260,000 kilos were for external markets.

Swedish Alloy Discovery.—A quite new alloy of copper and aluminium without impurities—which have hitherto frustrated all previous experiments in the practical utilisation of the alloy—is reported to have been worked out for practical use by a Swedish factory. The new alloy has been named "alcobrons" As the material in question is not affected by salt water, it is specially adapted for ship's metal work, propellers, and condensing tubes, and it is said to be of considerable utility in other respects.—*Morning Post.*

INSTITUTION NOTES.

Institution of Electrical Engineers.—On Thursday last week, Prof. Sir William Bragg, K.B.E., F.R.S., delivered the twelfth Kelvin lecture, taking as his subject "Electrons." Before a crowded meeting, the lecturer, starting "at the beginning," outlined in a most interesting and able manner the discoveries that have been made in recent years in connection with the subject. The President, Mr. Ll. B. Atkinson, announced that the Council had decided that descriptions of inventions or new patented devices should be accepted for publication in the Institution *Journal.* Such matter would be given priority of publication, and it was thought that the value of the *Journal* would thereby be enhanced.

North-Eastern Centre.—At a meeting of this Centre, held at Newcastle-on-Tyne, on the 10th inst., Mr. J. R. Beard, in the chair, Mr. Ll. B. Atkinson, President of the Institution, delivered an address, taking as his subject portions of that which he delivered in London, emphasising especially the application of electricity to agriculture, and electric vision. He then turned to what he called politics in industry and production, and spoke of social and industrial unrest. In reply to a question as to his association with the North of England, the President said he commenced his connection with mining in that district in 1885 or 1887, when the transmission of power by means of electricity was engaging the attention of no one more keenly than the mining expert. In that district he was mainly engaged in the application of electricity to coal-cutters, and the first large installation was that at the Lambton Collieries, where there was a generating plant of about 400 h.p.; the electrically-driven winding engine put down there was the first placed in the world. The dangers that might arise were the cable to be cut by a fall, turned his attention to that question, and he found its solution in the making of a split conductor. There was great difficulty in the working of the coal-cutters, because the organisation in those days was not what it was now. It was interesting to note that the coal-cutting machines used to-day hardly differed from the early ones, but it was needless to say that coal mines were very much better organised.

Associate Membership Examination.—It is proposed, if a sufficient number of candidates make application, to hold in London, in April, 1921, an examination for associate membership. Arrangements will also be made for the examination to be held at Local Centres in the United Kingdom and abroad. Applicants desiring to sit for the examination should send their entry forms and examination fees in time to reach the Secretary of the Institution, 1, Albemarle Street, London, W. 1, not later than March 1st, 1921. Entry forms and copies of the examination regulations may be obtained on application to the Secretary.

Liverpool Sub-Centre of the North-Western Centre.—Three papers on "Electric Welding" were read before this Sub-Centre, at the Laboratories of Applied Electricity, the University, Liverpool, on Monday last. Dr. J. H. Paterson dealt with "The Chemical and Metallurgical Aspects of Electric Arc Welding." He very briefly pointed out the difficulties yet to be overcome in electric welding, especially on the metallurgical side, and hinted that there was a very wide field open for research. Mr. L. B. Wilson dealt with "The Cost of Electric-Resistance Welding," and gave some very interesting figures relating to the financial side of electric welding. He further showed on the screen the latest developments in machines for the purposes of resistance welding. Both Dr. Paterson and Mr. Wilson displayed some very interesting samples showing the possibilities of electric welding. Mr. F. J. Heyes outlined briefly the work that he had accomplished on "Electric Arc Welding Applied to Aluminium" in the course of a research carried out in the Laboratories of Applied Electricity, the University, Liverpool. The paper was very interesting, and opened up the possibilities of the welding of aluminium. A very interesting discussion followed, in which Messrs. Turney, Malpas, Rettie, Astley, Morton, Collie, Wilson, Harrison, Miller, and Dr. Marchant took part.

Scottish Centre.—Conversazione, February 3rd, 1921. Referring to the circular dated November 23rd, 1920, members who have not yet applied for tickets are requested to communicate not later than Wednesday, January 26th, with Mr. R. B. Mitchell, Glasgow Corporation Electricity Department, or Mr. Joseph Taylor, hon. secretary.

Chelmsford Engineering Society.—At a meeting held on January 13th, at the East Anglian Institute of Agriculture, a lecture on "Polyphase Induction Motors" was given by Mr. P. Huggins, of Messrs. Crompton's engineering staff. The lecturer outlined the history of the invention, and Mr. Huggins explained the working of induction motors, illustrating his remarks by a number of lime-light slides. In conclusion, Mr. Huggins acknowledged his thanks to Messrs. Crompton & Co. for kindly giving him permission to illustrate the construction and performance characteristics of their machines. The lecture was then discussed.

Railway Engineers' Conference.—At the meeting of the Railway, Electrical, and Telegraph Engineers' Conference in London, on December 12th, Mr. F. Downes, telegraph engineer, of the Great Northern Railway, was appointed President for the year 1921.

National Association of Supervising Electricians.—On Saturday last week the annual dinner of the Association was held at the Holborn Restaurant; the president, Mr. J. S. Highfield, occupied the chair, and the company numbered some 150 members and guests. After the toast of "The King" had been duly honoured, Mr. Whitley, chairman of the Council, proposed "The President," remarking that if institutions, like nations, deserved the Governments they got, the Association must indeed be one of the most worthy institutions in the country, for its three presidents—Messrs. Dykes, Trotter, and Highfield—were of superlative excellence. Mr. Highfield had occupied that post for three years; at their meetings he was always able to draw upon an extraordinarily wide experience to engage their interest on any subject that came under discussion, and they regarded him with feelings not only of admiration, but of affection. The toast was accorded musical honours with enthusiasm, and Mr. Highfield, responding, expressed his sincere appreciation of the compliment at the hands of so eminent a body of friends. He was glad that they held their president in honour as president; the principle was of fundamental importance to the national interests, that an association of men, for whatever purpose, should choose a leader and follow him with loyalty.

Captain Masters, proposing "The Association," said that though he was not a supervising electrician, at any rate he supervised *The Electrician*, a function which, like theirs, demanded tact and patience. The Association was bound to grow in size and usefulness as the electrical industry developed; it was a kind of institution that was both desirable and necessary. Speculating on the part that would be played by the gentler sex in the future of the industry, he pointed out that there were many women supervising electricians already.

Mr. Revell, in reply, paid a well-deserved tribute to the titanic work that had been done for the Association by Mr. Banister, their hon. secretary, who, unfortunately for the Association, was obliged to retire from the post next month on account of ill-health. The Association was founded for purely educational purposes, but had been compelled by circumstances to enter Trade Unionism; its educational objects, however, would never be lost sight of. In its ranks supervisors and foremen mingled and exchanged experience in the spirit of true fraternity. The Association had had to face much trouble, but bore no ill-feeling against the bodies which had attacked it.

Mr. Windebanke proposed "The Press," to which he offered useful hints for the enlivening of its pages, concluding with a tribute to its impartiality and instructional qualities, and the assistance which it afforded to the profession to which they were all proud to belong. Mr. A. H. Allen, responding, pointed out that the Association was the only one of its kind with which the Electrical Press had never had occasion to differ, and expressed the hope that it would continue to prosper and progress on the lines which it had marked out for itself.

Mr. A. J. Stiling proposed "The Visitors," and incidentally announced that on March 29th the Association would hold a discussion on "Gas *v.* Electricity for Lighting, Heating, and Power," with Mr. Goodenough leading for gas, and Mr. J. W. Beauchamp for electricity. Responding to the toast, Mr. A. W. Wyatt remarked that the Association was founded on the sound principles of altruism and education.

The toasts were interspersed with a well-arranged programme of music and song, and the proceedings were thoroughly enjoyable.

Edinburgh Electrical Society.—The opening meeting of the year was held on January 14th, when Mr. W. F. Mitchell read a paper entitled, "Some Notes on Cables." The author briefly described the development of practice with regard to heavy town mains and distributors. The various methods of insulating were illustrated, and the reasons given for the failures or successes of some of these. The question of v.i.r. cables for direct-current supply was specially considered, and numerous specimens of faults were exhibited. At the close the author replied to a number of questions as to fault localisation and method of jointing, and in the course of his reply referred to the possibilities of having perished rubber or bitumen cables reinsulated with paper or other covering.

Physical Society of London.—On Friday, January 28th, at 5 p.m., at the Imperial College of Science, South Kensington, the following papers will be read:—

"The Magnetic Separation of the Neon Lines and Runge's Rule," by Prof. H. Nagaoka, Imperial University of Tokio.

"A Method of Demonstrating the Retro-active Property of a Triode Oscillator," by Captain E. V. Appleton, M.A., B.Sc., R.E.

"The Quickness of Response of Current to Voltage in a Thermionic Tube," by D. Owen, B.A., D.Sc., and R. N. Archer, B.Sc., M.I.E.E.

Institute of Marine Engineers.—Mr. W. Brooks Sayers, lecturing on electronomy, at the Institute, on January 11th, gave some interesting experiments in support of the theory that varying weather conditions are to be accounted for by the effect on our atmosphere of electro-vaporous streams from the sun. The violent atmospheric disturbances which occur during storms were explained on the basis that these electric streams from the sun charged the higher atmosphere both with water vapour and electricity up to a point at which the disruption discharge known as lightning occurred, or there was a huge, more or less continuous, leak through which the electric fluid passed, and produced tornadoes, whirlwinds, waterspouts, and other violent phenomena.—*Morning Post.*

Paisley Association of Electrical Engineers.—Mr. C. J. Gregg, director (Glasgow Branch) Messrs. Falk, Stadelmann & Co., Ltd., delivered a paper on "The Progress of Lighting," to the Association, on January 12th. The speaker traced the progress of artificial illuminants through various periods. Industrial, domestic, and street lighting were dealt with in their various phases. He contended that employers of labour had not yet been educated to the many advantages to be derived from an efficient lighting system properly applied, and that an improved standard of lighting should be incorporated in the Factory Act; that it was also a matter of immediate concern to insurance companies, and that they should be prepared to allow more favourable rates to factories, workshops, and houses which were considered well lighted.

Barrow and District Association of Engineers.—At a meeting for apprentices, held on January 12th, Mr. J. S. Milner delivered a lecture on "The Manufacture of Jigs and Profile Gauges." Mr. Milner stated that although jigs and gauges were introduced with the object of securing interchangeability of details, the main modern incentive to their use was the cheapening of production. The jig system had lately been applied in foundries for the accurate placing of patterns on moulding machines. This enabled castings to be made in perfect register at a minimum cost. Mr. Milner carefully and clearly explained the machines used and the methods adopted in the manufacture of jigs. The lecture throughout was illustrated by lantern slides, and numerous examples of special tools, jigs, and gauges were exhibited.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the **Electrical Review** *posted as to their movements.*

Prof. W. M. Thornton, head of the Electrical Engineering Department of Armstrong College, Newcastle-on-Tyne, has been ordered complete rest by the doctors. Dr. Thornton's work has been especially heavy recently, owing to the large increase in the number of students studying electrical engineering, and it has been intensified by his continuing certain work begun during the war at the experimental station at Shandon-on-the-Clyde, by the Admiralty. At a meeting of the North-Eastern Centre of the I.E.E., last session, Dr. Thornton gave some interesting particulars as to the work that had been carried out at Shandon and elsewhere in the matter of under-water signalling.

Exeter Town Council is recommended to increase the salary of the electrical engineer, Mr. H. D. Munro, from £700 to £760, as from October 1st last. The pre-war salary was £475.

Mr. A. P. Rutherford, late borough engineer at Leith, has claimed from the Edinburgh Town Council, owing to the amalgamation of Leith with the city, a capital sum of £500 as compensation for loss of office.

Mr. W. G. Watson is returning to Australia on January 29th. His London address is c/o Messrs. Coombs and Richards, 150, Southampton Row, London, W.C. 1.

Mr. E. A. Uttley, M.I.E.E., M.I.Mech.E., and Mrs. Uttley returned to South Africa last Friday en route for Rhodesia, where Mr. Uttley will resume his post with the Government as Chief Construction and Electric Inspector. He volunteered for war service in 1917, and was appointed to the Ministry of Munitions; he has been with the Admiralty for the last three years as an electrical engineer at H.M. Dockyard, Portsmouth.

Members of the electricity department of the Rhondda Urban Council, at their annual dinner at Pontypridd on Saturday, presented Mr. H. H. Reed, the chief clerk, with a cruet stand. The gift was handed to him by Mr. Mark Harcombe, chairman of the Gas and Electricity Committee.

Burton-on-Trent Town Council has increased the salary of the borough electrical engineer by £250 a year, making £900 a year.

Mr. W. M. Acworth, on whom the King has authorised the Viceroy of India to confer the honour of Knight Bachelor, was a member of the Royal Commission of Inquiry into Canadian Railways, 1916, and is a director of the Underground Electric Railways of London, and other companies.

Councillor H. W. Wale, who has been three years chairman of the Electric Tramways Committee of the Coventry Corporation, has been presented by the staff and employés with an illuminated address and a silver cigarette case. The presentation was made by the general manager, Mr. T. R. Whitehead.

Obituary.—Mr. Robert McLean.—We regret to record that Mr. R. McLean, for 20 years manager and engineer of the Guernsey States Telephone Department, died suddenly on December 30th. Mr. McLean, who was well known in telephone circles, was born in 1869 at Musselburgh. He was apprenticed to the National Telephone Co. at Edinburgh in 1885; became chief inspector to the Mutual Telephone Co., Manchester, in 1890; chief inspector to the New Telephone Co., London, in 1892: local manager with the National Telephone Co. at Cardiff and elsewhere in 1894; and was appointed to Guernsey in 1900. Under his care the Guernsey Telephone System increased from 679 stations in 1900 to 2,700 at the end of 1920, and obtained a reputation for good and economical service and administration.

Wills.—The late Mr. George Tangye, chairman of Tangye, Ltd. left £207,137, net personalty £172,319.

The late Mr. Francis Ince, a director of the Electrical Standardising and Training Institution, left £79,858 gross and £69,457 net.

NEW COMPANIES REGISTERED.

Electric Lamp and Bulb Co., Ltd. (172,518).—Private company. Registered January 10th. Capital, £100 in £1 shares. To carry on the business of electrical manufacturers, supply agents and wholesale and retail factors, electrical engineers and contractors, manufacturers of glassware of all kinds, &c. The first directors are: F. Kitchener, 25, Boileau Road, Ealing, W. 5; A. H. Greening, 15, Cliffords Inn, E.C. 4. Registered office: 15, Cliffords Inn, E.C.

Elco Electric Manufacturing Co., Ltd. (172,517).—Private company. Registered January 10th. Capital, £12,000 in £1 shares. To take over the business of a manufacturer, factor and repairer of switchboards, control panels, starters and electrical appliances carried on by A. C. Wiley, at Colston Yard, Colston Street, Bristol, as the "Elco Electric Manufacturing Co." The first directors are: A. C. Wiley (chairman and managing director), Wansdyke, Portbury, Somerset; W. F. Cook, no address stated; F. W. Fifield, 30, Whiteladies Road, Clifton, Bristol. Registered office: 9, Denmark Street, Bristol.

E. A. Ingold, Ltd. (172,591).—Private company. Registered January 14th. Capital, £2,000 in £1 shares. To take over the business of an electrical engineer, factor and agent carried on by E. A. Ingold at 17, East Parade, Leeds. The first directors are: E. A. Ingold, 22, Cedar Grove, Wortley, Leeds; J. M. H. Hoffman, Prosepct House, Oak Lane, Bradford (both permanent, subject to holding 500 shares each, with £50 each per annum as remuneration). Solicitor: G. F. Hart, 26, Bond Street, Leeds. Registered office: 17, East Parade, Leeds.

Miriograph Co., Ltd. (172,524).—Private company. Registered January 10th. Capital, £1,500 in 20,000 ordinary shares of 1s. each and 500 10 per cent. preference shares of £1 each. To carry on the business of advertising sign manufacturers and agents, &c. The subscribers (each with one share) are: F. Bindley, 4, Mitre Court, Temple, E.C., solicitor; P. J. Powell, 4, Mitre Court, Temple, E.C., clerk. The first directors are: F. G. Carter (managing director), P. Rowley, Capt. J. C. W. Anderson, G. Udal, and H. Sutton. Registered office: Regent House, Regent Street, W.

White, Andrews & Co., Ltd. (172,586).—Private company. Registered January 13th. Capital, £10,000 in £1 shares. To carry on the business of electrical and general engineers, founders, smiths, machinists, &c., and to adopt an agreement with A. E. White, H. G. Andrews, senr., and H. G. Andrews, junr. The permanent directors are: H. G. Andrews, senr. (chairman), 73, High Street, Reigate; H. G. Andrews, junr., 73, High Street, Reigate; A. E. White, 52, Totterdown Street, Tooting, S.W.; G. F. Bennett, North Villa, Elgin, N.B. The two last named are joint managing directors. Secretary: H. G. Andrews, junr. Registered office: 9-10, Water Lane, Ludgate Hill, E.C. 4.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Metal Industries, Ltd.—Charge on the whole of the company's property, dated December 15th, 1920, to secure £160 and further advances. Holder: Sir Wilfred Stokes, K.B.E., 32, Victoria Street, Westminster.

Leatherhead & District Electricity Co., Ltd.—Particulars of debentures authorised December 20th for an unlimited amount, but not to exceed the amount of the issued capital for the time being, and covered by trust deed dated December 28th, 1920, present issue £34,200, charged on freehold land and hereditaments at Fetcham, Surrey, and the company's undertaking and property, present and future, including uncalled capital. Trustees: P. P. Ralli and J. W. Chalkley.

Norwegian Electric Smelting Co., Ltd.—Declaration of trust and deed of indemnity dated December 30th, 1920, to secure all moneys payable, under a contract referred to therein, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: H. H. Blackburn, 24, Bank Street, Bradford.

James Keith & Blackman Co., Ltd.—Satisfaction in full on December 7th, 1920, of debentures dated October 29th, 1901, securing £300.

Quead, Ltd.—Particulars of £5,000 debentures authorised October 30th, 1920, whole amount issued. Charged on the company's undertaking and property, present and future, including uncalled capital.

Electrical Contracts and Maintenance Co., Ltd.—Satisfaction in full on December 6th, 1920, of debenture dated February 12th, 1918, securing £13,000.

Semco, Ltd.—Mortgage dated December 3rd, 1920, to secure £800, charged on 440a, Romford Road, Forest Gate, E., and right of way. Holders: Misses M. A. and R. Baines, 124, Station Road, Wood Green; and Sir John H. Bethell, Bt., Bushey House, Bushey, Herts.

Yorkshire Cable Co., Ltd.—Satisfaction in full on December 23rd, 1920, of debenture dated December 10th, 1917, securing £4,000.

Brecknell, Munro & Rogers, Ltd.—Satisfaction in full on August 12th, 1920, of debenture dated September 1st, 1919, securing all moneys or liabilities then due or to become due.

A. L. Brown & Co., Ltd.—Debenture dated December 17th, 1920, to secure £225, charged on company's property, present and future, including uncalled capital. Holder: Rev. S. E. Ward, Eldon House, Lower Bourne, Farnham, Surrey.

Musselburgh and District Electric Light and Traction Co., Ltd.—Satisfaction to the extent of £1,300, on December 20th, 1920, of charges dated November 13th, 1905, and May 11th, 1909, securing £90,000.

CITY NOTES.

The Edison Swan Electric Co., Ltd.

Presiding at the ordinary general meeting on Monday last, Mr. Charles J. Ford said it would be noted with satisfaction that the debenture stock sinking fund was gradually increasing, although it had only been in operation about two years. At the date of the balance sheet, under the operation of the fund, they had set aside a total amount of over £23,000, with which stock had been redeemed to the nominal amount of over £29,000; the stock having been purchased at a discount. In addition to that amount there had been purchased, in anticipation of the requirements of the sinking fund, £18,184 stock, at a cost of £14,620, making a total of both classes of stock purchased to date of £47,278, at a cost of £37,620. Sundry creditors and credit balances appeared at a figure of over £240,000 more than they did last year, and their liability on loans had largely increased. The amount of investments, standing at over £77,000, had also been very largely increased, and included an interest amounting to £50,000 in the Enfield Ediswan Cable Works, Ltd., and £25,000 in the Brotherton Ediswan Tubes & Conduits, Ltd. Freehold and leasehold property had been increased by over £78,000, and plant and machinery to the extent of about £48,000. Stocks, including work in progress, and sundry debtors, had also very largely increased. About a year ago they entered into an arrangement with the Philips Glowlampworks, Ltd., of Eindhoven, Holland. The Philips Co. possessed methods, processes, and novel labour-saving plant far in advance of that in the works of other manufacturers. They were now turning out lamps, particularly gasfilled, in large quantities, equal in every respect to those manufactured by Messrs. Philips in Holland, and they were obtaining a ready sale for them. That could not be carried out without the expenditure of a large amount of capital, far more in fact than it was possible to provide out of their own resources. They therefore made an arrangement with Messrs. Philips for the formation of a new company, to be called The Ediswan Lampworks, Ltd., the capital being provided in equal shares by Messrs. Philips and the Edison Swan Co. Under that arrangement their lampworks would be leased to the new company, except that portion of them which they had recently erected, together with the machinery and plant thereon. The last would be sold to the new lampworks; at the same time the new company would take over from them certain stocks and raw materials. The outcome of that arrangement would be that they would not have to put up any cash, the whole being provided by Messrs. Philips. The increased capacity of the factory to turn out lamps on a more economical basis would doubtless help the company to bear the higher charges for wages, and provided there was no material falling-off in the demand for their lamps, he was satisfied they would be able to show satisfactory profits in future, in spite of the increased wages bill. The shareholders were aware that they had entered into arrangements with the Sangamo Electric Co. of the United States to co-operate with that company in the production of all classes of electric meters at their Ponders End works. They had erected buildings there which were now being equipped with the necessary plant and machinery, capable of turning out those articles on a large scale, and they believed from the support which they had already received that they would readily dispose of the whole of the output. When they looked at the very great increase in the turnover which had taken place, they would see that the capital did not bear a reasonable proportion to the expansion of the business and the higher costs of production. The solution of the difficulty was additional capital, but at the present moment it was wholly impossible to provide that. In the absence of further capital it had become absolutely necessary to husband their cash resources, and although a substantial profit had been earned, it would have been a suicidal policy to dip into those resources in the payment of even a dividend of, say, 5 per cent., which would absorb about £50,000. If they could without prejudice to the position, see their way to pay an interim dividend before the end of the financial year at June 30th next, they would do so. The business of the company was proceeding satisfactorily; the sales were increasing, and up to the present they had not been affected by foreign competition.

Replying to a short discussion, the chairman said the board could not be held responsible if gentlemen bought the shares of the company at a high price on rumours of amalgamation or absorption by another company. The Enfield and Brotherton Tube Companies were perfectly good investments. They got large dividends from them, but they did not go into those companies as investors, but as manufacturers, and it had been a very satisfactory arrangement. With regard to the export trade, they were doing as much business in that direction as it was possible for them to do. They had three branches in Australia, and they did a very big business there; and the same remark applied to India and South Africa.

The report was then agreed to.

Subsequently an extraordinary general meeting was held, at which a resolution was passed authorising the creation of additional capital by the board from time to time, the chairman explaining that the board did not intend to make any issue of capital on any terms until they had first called the shareholders together and received their authorisation.

New Issues.—*W. T. Henley's Telegraph Works Co., Ltd.*, is issuing 250,000 ordinary shares of £1 each at the price of 24s. per share. The shares will rank for dividend as from January 1st, 1921, but will not participate in the final dividend which will be paid for 1920. Applications from shareholders and debenture stock holders of the company will receive preferential treatment. The prospectus states that the new capital is required to finance increased business and to provide for additions to the works to meet future demands. The list closes on January 25th.

Tramways, Light & Power Co.—The British Trusts Association is offering £200,000 8 per cent. five-year notes at 95½. The notes are part of a total amount of £375,000 authorised, and are redeemable at £106 on January 7th, 1926.

Stock Exchange Notices.—The following have been ordered to be officially quoted :—

Anglo-Portuguese Telephone Co., Ltd.—£50,000 5 per cent extension debenture stock.

Liverpool Overhead Railway Co.—Final dividend of 1¾ per cent. on the ordinary shares, making 3 per cent., less tax, for the year ended December 6th.

J. G. White & Co., Ltd.—The net profit for 1920 (according to the *Financial Times*) was £28,100. Dividend 7 per cent. on both classes of capital. £30,000 to reserve.

Lima Light, Power & Tramways Co.—Dividend of 2 per cent.

STOCKS AND SHARES.

TUESDAY EVENING.

INVESTMENT stocks show the greatest amount of strength in the markets of the Stock Exchange. The volume of business in purely investment securities forms the chief part of Stock Exchange work to-day. In other words, speculation is dormant; indeed, is nearly dead in most of the areas which used to be regarded as favourite gambling grounds of the public. But money accumulates. There is still plenty of capital seeking investment in Stock Exchange circles. By steady degrees, the amount of debenture stocks which was available for purchasers a month ago is being reduced. The stream of new issues runs more slowly than it has been doing of late, but there are several new flotations said to be pending, of which some at least are on behalf of Colonial electric corporations. Stock Exchange betting runs strongly in favour of a reduction in the Bank Rate this week.

The way in which the value of the pound sterling is increasing, in comparison with that of the dollar, has brought about further falls in the prices of dollar securities, amongst them the issues of utility companies working in Canada, the United States, South America, Japan, and elsewhere. As things are, however, the exchange is still sufficiently disgruntled to make the difference between parity prices in this country, and those which rule in the American markets, to be extremely pronounced. People who continue to keep alive the business of buying and selling between this country and the other side of the Atlantic are frankly sceptical about any real revival of interest until such time as the quotations in the two continents can be brought into much closer correspondence with each other than is possible at present. The position is, of course, that American stock, say of an electric lighting or telephone concern, is priced very much higher in this country than it is in New York, the difference arising simply from the rate of exchange. The British capitalist, however favourably inclined he may be toward the American investment, fights shy of giving so very much more in London than he would be asked to pay in New York, although the actual amount of money required in both cases would be the same, measured in terms of pound sterling and dollars. Were an Export Credit scheme to be established, upon which a good many hopes are centring now, it is a reasonable assumption that something of the same kind would be attempted between this country and the United States, but until this comes about, arbitrage business in Stock Exchange securities is bound to continue restricted.

Radio Corporations of both classes have given way, the common to 9s. and the preferred to 11s., for which the reason seems to be a decline in Marconis to 2⅛. The market lately has been a dull one, with no particular interest taken in it, and since the dividend disappointment, a continuous selling movement has been on foot. Marconi preferences have eased off to 2, and the other Marconi shares are heavy.

At the meeting of the Edison-Swan Company on Monday, the Chairman practically denied that there was anything in the nature of any amalgamation on foot with another company. The price of the shares is unchanged at 12s. 6d. Metropolitan-Vickers preference have been a good spot, with a sharp rise to 40s., the ordinary improving also at the same time to 20s.; the buying is said to be traceable to Birmingham. Vickers, however, have given way a little, and other armament issues, together with those of the iron, coal and steel group generally, are lower owing to the closing down of various works in the country, and to the difficulties presented to traders and workmen alike. Babcock & Wilcox have risen to 2 5/16, British Insulated are a good market at 32s. 6d., Siemens are better at 21s. 3d., and Telegraph Constructions have gained 10s. at 21½. Henley's are unchanged at 30s. The company is making a new issue of 250,000 ordinary shares of £1 each at 24s. per share, to rank for dividend as from January 1st this year, but not to participate in the ordinary dividend which will be paid for 1920. Applications from shareholders and debenture holders of the company will receive preferential consideration. It will not be surprising if some of the holders of the existing shares were to sell these in order to apply for the new issue. General Electric preference are a little better at 18s., and the ordinary at 24s. 4½d. English Electric Notes are firm at 94½, and Westinghouse Brake debenture stock hardened to 96.

The Eastern Telegraph group has again strengthened, and the usual procession of rises is shown in Westerns, Easterns, Globe ordinary and Eastern Extensions. Investors on the lookout for safety and six per cent. are taking up these stocks, with the knowledge that to these advantages is added the further benefit of the dividends being paid free of tax on the ordinary shares. Great Northern Telegraphs have risen to 20½. The Anglo-American group is quiet, and there is not much doing in other telegraphs or telephones.

Tube railway stocks are better, with rises in the three issues of the Underground Electric Company and in Metropolitan ordinary. The dividend declaration on the latter will be out this week. It cannot be said, however, that the railway market as a whole is in a satisfactory state. The claim of Mr. J. H. Thomas, on behalf of the workmen, that the latter should be given a share in the management of the companies is not read as a bull point, and the prices of the steam stocks are disposed to sag. The Underground Companies will announce their dividends on February 3rd. In the foreign group, Brazil Tractions are better at 39, and the preferred shares rose to 77½.

Westminster Electric ordinary have recovered to their par price of 5, and County of London preference at 7¾ regained half their loss of last week. City of London ordinary are also better at 23s. 1½d. Canadian General Electric ordinary shares at 110 and the preferred at 101½ are both better than they have been of late. British Electric Transformer preference rallied to 13s. 9d. British Electric Traction 5 per cent. debenture stock at 60 is 2 points higher. Adelaide Electric Supply preference gave way to 17s. No importance need be attached to tho humorist's effort to connect this with the result of the Test matches. The market in rubber shares is stagnant, and after their recent premature rush-up, prices of most of the leading shares show a tendency to ease off again.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Jan. 18, 1921.	Rise or fall.	Yield p.c.
Brompton Ordinary..	8	12	5⅞	—	£10 4 4
Charing Cross Ordinary	4	7	8½	—	10 0 0
do. do. do. 4½ Pref. ..	4½	4½	2¾	—	8 8 8
Chelsea..	3	4	3⅛	—	6 8 0
City of London	8	10	1 5/32	+ 1/32	8 12 9
do. do. 6 per cent. Pref. ..	6	6	17/6	—	6 17 2
County of London	7	8	7½	—	10 18 4
do. do. 6 per cent. Pref.	6	8	7¾	+ ⅛	7 15 0
Kensington Ordinary	6	7	8⅞	—	9 0 8
London Electric	Nil	2½	¾	—	10 0 0
do. do. 6 per cent. Pref...	6	6	2¾	—	10 18 2
Metropolitan..	5	6	2¾	—	10 18 2
do. 4½ per cent. Pref. ..	4½	4½	2 9/16	—	8 15 8
St. James' and Pall Mall	10	12	6¼	—	9 12 0
South London	5	6	2½	—	9 12 0
South Metropolitan Pref... ..	7	7	18/9	—	10 8 8
Westminster Ordinary	8	10	5	+ ⅛	10 0 0

TELEGRAPHS AND TELEPHONES.

	Dividend 1918.	Dividend 1919.	Price Jan. 18, 1921.	Rise or fall.	Yield p.c.
Anglo-Am. Tel. Pref.	8	6	75½xd	+ 1	7 19 0
do. Def.	33/6	1½	15xd	—	10 0 0
Chile Telephone	8	6	5⅝xd	—	*5 4 4
Cuba Sub. Ord.	7	7	6¾	—	*10 7 4
Eastern Extension	8	10	15⅛xd	+ ¼	*6 12 3
Eastern Tel. Ord.	8	10	154½xd	+ 2½	*6 9 6
Globe Tel. and T. Ord.	8	10	15⅛	+ ⅛	*6 12 3
do. do. Pref.	6	6	8½	—	7 1 2
Great Northern Tel.	22	22	20½	—	10 14 8
Indo-European	18	10	80	—	6 6 8
Marconi	25	25	2⅛	— ⅛	—
Oriental Telephone Ord.	10	12	2 7/16	—	*6 4 0
United R. Plate Tel.	8	8	5⅞	—	*6 16 4
West India and Panama	1/8	Nil	½	—	Nil
Western Telegraph..	8	10	15⅛	+ ½	*6 12 3

HOME RAILS.

	Dividend 1918.	Dividend 1919.	Price Jan. 18, 1921.	Rise or fall.	Yield p.c.
Central London Ord. Assented ..	4	4	43½	—	9 4 0
Metropolitan	1	1¼	20½	+ ½	6 2 0
do. District	Nil	Nil	15½	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅞	+ ⅛	Nil
do. do. "A" ..	Nil	Nil	6/-	- 6d.	Nil
do. do. Income ..	5	4	68½	+1	—

FOREIGN TRAMS, &c.

	Dividend 1918.	Dividend 1919.	Price Jan. 18, 1921.	Rise or fall.	Yield p.c.
Anglo-Arg. Trams, First Pref. ..	Nil	5½	2¾ xd	—	10 0 0
do. do. 2nd Pref. ..	Nil	Nil	3¼	+ ⅛	Nil
do. do. 5 % Deb. ..	5	5	56½	+2	8 17 0
Brazil Tractions	Nil	Nil	39	+1	Nil
British Columbia Elec. Rly. Pfce.	5	6	55xd	—	9 1 10
do. do. Preferred	2½	5	64½	—	*8 9 9
do. do. Deferred	Nil	3	61½	—	*11 8 4
do. do. Deb. ..	4½	4½	64½	—	7 16 0
Mexico Trams 5 per cent. Bonds..	Nil	Nil	38	+1	Nil
do. 6 per cent. Bonds..	Nil	Nil	28½	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	22½	—	Nil
do. 1st Bonds	Nil	Nil	63½	+8	Nil

MANUFACTURING COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Jan. 18, 1921.	Rise or fall.	Yield p.c.
Babcock & Wilcox	15	15	2 5/16	— 1/16	*6 10 4
British Aluminium Ord.	10	10	⅞	—	11 8 6
British Insulated Ord.	12½	15	1⅝	+ ⅛	9 6 10
Callenders	25	15	1⅜	—	10 18 2
,, 6½ Pref.	6½	6½	17/6	—	7 8 7
Castner-Kellner	20	17	2⅞	—	7 12 9
Crompton Ord.	10	10	16/9	−9d.	12 14 0
Edison-Swan	10	10	12/6	—	—
do. do. 5 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	⅞	—	11 8 6
Gen. Elec. Pref.	6½	6½	18/-	+6d.	7 4 5
do. Ord.	10	10	1 7/32	+ 1/32	*8 4 8
Henley	25	15	1½	—	10 0 0
do. 4½ Pref..	4½	4½	8⅛	—	7 4 0
India-Rubber	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	2	+ ¼	8 0 0
Siemens Ord...	10	10	1 1/16	+ 1/32	*9 8 2
Telegraph Con.	20	20	21½	+ ½	*5 11 8

* Dividends paid free of Income Tax.

THE USE OF BALL BEARINGS IN ELECTRIC MOTORS.

(COMMUNICATED.)

Only a few years ago ball bearings on electric motors were almost unknown; to-day their use is a matter of general practice. Apart from the realisation of their advantages that has resulted from experience, the sudden demand is to a certain extent due to the advances that have recently been made in the construction of the bearings themselves. The fine material used in the manufacture of modern ball bearings, and the extreme accuracy which distinguishes the construction of those of the highest class, have resulted in an article superior to the ring-oiled bearing, not only as regards its coefficient of friction, but also in reliability; and the last argument against the ball bearing has thus been answered. Modern ball bearings have, in fact, proved to add very considerably to the reliability of the motors in which they have been incorporated, while greatly increasing their efficiency and economy. While the suitability of the ball bearing for electric motor applications is generally accepted by the larger manufacturers in this country, there are still some who adhere to the policy of fitting ring-oiled or waste-packed bearings, particularly in the manufacture of very small or very large motors. In most cases, no doubt, the maker is deterred from the use of ball bearings by their initial cost, and the consequent necessity of raising the price of the motor. With the object of showing that the substitution of ball for plain bearings not only justifies the extra expense, but actually increases the selling power of the motor, the following summary of the advantages accruing from such a change has been compiled.

Cost.—To begin with, the charge made against the ball bearing that it is expensive requires investigation, because if a careful estimate of the cost involved in the two cases be made, the difference will be found to be very slight, if any at all.

In the first place, the plain ring-oiled bearing uses more material and more costly patterns, and involves a considerable amount of labour in scraping the bearings. The ball-bearing housing, on the other hand, is perfectly simple, smaller in size, and no time whatever need be spent in the fitting of the bearing, which is a self-contained unit, and simply slips into the housing. Users will, therefore, be well advised to carry out this comparison before making assertions on the subject.

Maintained Air Gap.—Accuracy and freedom from wear are among the most notable features of the ball bearing. The consequent retention of adjustment keeps the rotor in the centre of the magnetic field, and permits the manufacturer to employ small air-gap clearances that would be out of the question in a motor running on plain bearings. In induction motors a small air gap is of vital importance to the efficiency and power factor of the machine. It is one of the chief drawbacks connected with plain bearings, that after a time they wear down to an extent dependent on loads and conditions of service. If the wear is allowed to continue, the armature will finally come into contact with the pole pieces, and stripping of the armature will probably result. With a ball bearing, in which rolling is substituted for rubbing friction, wear is negligible, and a breakdown such as the above could never occur.

Improved Commutation.—On direct-current machines the ball-bearing feature of lubricant retention is of the utmost importance. Ball-bearing housings are sealed so as to prevent the escape of lubricant, and the commutator is thus kept clean; fouling of the commutator by an accumulation of conducting dust and oil is rendered impossible, and commutation is consequently improved. The precision and durability of bearing setting also results in better commutation. The resulting freedom from sparks from the commutator is of great importance in coal mines, flour mills, woodworking shops, and wherever combustible dust is met with, since the danger of fire or explosion is materially decreased.

Comparative Efficiency.—On motors in which the shaft is subject principally to torque strains, the bearing friction forms a comparatively small percentage of the power losses. This is the case with direct-coupled units, centrifugal pumps, motor-generator sets, &c. The bearings have nothing but the weight of the rotor to carry, and bearing friction is consequently inconsiderable. Where the shaft is subject to bending action, however, bearing friction becomes an important consideration. This is the case with belt- or gear-driven motors, whose bearings are subject to severe bending or shock strains, especially at the driving end. Self-aligning ball bearings here show a decided saving over plain bearings. This will be conceded when it is considered that the coefficient of friction in the double-row, self-aligning ball bearing is about 0.001, and constant under all conditions, whereas the friction in the plain bearing may vary according to the intensity of pressure, running conditions, and even materials used. A smaller motor can frequently be used where ball bearings are applied, on account of the reduced starting effort.

Compactness.—Compactness is usually a consideration of some importance in the conditions governing the industrial use of induction and direct-current motors; as a result, manufacturers develop the greatest possible horse power from a given size of motor frame. The length of the bearings affects the compactness of the whole unit to an important degree. Babbited bearings are usually designed on the principle of using a bearing length of 2½ times the diameter of the shaft they support. The length of a ball bearing, on the other hand, is usually not more than half the shaft diameter. Surrounding the ball bearing is the lubricant chamber, whose overall length is anything from ⅓ to ½ shorter than the plain bearing for the same motor. As a result, the overall length of the whole motor can be reduced by from 10 to 27 per cent. by the use of ball bearings. When a consideration of floor space or machine arrangement arises, a ball-bearing motor is thus of considerable help in solving the problem.

Simplicity and Cleanliness.—The use of ball bearings reduces head construction to absolute simplicity. Instead of oil rings, wicks, waste packing, chains, and other devices necessitated by the use of plain bearings, ball bearings require no oiling devices whatever. They do away with the need for constant inspection, frequent renewal of lubricant, and occasional rebabbiting, and need no other attention than periodical lubrication. The latter is necessary at intervals of from one week to six months, according to service conditions. Cleanliness is assured by fitting the bearing heads with sealing grooves, and the danger of goods becoming soiled or contaminated by oil is no longer present.

Gear-driven Motors.—Wherever a gear drive is employed, ball bearings are of particular advantage. If gears are to run smoothly and quietly, the proper distance between pinion and gear centres must be maintained. Wear in plain bearings is often responsible for noisy, chattering gears, but ball bearings, which show no appreciable wear after long service, ensure accurate mesh and consequent good service on the part of the gears. Ball bearings are designed for high speeds and heavy loads. Their housings are short, and the motor on which they are used may be made very compact. Because of this compact construction the distance between the bearing and the pinion can be decreased, and the overhung load on the bearing proportionately reduced.

The Lubrication Problem.—Ball bearings offer the user of the electric motor the simplest possible solution of the lubrication problem. The ball bearings are contained in simply constructed head brackets which are sealed at both sides and by end caps. These end caps are fitted close to the motor shaft, and are proof against leakage of lubricant as well as against the intrusion of moisture, grit, and other foreign substances. The ball cage, or retainer, is of such construction that the bearings are open at the sides, and free circulation of the lubricant in the ball paths is thus assured.

THE DISTRIBUTION OF ELECTRICITY.

Discussion at Liverpool.

At the eighth ordinary meeting of the Liverpool Sub-centre of the North-western Centre of the I.E.E., Mr. W. B. Woodhouse's paper on the above subject, which was abstracted in our issue of December 3rd, and Mr. R. O. Kapp's paper on "Some Economic Aspects of e.h.p. Distribution by Underground Cable," which was abstracted in our issue of December 17th, were discussed together on December 13th.

Mr. **Welbourn** noted that Mr. Kapp took as his basis 33,000 volts for transmission and 6,600 volts for detail distribution; Mr. Woodhouse, on the other hand, took 11,000 volts for his detail distribution, and the speaker wondered whether they ought not to invite them to discuss what the detail distribution should be. He could not help thinking that those gentlemen had specific cases in their minds rather than the general case, and they were recommending what they found the right pressure for their particular case. Mr. Kapp laid it down as fundamental that they must have one spare cable, but surely that could not be a general rule. If they had a cable supply into a consumer's premises one spare cable gave a duplicate supply, but if a supply to a sub-station required six or eight cables it surely could not be right to have one spare cable. With the modern cable at 6,600 volts, the overload capacity would be quite sufficient during the time one broken down cable was out of commission. Mr. Kapp said: "It is very doubtful indeed if engineers will decide in future schemes that the advantages of cable protective gear are great enough to justify its cost," but that seemed to him to be quite a fundamental difference, and if he understood Mr. Woodhouse's paper on that subject, he advocated wholeheartedly the necessity for some protective gear, especially in those cases where they had an interconnected network. On some of the large networks in this country it had been found an absolute *sine qua non* that they should have instantaneous protective gear so that in the event of a fault between phases, or to earth, the line should be automatically disconnected before any synchronous motor could fall out of step. Mr. Kapp's contribution to the subject of cable temperatures was one of the most helpful he had seen. Mr. Woodhouse's expression for the current-carrying capacity of 11,000-volt armoured cable laid direct in the ground was an entirely arbitrary expression, and did not convey very much unless they were told the continuous copper temperature he was considering. The total operating experience of the world with 33,000-volt cable was limited to some 50 miles of cable, if his information was correct. It seemed to him rather unwise and opposed to British conservative methods to talk of jumping wholesale from 33,000 to 66,000 volts without having a great deal more experience, which could only come from extended knowledge of the behaviour of compound dielectrics under continued stress over a period of years under operating conditions.

Mr. J. A. **Morton** wanted to know how Mr. Kapp arrived at his statement that "the capital charges on the e.h.t. distribution system of a super-power scheme will be comparable with the coal bill and may even exceed it." He did not think such capital charges could ever come near the cost of the coal bill; if the figure was one-third he thought it would be nearer the mark. Later on he said "the average charge per unit may be as low as about 0.05d. or as high as about 0.22d. to cover the capital charges alone on e.h.t. distribution." From his (the speaker's) figures he thought the capital charges ought really to be about half what Mr. Kapp mentioned. The lack of taking feeder loss into account in Mr. Kapp's paper made one feel that one would have to use the figures, &c., which he put down, very carefully. Mr. Woodhouse pointed out that those losses were a very important part of the transmission of energy, just as important as the capital cost which Mr. Kapp dealt with, and he would probably find that if those losses were taken into account he would come to different conclusions on several points. With regard to "the most economical position of a sub-station," a method which was sometimes used was to let L_1 L_2 L_3, &c., represent the individual loads, and x_1, x_2 x_3, &c., and y_1 y_2 y_3, &c., represent the distances of those loads from any two fixed lines OX and OY at right angles to each other. Then the "sub-station position" was that point which was the distance

$(x_1 L_1 + x_2 L_2 + x_3 L_3$, &c.$)/(L_1 + L_2 + L_3$, &c., (from OX, and) $y_1 L_1 + y_2 L_2 + y_3 L_3$, &c.$)/(L_1 + L_2 + L_3$, &c.,) from OY.

Personally, he thought that method was near enough, and he mentioned it because Mr. Kapp said he had not met with any other method of doing it except by that ingenious string method which was a very good one, and would be very useful. Mr. Kapp decided on economical voltage purely from the point of view of capital cost. If he had taken the *annual* total costs into consideration he would have probably found it would pay to use 30,000 volts at a less distance. He thought Mr. Kapp had an inkling of that because he mentioned that he would be inclined to adopt that pressure for less distance. A rather extraordinary statement, to his mind, was that he believed "that 0.075 sq. in., or some figure near to it, will in future become the standard cross section on 6,600-volt networks, with possibly feeders of some smaller cross section on the outer fringe of the supply area." For instance, there was a distinct saving in capital cost by the use of one .25 cable instead of two .075 cables; in one case it was £1.045 per kVA per mile laid, and the other £0.93. If the annual I^2R losses had also been taken into account and added to the capital cost, the comparison would be still more in favour of the one .25 cable. His experience in cables suggested that wherever possible they could use one cable up to .3 sq. in. for economy rather than two smaller ones, such as suggested by Mr. Kapp. Mr. Woodhouse mentioned the fact that "the load factor of the losses was less than that of the load, and that allowance ought to be made in the cost of the waste energy on account of this." Another similar point was that the annual charges on the increased size of main to transmit the losses ought also to be taken into account. When they took those into account they might get the cost of wasted energy in a cable 30 per cent. more than the actual cost at the power station. Dealing with the economic pressure, he did not think there were any simple formulæ of the Kelvin's law pattern which could deal with that question in a simple, straightforward way, especially when they were dealing with e.h.t. transmission. For overhead lines, Prof. Still gave a rough formula for the voltage for lines over 20 miles long, and the economic voltage (kV) was 5.5 √ miles kW/100. He had found that useful for overhead work, but not for underground cables. Mr. Woodhouse stated that the extra cost involved by an increased size of conductor forming part of a cable laid direct in the ground did vary in strict proportion to the weight of metal. He (the speaker) did not think that was so. For instance, taking a .04 l.t. 3-core and a .25 l.t. 3-core cable, the metal cost varied as 1 : 6.65, while the cost of insulation and lead, &c., varied as 1 : 2.65, while with the same sizes of 6,600-volt armoured cable the cost of insulation, &c., varied as 1 : 1.3. It was such things which made it difficult to use simple formulæ for cable work. Mr. Woodhouse mentioned many modifying influences which spoiled the simple beauty of those formulæ. They took no account of the dielectric losses which went on all the time whether a cable was carrying a load or not. Those losses might even be the governing factor, being very considerable in some cases, such as in, say, a ten or 20-mile transmission of 12,000 kW as between 30,000 and 60,000 volts, because in that case the dielectric loss in a 60,000-volt cable at 40 per cent. l.f. would be more than the I^2R loss, and although the dielectric losses cost less than the I^2R losses, having 100 per cent. load factor, yet when they were taken into account they put a different aspect on matters in the case of bulk transmission where heavy loads had to be taken over a considerable distance. Another point was that the power factor of such e.h.t. cables rose with the pressure so that the dielectric losses did not vary as the square of the pressure, but as something more. The power factor of a 30,000-volt cable would be less than one for 60,000 volts, though no one knew much about 60,000-volt cable yet. Those were points which had to be taken into account, and made an important difference in arriving at the most economical size and voltage. For bulk supply, he found, working on dielectric losses which a cable maker might be expected to get, and taking costs of switchgear, &c., into account, that generally speaking, if the load was not too great for one cable to carry then a 30,000-volt cable was equally if not more economical than a 60,000-volt cable up to 20 miles run, and the risk was less. One could lose a lot of money in dielectric losses. He wished personally that instead of having to qualify all those nice equations, someone would invent a high voltage d.c. system so that they could apply Kelvin's law in its pristine simplicity without any tomfoolery. Mr. Woodhouse suggested that by his equations they could ascertain economic size and pressure, but his experience was that they could not; it was usually only by laborious processes tried upon different cables that a man could arrive at what was the economic pressure. When they came to really high pressures they had to consider other matters besides I^2R losses and capital charges—they had their transformer losses and the extra risk, a very important thing which could not be expressed in £ s. d.

Mr. **Nisbett** said that both papers were particularly appropriate, because a fashion had set in for the concentration of large amounts of power into one central station, with consequent increase of the area supplied from one source, and in his opinion it was being rather run to death without counting the cost or even proper investigation concerning the cheapest way in which the district could be supplied. In order partly to justify such super-schemes, and to cut the capital charges, engineers were calling on the cable makers for higher and higher pressures, and were willing to accept super-tension cables with a very much lower factor of safety than anything yet employed. A huge experiment was being tried and dielectric stresses were being imposed vastly in excess of those of which they had any experience. For instance, taking for comparison a 0.10 sq. in., 3-core cable built to B.E.S. specification:—

3,300-V cable had a maximum stress of 834 V per mm.
6,600-V cable had a maximum stress of 1,348 V per mm.
11,000-V cable had a maximum stress of 1,753 V per mm.

Now in the case of super-tension cables not standardised, but built to the dielectric thickness commonly employed:—

22,000-V cable had a maximum stress of 2,950 V per mm.
33,000-V cable had a maximum stress of 3,880 V per mm.
66,000-V cable had a maximum stress of 6,150 V per mm.

It might be that with good luck these highly stressed cables would be all right, but only years of use could prove if it was so or not. Meanwhile, in any comparison of cost between cables working at one pressure or another the difference in the safety provided must be kept in mind. Mr. Woodhouse's cable cost curves, fig. 1, were totally misleading. In the first place, he had used some 1907 prices, while others were up-to-date; for even an approximate comparison the three lower curves should be lifted from 200 to 250 per cent. in cost. Moreover, there was some obvious error in the calculation of them, as the higher the pressure the more the cost rose in proportion with increase of section, so that the lines should diverge from the left of the diagram. The curves could not be straight lines, as the cost of laying was included in the price, and that was practically a constant quantity whatever the working pressure or size of the cables. If engineers were willing to work the lower-tension cables at the dielectric stress now commonly employed in super-tension cables of, say, 33,000 volts, then only mechanical reasons determined the thickness of the dielectric for all tensions up to 11,000 volts. Assuming 0.08 in. to be the minimum safe insulation thickness, then exactly the same cable could be used for any working pressure up to 11,000 volts, even allowing for possible surges of a higher percentage above the normal in the case of the lower-tension cables than in those for super tension. It was not suggested that those reduced thicknesses should be worked to in practice; money spent on providing a reasonable modicum of safety was money well spent, but it seemed that the B.E.S. standards were at present unnecessarily generous in the matter of insulation thicknesses. If the proposed "super-power" stations serving wide areas were to come into being, then in fairness a universal tariff must no longer be used, but a rate per unit, increasing with the distance between the consumer and the source of supply. The limiting load on a long feeder cable might be determined by quite a short stretch of soil that had a high heat resistance or low absorption. If cables were to be worked fully up to their maximum allowable temperature, it was necessary to join up lengths of cable of much larger section than the normal at points where the feeder entered a power or sub-station, because there the conditions were not so favourable for the dissipation of heat and the surrounding temperature was much higher.

Mr. Holttum asked if it would not be possible to settle on the final distribution system and pressure for any particular case and maintain them throughout, adopting higher pressures for generation and transmission as necessary as the system expanded. Thus, the first power station might at a later stage be rearranged as a sub-station, and so on. He asked the authors whether they considered the Thury system entirely out of the running for general transmission in this country. Turning to Mr. Kapp's paper, he asked whether the statement he made with regard to the position of the power house was an argument against super power houses, and whether it was considered that undue weight would be given to considerations of water and coaling facilities and so in the end a more expensive system would be put into operation. (Mr. Kapp: Yes.) Mr. Carrothers's method of finding the most economical position of a power station with weights and strings was a very good one; the problem could not be solved theoretically, and the solution given by Mr. Morton earlier in the discussion would not give the result aimed at. Mr. Kapp's method of determining the temperature to which a cable rose could very easily be applied in practice, but seemed to have some practical objections, as one or two speakers had already hinted. There was, first, the cumulative error; each element of the heating curve was commenced from where the last one left off, and successive errors in the same direction would mount up. Then the initial temperature of the cable would appear to require special determination for the starting point of each curve. There was also the variation of the quality of the ground which Mr. Nisbett had mentioned, and, finally, the ignorance of the heating time constant. It should be borne in mind that the way in which a cable heated up depended not only on the load at the moment and on the time constant, but also on the earlier part of the heating curve. For example, suppose the cable received a 10 deg. rise, the rate at which the immediate subsequent heating took place would depend on whether the initial 10 deg. occurred under heavy load or light load, for in the former case the ground round about it would have had time to become only slightly warm, while in the latter case the ground would be warmed considerably, and subsequent heating would consequently be more rapid. As in the majority of cases the load continuously increased step by step up to the peak, there would be an accumulation of error. He supposed that the author's method would only be applicable in cases where the time constant was fairly long.

Mr. T. D. Clothier said that, with regard to Mr. Kapp's quotation of distribution cost of 0.22d. per kelvin over a distance of less than 10 miles; that cost increased with increasing distance against the cost of transmitting an equivalent weight of coal by rail which, at 2.24 lb. per kelvin, was only 0.029d. per 10 miles, or 0.058d. per 10 miles at 4.48 lb. per kelvin, and that decreased with increasing mileage. He doubted the strict accuracy of fig. 3. The cost of the intermediate-pressure mains required to supply the hypothetical uniform area represented by a rectangle, would surely require some cost at the points A and B. Should not that figure be raised upon a rectangular base? With regard to the economical limits to the size of sub-stations at various pressures, assuming the reduction from 30,000 volts to the low-tension system could be made without cost by direct reduction from the 30,000-volt cables, the lower rectangle would become a triangle, the intermediate system would disappear, and the area representing cost would be reduced to exactly one-third of the expenditure shown in fig. 3. Then again, by placing three sub-stations instead of one, the area could be reduced by more than 30 per cent., so that the economical size of a sub-station was a matter of first-rate importance. Mr. Kapp's suggestion to use smaller cross sections of copper on a ring main on the feeders furthest from the power house would hardly be generally commendable, for if the ring main was to be used as a duplicate means of supply to all users on the ring, it must be contemplated that the section between the power house and the first user either way might be disconnected, in which event all users between the furthest point and the first user would be supplied through the section which it was suggested should be reduced. The temperature charts carefully avoided giving any actual temperatures; a device which could be made for attachment to underground cables at selected points for the purpose of enabling the temperature of the lead sheath or armour to be kept under observation might be of considerable practical use. However crude the result, it would be better than no information at all. Mr. Woodhouse's diagram of cost for extra-high-tension work did not include any provision for telephone and pilot cables, and must be adjusted for open country work; it would require modification for urban work especially if the roadways with reinstatement had to be used. The use of 6-core cables for 30,000-volt underground uninterrupted trunk feeders, with the protective devices which could be used with them, seemed eminently suitable. The smaller conductor section appeared to give a larger carrying capacity per equivalent cable to offset the 60 per cent. or so increase in the bulk of the dielectric.

Dr. E. W. Marchant pointed out that Kelvin's law was originally laid down to decide which was the most economical cable to use for transmitting a given amount of energy from one place to another, and his law was based on the fact that they wanted to make a total cost of transmitting energy from one place to another a minimum, actually that was not the right basis to take in working out the most economical working current for a cable already laid. If a cable were laid in the ground and they wanted to find out what was the most economical current to send through it, they could not take as a basis that the total cost of transmitting energy should be a minimum. The right basis to take was that the ratio of the amount of revenue earned by the energy transmitted to the total cost of sending it along the cable should be a maximum. If this basis was taken, the result was not in agreement with Kelvin's law. The most economical section was that for which the cost of energy wasted was equal to the charge for interest and depreciation on the total cost of laying the cable, not to the part of the cost which was proportional to the area of the conductor, and that, he maintained, was the real and proper economic basis on which the most economical current density should be decided; that point was not fully appreciated. It was shown many years ago by Mr. Russell in a book he wrote, but he had seen little reference to it; it was an important point, because Kelvin's law had been looked upon as something beyond dispute. The formula for current-carrying capacity which Mr. Woodhouse had given for cables of varying cross section corresponded very closely with the figures that had been obtained in the experiments made on the heating of buried low-tension cables, and they had found that the current that passed through a cable which produced a given temperature rise was very nearly proportional to the square root of its area. That seemed to lead to the conclusion that it would be more economical to transmit power with a number of small cables rather than with a small number of large cables. With reference to Mr. Kapp's paper, he fully agreed with the stress that he laid on the importance of an economical network lay-out. In Mr. Kapp's fig. 6 the crossing points of the curves, the 6,600- and the 50,000-volts, and the crossing point of 11,000 and 30,000 volts, corresponded fairly closely to the old rule that the most economical pressure for a given distance was about 1,000 volts a mile; it was an interesting coincidence. Regarding Mr. Kapp's remark that "very little was known about the time constants of cables," he hoped the figures and curves given in "The Heating of Buried Cables Report" would provide Mr. Kapp with some of the information he required.

Mr. W. B. Woodhouse, in reply, said he was in full agreement with Mr. Kapp on the question of protective gear. His feeling was that the elaborate inter-connecting network such as some people imagined was altogether too costly, and the proper thing to do was to split up that network into sections, feed those independent sections at a comparatively small number of feeding points, and cut down the cost of protective gear. Dealing with the equation on cost of cable, he could not agree to either of Mr. Nisbett's statements. As to showing the present-day costs for the lower-pressure cables in fig. 1, he thought it was perhaps better not to confuse them, but it was quite easy by proportion to work down from the top and put in the curves for 22,000 and 11,000 volts, and so forth. Kelvin and Prof. Marchant were both correct, but the point of view was different. There came a time when they must consider either one or the other, they could not consider both together. They had got, somehow or other, to cut down the cost of supplying electricity for a wide area; as they developed they had to make it correspondingly cheaper. Also there was the case of supplying farmers in the country.

The farmer was used to being upset in his ordinary operations for a day or a week at a time by the weather, or because the threshing machine had not turned up. He did not think the farmer minded very much if his supply was cut off for a day, he was more or less used to it. The problem of supplying a farmer was "were they to duplicate their system, or give him a supply and let him take the risk of its being cut off occasionally?" From what he knew of farmers, they were prepared to take the risk, he thought. Mr. Clothier referred to the increment cost. They had got to pay for protection somewhere or other; if they put the copper up in the air they had to provide the poles to support it and the insulators and protection, and all sorts of other things. He agreed that they must not go forward too rapidly; it would be a disastrous thing if some of the big schemes tumbled to pieces because they went ahead too fast.

Mr. R. O. Kapp, also replying, explained that the advantages of feeder-protective gear would be less strongly emphasised if one did not call it "protective" gear, which was really a misnomer, as it did not come into operation until the cable had been damaged. There appeared to be some misapprehension as to what Kelvin's law really says. According to that law the capital charges of the cost of everything that varied with the cross-section should be equal to the cost of losses for the most economical current density. In most distribution schemes the proposition was not that of laying a single cable of which the cross section had to be determined, but that of deciding how many cables of a cross section already settled had to be laid; therefore, the total cost of cables as well as a large proportion of the cost of laying them, depended on the cross section, from which it followed that, rightly applied, Kelvin's law gave far too high a current density for the safe working of 6,000-volt cables. Having regard to the greater cost per unit of the capital charges on the distribution system in the case of very large stations, it would be found that for the average conditions in this country, the cheapest electricity at the consumers' terminals was obtainable from power stations having an installed capacity in the neighbourhood of 100,000 kW. In reply to Mr. Clothier, the reason why the cross section of copper on a ring main should be reduced at parts furthest from the generating station was that at those parts the main need never carry more power than the demand between it and the generating station on one side or the other, whereas the cables leaving the generating station must allow for the whole of the power to be fed through them either clockwise or counter clockwise, so both branches of the ring must be able to pass the whole of the load on the ring. Mr. Clothier's suggestion of using pyrometers on feeders seemed to be well worth following up.

WESTERN AUSTRALIAN GOVERNMENT TRAMWAYS AND ELECTRICITY SUPPLY.

Annual Report.

The statutory annual report of the Commissioner of Railways for the year ended June 30th, 1920, covers also the operations of the tramway and electricity supply undertakings, and the statements of costs are given on identical lines as similar ones in this country; they are, therefore, comparable. The case under consideration is one in which a modest "super-power" station was established by the State to supply power to the Government tramways, and to supersede the Perth City power station (which condition has, however, not yet been fulfilled) as well as to supply electricity in general in the neighbourhood of the capital of Western Australia.

Tramway Undertaking.

The report points out that the tramways were formerly controlled by the (*a*) chief engineer of existing lines (permanent way); (*b*) electrical superintendent (rolling stock, overhead line equipment, repair shops, East Perth power house, and electricity supply); and (*c*) chief traffic manager. Soon after Mr. H. Pope took control as Commissioner of Railways the department was reorganised, the tramway and electricity supply undertakings being placed under the management of Mr. W. H. Taylor (formerly electrical superintendent), and the results have fully justified the rearrangement.

The financial result of the year's working was, after paying interest on capital invested (£28,223), a profit of £10,106, representing a return of 1.63 per cent. on the capital invested.

This profit compares with a loss of £4,046 in the preceding year. The earnings for the year (£187,981) show an increase of £53,922. A total of 19,175,143 passengers was carried, representing an increase of 1,708,236. The operations for the year under review show a marked advance on the preceding year, which was seriously affected by the industrial trouble and the influenza epidemic. It is estimated that revenue to the extent of £21,600 was lost through these causes. Allowing for this, an amount of £32,322 is due to increased traffic compared with the year 1918-19.

The working expenses (£149,652) include an amount of £10,000 transferred to "belated repairs suspense account," and the payment of £5,473 to local authorities on account of the 3 per cent. contribution. The expenditure shows an increase of £38,554, although the cost per car mile is 0.16d. less than in the preceding year, which does not, however, afford a proper basis for comparison, for the reason that the system was closed down from December 21st, 1918, to February 7th, 1919. On this account, the expenditure was considerably less than it would have been under normal conditions.

During the year 2,530,730 car miles were run, an increase of 672,358 miles, equivalent to 36.18 per cent. The earnings per car mile were 17.83d., or an increase of 0.52d., and the number of passengers per car mile increased by 0.31.

On June 30th last the system operated consisted of 27 miles 20½ chains of route mileage. No additions to the system were made during the year.

The duplication of certain sections of the track will be undertaken as soon as the electric welding plant (which has been on order for some time) comes to hand. In the past the rail joints have been thermit welded, but it has been decided to adopt the electric welding process, in accordance with the latest practice. It is expected that substantial economy will be effected by this means.

The condition of certain sections of the track will necessitate relaying at the earliest opportunity. Twenty additional bogie cars, each having 92 seats, are to be built in the Midland Junction workshops, and a complete scheme of tramway extensions, providing for the requirements of the city and suburban area, covering both immediate and future needs, with estimates of the costs of the individual works, has been prepared.

On June 1st last the fare system applying on the tramways was revised, and the cash sectional fare system—based on one penny sections—was introduced. All concession tickets, including workers' return tickets and transfers, were abolished. Workers now pay one penny on the morning journey and full fare on return, in lieu of full fare in the morning with a ticket entitling them to free return at any time of the day. One of the features of the net result has been the reduction from twenty to five only, as a maximum, of the number of different chits and tickets handled by conductors and others of the staff. In addition to the saving in cost of printing, this has simplified the work of the conductors, and reduced the clerical work considerably. The new system is working satisfactorily, and gives every indication of leading to increased business, as short-distance passengers who formerly walked in preference to paying the 3d. fare, are now using the cars.

Electricity Supply.

The past year has been one of marked progress for this undertaking, and in view of the fact that the output from the plant only commenced in December, 1916, the result which has been attained is very gratifying. The rapidly increasing sales of energy, and the nature of the prospective new business, indicate that the concern is fulfilling the purpose for which it was established, *i.e.*, an assured and ample supply of power, at a cheap rate, to encourage the establishment of secondary industries within the State.

The sale of energy during the year totalled 18,446,896 units, an increase of 5,024,818 units over the preceding year; the average selling price was 0.869d. per unit. The earnings amounted to £66,852, an increase of £19,945.

The operating expenses were £43,163, an increase of £14,862. The price of the "small" native coal used was increased from 6s. 11d. to 9s. 6d. at the pit's mouth, and applied throughout the year; this item represents 75 per cent. of the operating costs, and of the increased operating expenses (£14,862), an amount of £11,029 is in the fuel account.

The financial result of the year's operations was, after paying interest on capital invested (£19,643), a profit of £4,046; £5,896 was, however, transferred to "antiquation suspense account," and after allowing for this the result was a loss of £1,850 on the year's operations. Compared with the preceding year, wherein the loss was £5,722, this result must be regarded as satisfactory.

The complete installation of the switchgear under the original contract has been practically completed; the switchgear at the power house for the Fremantle and Midland Junction transmission lines is also complete. There is now an entirely duplicate supply to each of these districts. The boiler house efficiency has received much consideration during the year, in view of the increasing cost of fuel, to enable the poorer grade coal to be burnt economically. For the purpose of enabling "duff" coal to be used, a Sandford-Riley multiple retort stoker is to be fitted to one of the existing boilers. It is considered that substantial economies will be possible by the adoption of these stokers.

The distribution system has operated satisfactorily throughout the year. Considerable improvements have been made to the outdoor switching arrangements, to ensure continuity of supply, and the change over to the Government system by the Perth City Council is expected to be effected shortly. A 20,000-V transmission line has been taken out to Keswick, to provide a supply at that point, as well as to Gosnells and the surrounding districts. In addition to ordinary industrial establishments, there are large possibilities in the utilisation of electric power for the treatment of minerals, such as iron, lead, and copper. This aspect has been receiving consideration, and the question has been gone into somewhat fully. It is hoped that something tangible may be done in this respect.

With regard to plant extensions, the following tenders have been accepted: Messrs. C. A. Parsons & Co., one 7,500-kW turbo alternator and condensing plant, &c. Messrs. Babcock and Wilcox, Ltd., two boilers, economiser, fan, chimney, &c. The turbine embodies the new form of blading, which ensures low steam consumption. The new boilers will be fitted with Sandford-Riley stokers. It is hoped that circumstances will permit of this plant being promptly delivered, as it is desired to have it installed in time for next winter's load.

Turning to the technical statistics, the plant capacity is 12,000 kW; the maximum load 6,600 kW, an increase of 700 kW; and load factor 36.65 per cent., an increase of 6.09 per cent. The units sold numbered: tramways 5,535,977, an increase of 1,708,236; Perth City Council 6,119,590, an increase of 1,636,391; a.c. bulk supplies 6,791,329, an increase of 1,680,191. The coal burnt per kWh was 3.3 lb., a decrease of 0.1 lb.; its energy value (B.th.u.) was 2.64 kWh and the amount used was 31,978 tons, an increase of 8,602 tons.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR DECEMBER, 1920.

In the aggregate there is little difference between the returns for December and those for the previous month. Exports fell £9,958, or about ·6 of 1 per cent. Decreases occurred in the figures for the export of unenumerated goods, insulated wire, glow lamps, batteries, meters, "other motors and generators," electrical machinery (unenumerated), and switchboards. The total figures were kept level by large increases in the export of telegraph and telephone cable and material. This class showed an increase of £281,644—or approximately 88 per cent. on November's figures.

Imports rose £33,135, the principal items of increase being the "unenumerated" goods and apparatus and telegraph and telephone instruments.

Re-exports, however, were £10,476 higher than in the previous month, an increase of 56 per cent.

Values of Electrical Exports and Imports for December, 1920.

	Exports.	Imports.	Re-exports.
Electrical goods and apparatus (unenumerated)	£244,543	£132,624	£9,378
Insulated wire	313,350	14,351	—
Glow lamps	26,461	12,236	2,958
Arc lamps and parts	4,742	9,107	15
Batteries	75,932	13,162	—
Meters	29,888	15,468	2,649
Carbons	29,288	18,304	100
Electrical machinery:—			
Railway and tramway motors ...	15,127	—	—
Other motors and generators ...	191,964	—	—
Electrical machinery (unenumerated)	121,609	146,822	5,281
Switchboards (not telegraph or telephone)	13,860	8,668	—
Telegraph and telephone cable and material:—			
Telegraph and telephone wire and cable (not submarine)	125,079	6,319	1,215
Submarine telegraph and telephone cable	326,295	—	—
Telegraph and telephone instruments and apparatus	150,844	52,037	7,426
Totals... ...	£1,668,982	£429,098	£29,022

Below we give comparative figures of the values of electrical exports for 1919 and 1920, taken from the latest B o.T. returns.

Electrical Exports for 1919 and 1920.

	1919.	1920.	*Inc. or dec*
Electrical goods ...	£1,331.844	£2,117,453	+ £785,609
Insulated wire ...	1,906,731	3,797.310	+ 1,890 579
Glow lamps... ...	149,907	319.382	+ 169.475
Arc lamps and parts	18,514	36.057	+ 17.543
Batteries	435.332	627,584	+ 192,252
Meters...	239.848	396,421	+ 156,573
Electrical machinery	1,952.528	2,794,099	+ 841.571
Carbons	12,801	149,757	+ 136.956
Teleg. & telep. material and apparatus.	1,563,644	4,043,390	+ 2,479,746
Totals	£7,611,149	£14,281,453	+£6,670,304

British Engineering Standards for Argentina.—A special correspondent of the *Times Trade Supplement* of Jan. 8th drew attention to the desirability of standardisation, to reduce the cost of manufactured goods. For this purpose a Committee was formed in Buenos Aires, and was affiliated to the British Chamber of Commerce in that city; the Committee has drawn up new metric standards for steel beams, angles, and channels, which, it is claimed, are superior to the local or "Continental standards," combining strength, lightness, and even metric sizes. It is pointed out that those working on the spot are constantly meeting with cases which show the urgent need for standard types when important contracts are at stake. Various other subjects are being examined by the Committee, including electrical plant of all kinds.

ELECTRICITY SUPPLY IN N.E. LONDON.

A copy of the report on the future development of electricity supply in the eastern districts of Greater London north of the river Thames, which has been submitted by Mr. E. M. Lacey, M.I.E.E., consulting engineer, to the Electricity Committees of the county borough of West Ham and the metropolitan borough of Poplar, has just reached us. It is dated May 12th, 1920, and an abstract of a preliminary report dated March 28th, 1919, has already been published.[*] Mr. Bruce Dawson, F.R.I.B.A., and Mr. W. M. Selvey, M.I.E.E., assisted in the preparation of the report, and both would collaborate with Mr. Lacey so far as regards any further work which may arise in connection with the scheme he has recommended. The report is an extensive one and is divided into two parts, viz., Part 1: Administrative scheme for Greater London, and Part 2: Electricity supply in north-east London, with appendices, maps, and plans. The chief recommendations of the report are:—

Part I.—The area primarily considered for the administrative scheme proposed in this report is that known as Greater London and certain districts adjacent thereto. In order to achieve the object of the Electricity (Supply) Bill, 1919, main generating stations should be erected on selected sites adjacent to the river Thames, and should be operated in conjunction with the more efficient of the existing generating stations. The new main generating stations should be designed for an a.c., three-phase supply and a frequency of 50 cycles per second. An electricity authority for Greater London should be constituted to exercise supreme control of the incidence and extent of all capital expenditure and over all such works, matters and things as may be necessary from time to time to secure the effective co-ordination of the electricity undertakings of Greater London and the most economical production and supply of electricity. In order to avoid the evils of over-centralisation and to secure the co-operation and valuable local knowledge of the existing organisations and their executive officers, the Electricity Authority should delegate to Divisional Boards all executive functions; for the technical guidance of each Divisional Board an Advisory Committee consisting of engineers of the existing undertakings should be appointed. The Electricity Authority should confine itself to broad principles and financial policy, and should delegate to the Divisional Boards all technical functions, which would be exercised under the technical guidance of the Advisory Committees. The engineers of the existing undertakings should suffer no loss of status by reason of the proposed amalgamation, and it must be recognised that the success of any joint scheme will always depend upon the zeal and enterprise of the principal technical and executive officers, and the organisation should be sufficiently flexible to obtain the assistance and advice of consultants. In the event of differences arising there should be the following rights of appeal: (*a*) By Divisional Boards to the Electricity Commissioners as to the decisions or directions of the Electricity Authority. (*b*) By authorised distributors to the Electricity Authority, and finally to the Electricity Commissioners, as to the decisions of the Divisional Boards. (*c*) By large consumers to the Electricity Authority, and finally to the Electricity Commissioners, as to the terms and conditions of a Divisional Board for electricity supply. (*d*) By ordinary consumers to the Divisional Board concerned as to the terms and conditions of the authorised distributor.

A comprehensive administrative scheme for Greater London should provide for the friendly co-operation of company-owned electricity undertakings, and one way to secure this would be for the Electricity Authority or the Divisional Boards to take on lease the existing generating stations of the companies, for the remaining period of their tenures. Municipal credit should be utilised to the fullest extent possible, by the guarantee of stock or otherwise, in order to raise the capital required on the most advantageous terms. No direct profits should be made by Divisional Boards on supplies to authorised distributors, but a limited profit might be made on direct supplies to railways or large consumers.

Part II.—The aim of the scheme formulated above is to provide an Electricity Authority as being most conducive to convenience of administration and to the efficiency and economy of the supply of electricity in the whole of Greater London and the contiguous areas. The application of this scheme to North-East London, in which the Corporations of West Ham and Poplar are more particularly concerned, has now to be considered.

The proposed field of supply extends from Grays Thurrock on the east, to Shoreditch on the west, and from the river Thames on the south, to the boundary of Greater London on the north. It is by far the most important industrial area of Greater London, and with the unimportant exceptions of a few outlying districts, viz., Chingford, Orsett, Romford, Tilbury, and Waltham Holy Cross, the powers to supply electricity are in the hands of local authorities, comprising the metropolitan boroughs of Bethnal Green, Hackney, Poplar, Shoreditch, Stepney, Stoke Newington, and Woolwich; the county boroughs of East Ham and West Ham; and the urban districts of Barking, Grays Thurrock, Ilford, Leyton, and Walthamstow. The inclusion of Woolwich, which lies both north and south of the river Thames, presents no engineering difficulties, there being a tunnel under the river which can be utilised for inter-connection or transmission mains. With regard to certain contiguous areas, such as the metropolitan boroughs of Islington, Hampstead, St. Marylebone, and St. Pancras, the prospective business in North-East London alone is more than sufficient to justify the initiation of a scheme of considerable magnitude, and although these contiguous areas might well be included, there is for the time being no urgent necessity to do so.

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[*] Elec. Rev., June 13th, 1919, p. 711.

The population of the district which is considered in this scheme is 1,873,699. The present consumption of electricity exceeds 165,000,000 units per annum, being less than 100 units per head of the population, which is considerably above the average for the whole of London. That this consumption will be increased largely in the future cannot be disputed, more particularly having regard to the future requirements for railway traction. It does not seem unreasonable to assume that possibly within six or seven years, the units consumed will be at least 200 per head of the population, or about 374,000,000 per annum.

The most effective policy of development would be to complete the inter-connection of existing generating stations, to close down inefficient generating stations, and to concentrate in one main generating station all the plant necessary to meet progressive needs, such station to be operated in conjunction with the more efficient of the existing generating stations, the latter remaining in being for so long only as the actual results show that they are for the general good of the co-ordinated system.

A frequency of 50 should be the standard for the whole of London; there is now no reason why rotary transformers of this frequency should not operate perfectly satisfactorily for railway supplies. In the proposed area the total plant capacity is about 98,000 kW, there being some 42,000 kW of small and inefficient sets and 56,000 kW of reasonably efficient ones, comprising steam-turbine-driven alternators of from 1,500 up to 6,000 kW each. In addition there are some 36,000 kW on order, and it may be taken that by the winter of 1921-22 there will be installed a total of at least 92,000 kW of efficient and fairly efficient plant which, having regard to the inter-connection of the Poplar, Shoreditch, Stepney, and West Ham generating stations, should be sufficient to assure the maintenance of the supply, up to a maximum demand of about 66,000 kW. Some of the stations, and more particularly Barking, East Ham, Ilford, and Leyton, are uneconomical, and the progressive needs of the areas they supply could be better met by a system of interconnected transmission mains linking them up to the West Ham, Poplar, Stepney, Hackney, and Walthamstow generating stations. Other stations, such as Poplar, are restricted by the limitations of the existing sites. Considerable extensions comprising three 10,000-kW sets for West Ham and Stepney, and 6,000 kW for Poplar have been put in hand with the approval of the Electricity Commissioners, but these will only meet the more immediate needs. Finally, none of the generating stations of the undertakers could be economically extended to accommodate the large units of plant which will be required to meet the progressive demands of North-East London.

The maximum demand on the feeders of the fourteen existing undertakings is 61,942 kW, and the load factors of the larger of the existing stations vary from 26 to 47 per cent. The total units sent out from the several stations may be taken as approximately 171,510,000. In order to arrive at the present maximum demand, if the existing stations were co-ordinated and operated as one system, it is necessary to take into account the diversity of the several demands; and if this factor be 1.2, the coincident maximum demand would be 51,600, with a resultant load factor of 36 per cent.

The estimated demand is 105,800 kW for the year ending March, 1924. This increase in the maximum demand of nearly 44,000 kW in five years is a little more than 10 per cent. per annum, and does not include the railway demand for traction purposes, which is almost certain to come, if not by the year 1924, then very shortly after, and it would be wise to provide for demands for all purposes aggregating not less than 125,000 kW by the year 1924-25 particularly having regard to the probable electrification of the railways in the district. The above total will be reduced by the diversity of demand, when the whole system is co-ordinated, and taking this factor as 1.25 for the increased demand, the operating plant required will be 100,000 kW which, on a 40 per cent. load factor, would represent an output of 350,000 units sent out per annum, or about 158 units sold per head of the population served. In order to meet the anticipated demand additional plant will be required in the immediate future for a further operating capacity of 34,000 kW.

An increase of the population of the district to 2,000,000, and a probable consumption of 200 units per head in the next decade, cannot be regarded as unduly optimistic. In order to provide for such a demand, the total units annually sent out from the combined stations would be about 160,000,000 which, with a 40 per cent. load factor, would represent a coincident maximum demand of about 130,000 kW. The existing generating stations will provide for a maximum demand of 66,000 kW and, therefore, the main station would have to be designed for a minimum operating capacity of 64,000 kW. This demand would justify the provision of an initial main station, designed for a total plant capacity of not less than 100,000 kW, comprising five sets of 20,000 kW each. At the same time, regard should be given to the progressive needs for electricity during the next generation, and the station should be designed on a selected site where an ultimate plant capacity of not less than 400,000 kW could be installed.

The site which appears best to meet the essential requirements is situated to the east of and adjacent to Dagenham Dock. In extent it is some 170 acres, of which 52 acres are made up land and suitable for building. Within about two hundred yards are sidings from the London, Tilbury, and Southend Railway, and a well-equipped coaling pier, which will accommodate vessels up to 5,000 tons at all states of the tides, and the unmade ground would be used for the deposit of ashes.

The main plant would consist of 20 water-tube boilers and five turbine-driven alternators. The boilers would be independent units, consisting of boiler, superheater, economiser, and mechanical stoker, with forced and induced draught, and would be designed for a working pressure of 320 lb. per sq. in., with a total steam temperature of 700 deg. F. The turbine-driven alternators would be designed for a continuous output of 20,000 kW at 0.8 power factor, the current being three-phase and 50 cycles, generated at a pressure of 6,600 volts. The latter would be increased to 33,000 V by means of step-up transformers, and all switchgear would be designed with a view to an ultimate station capacity of 400,000 kW. An auxiliary turbine-driven alternator would be provided for operating the circulating water pumps, the forced and induced draught apparatus, and other auxiliaries in cases of emergency; but under ordinary working conditions, all such auxiliaries would be operated by the main plant.

The total cost of the generating station would be £2,500,000, but the progressive needs will probably be met by the initial provision of 60,000 kW of plant.

The transmission mains would be designed for a working pressure of 33,000 V, three-phase, 50 cycles. They would be 6-core, paper-insulated, lead-covered, and steel armoured cables laid solid in a suitable compound. Subject to wayleaves being obtained, some of the mains would be carried overhead on steel masts to the northern outfall sewer of the London County Council, which would be utilised to the fullest possible extent in order to reduce the use of public roads to a minimum. From the sub-stations a subsidiary system of transmission mains would supply the various authorised undertakers. The total cost of the transmission system for a maximum demand of 72,000 kW will be £1,110,000. Considerable progress has recently been made in the manufacture of cables up to 66,000 volts and, provided satisfactory guarantees can be obtained from the makers, the above estimate could be reduced by well over £200,000. In the beginning it would in all probability be sufficient to arrange for the transmission of (*a*) about 20,000 kW to a point suitably situated for a supply to West Ham, Poplar, Stepney, Shoreditch, and Woolwich, and (*b*) about 15,000 kW to a point suitably situated for a supply to Hackney, Walthamstow, Leyton, and Ilford. A subsidiary system of transmission mains would also be required for inter-connecting the several existing generating stations. The cost of the initial scheme would be approximately £600,000. The cost of the energy delivered from the initial main station would be 0.768d. per unit.

It is probable that some considerable time may elapse before a voluntary scheme for the establishment of a Greater London Electricity Authority, in accordance with the provisions of the Electricity (Supply) Act, 1919, is finally agreed to. However, these questions need not delay the initiation of a scheme for North-East London, provided the Electricity Commissioners approve the general principles of the administrative scheme submitted in the preceding part of this report, *i.e.*, that there should ultimately be one electricity authority for the whole of Greater London. Subject to the above, the Corporations of West Ham and Poplar, in association with the other twelve local authorities owning electricity undertakings in North-East London, could proceed forthwith with a joint scheme for the reorganisation of their existing generating stations and the provision of a main generating station to meet their progressive needs. There would be no difficulties so far as regards the participation or co-operation of undertakings owned by companies, because there is none of any importance in the whole of the proposed area, and so far as regards finance the fourteen local authorities have vested in them powers to raise money for electricity purposes on the security of their rates, being in this respect in a better position than an electricity authority established under the provisions of the Electricity (Supply) Act, 1919. The approval of the proposed procedure by the Electricity Commissioners would, of course, be required, and this could be applied for under Clause 19 of the Electricity (Supply) Act, 1919.

Until some administrative scheme is approved by the Electricity Commissioners it would be necessary for the existing authorised undertakers to enter into arrangements for such an organisation as would best control the proposed joint electricity undertaking and which could, when the time arrived, be merged in a general administrative scheme for Greater London. Following the principles of the administrative scheme formulated in the first part of this report, the formation of a Joint Board is recommended, which would deal with all administrative and executive work, and the appointment of an advisory committee of engineers, which would be responsible for the joint operation of the whole of the existing generating stations in the manner best calculated to obtain the most economical production of electricity.

The basis of the representation on the proposed board should so far as possible be in accordance with the provisions of the Electricity (Supply) Act, 1919, as follows: For authorised distributors, one representative in any area for every 75,000 of population. For authorised undertakers owning generating stations, one representative per 10 million units output in excess of two millions per annum. For the consumers, two representatives to be appointed by an association of consumers to be formed for the purpose, and for labour, two representatives to be appointed by agreement between the recognised trade unions in the area controlled by the Joint Board, which would give a total of 60 representatives.

A JOINT ELECTRICITY AUTHORITY.

The West Riding (Aire and Calder) Scheme.

What follows is an abstract of the draft scheme (which is signed by Sir Robert Fox, town clerk to the City of Leeds, Mr. C. N. Hefford being engineer and manager of the electricity department) which has been submitted to the Electricity Commissioners by the Leeds Corporation for the constitution of a Joint Electricity Authority for the provisionally delimited West Riding (Aire and Calder) Electricity District.* Following our usual practice only those points are dealt with hereunder whereon the scheme differs from those of which outlines have already been published.†

The scheme is divided into three parts, viz., administration, technical, and financial. It provides that the Electricity Authority shall consist of 19 members and shall be representative of: (*a*) All authorised undertakers and distributors within the district, and (*b*) all local authorities having the right to purchase the whole or any part of the undertaking of any authorised undertakers within the district, and such local authorities and companies shall be entitled to one vote for every 60,000 units supplied during the last preceding financial year, provided always that each local authority with purchase rights shall be entitled to one vote for every 60,000 units supplied within its area by the authorised distributors.

The Electricity Authority may at any time after the expiration of 42 years from the date of coming into operation of this scheme, give notice in writing to the Yorkshire Electric Power Co. requiring it to sell its undertaking to the Electricity Authority upon the terms set out in Section 2 of the Electric Lighting Act, 1888.

The Electricity Authority, when formed, will proceed in stages to interlink generating stations in the area to a control station which it is suggested should be installed in the existing generating station at Morley (now in process of being shut down). The stations to be interlinked will be those at Leeds, Bradford, Batley, Thornhill, and Wakefield, with extensions from Bradford to Shipley and Keighley, from Wakefield to Barnsley, and from Batley to Dewsbury. At a later date the linking up system to Morley will be extended to embrace Halifax and Huddersfield, and still later to connect to the proposed third "capital" station at Knottingley.

The system of supply to be adopted will be three-phase a.c., 50 periods. The main transmission pressure is to be 33,000 V, stepped up from a generating pressure of 6,600 V. It is probable that the transmission pressure between Morley and Knottingley will be 66,000 V. Intermediate pressures of 6,600 and 11,000 V will be utilised in certain cases to take advantage of existing cable networks. The proposed transmission mains to be laid during the first few years will consist of 17 3-core cables each 0.2 sq. in. in section, and the extensions will consist of eight of the same type. Ultimately, it is estimated that 55 3-core 0.2 sq. in. cables will be laid to deal with the load of the area in 1935, and that the extensions of this network will consist of eleven cables of the same type.

It is proposed that a new "capital" generating station shall be installed in Leeds on the banks of the Aire near South Accommodation Road, generating electricity at a pressure of 6,600 V, 3-phase, 50 periods, which is to be stepped up by suitable transformers to 33,000 volts for main transmission; that a second "capital" station be constructed at Wakefield to be sufficiently in commission by 1930; and that a third "capital" station be constructed at Knottingley, with adequate boiler plant, to be sufficiently in commission by 1933. The ultimate capacities of these three stations to be: Leeds, six 25,000-kW generators, with adequate boiler plant. Wakefield, six 25,000-kW generators, with adequate boiler plant. Knottingley, eight 35,000-kW sets. Suitable capacity in transformers will have to be provided at the various generating stations linked up, and it is proposed to install units varying from 2,500 to 10,000 kVA, in accordance with the requirements of individual cases. The following extensions of plant in connection with main generating stations in the area are in course of construction: Leeds, one 12,000-kW set. Bradford, one 12,000-kW set. Halifax, one 10,000-kW set. Thornhill (Yorkshire Electric Power Co.), three 10,000-kW sets. There will still be space available for installing one more 12,000-kW set at Leeds.

Until the first "capital" station is in commission, all existing stations will be required, but when the "capital" station at Leeds is sufficiently advanced to give an output continuously of 50,000 kW, the stations at Batley, Wakefield, and Barnsley can be completely shut down and in addition, during the summer, the stations at Keighley, Shipley, and Dewsbury will cease to operate. Also in the summer time the amount of power generated by Bradford, Halifax, Huddersfield, Leeds, and Thornhill will be considerably reduced. The total of the maximum loads of the eleven generating authorities concerned is at the present time 105,000 kW, and it is anticipated that in five years' time this will increase to 180,000 kW. There is installed at present in the area approximately 188,000 kW of engine-room plant and 150,000 kW of boiler plant capable, when reasonable spare plant is deducted, of dealing with a load of 120,000 kW. In five years' time it is estimated that the ultimate capacity of existing power stations in the area with regard to boiler plant will be 205,000 kW, which, allowing for reasonable spare capacity, will deal with 165,000 kW, indicating a definite shortage by that date of at least 15,000 kW, assuming all the plant in the area to be in a fit condition for use.

It is proposed that the Ministry of Transport should proceed forthwith with the erection and equipment of the first section of the "capital" station at Leeds. The scheme will not be capable of providing for railway requirements until the second "capital" station is in commission, but tramway requirements can be dealt with when the first "capital" station is in commission.

The Minister of Transport shall, in pursuance of the Act, erect the necessary capital stations and provide and lay all transmission mains for the interlinking of generating stations, including the proposed capital stations and the Yorkshire Electric Power Co., and also such additional transmission mains as may be necessary for supplying electricity to all authorised distributors, and shall provide such working capital as may be necessary in connection with the operation of the said capital stations and the administration of the Electricity Authority, and all such capital stations and mains shall vest in the Electricity Authority within the period prescribed by the Act, and the amount so expended by the Minister of Transport, together with interest at the rate of £6 per cent. per annum, shall be repaid by the Electricity Authority out of the net revenue derived from the working of such capital stations after payment of all outgoings and expenses, including the costs and expenses of the administration of the Electricity Authority.

The reserve fund may be applied in providing for:—

(*a*) Any deficiency in the income of the Electricity Authority.

(*b*) Any extraordinary claim or demand which may be made at any time against the Electricity Authority.

(*c*) Depreciation and renewal of plant.

(*d*) Reducing the capital moneys borrowed by the Electricity Authority.

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* Elec. Rev., June 25th, 1920, p. 815.

† Elec. Rev., December 24th, 1920, p. 809; January 7th, pp. 4 and 10, and 14th, p. 61.

Electrical Supplies in South Africa.—The *S.A. Mining and Engineering Journal*, in its issue for December 11th, 1920, says: There is no improvement to report, business being very quiet in town and along the Reef. Prices generally remain very firm, but lamps, which are again becoming scarce, have increased in price about 10 per cent., and are now selling retail at from 27s. to 36s. This increase affects only existing stocks, as in view of a 12½ per cent. advance in home prices, owing to dearer raw materials, future consignments will be higher. Gas-filled lamps are also very scarce, but the price has not yet been raised here, although the home quotation is considerably higher. All lines of materials generally are arriving freely. The fact is being emphasised that Germany is coming into our market with wares at prices considerably below English quotations, varying from 40 per cent. to 75 per cent. Of course, Holland draws a great deal on Germany, and we are getting a lot of goods from the former country which are really of German manufacture. As showing the impossibility of English goods competing with those of Holland and Germany at the present time, one of the largest dealers in town has just received a large consignment of German stuff at a price about 75 per cent. below English cost. Can it cause wonder that when the difference in price between English and German goods is so tremendous, altruistic and patriotic feelings necessarily go by the board?

The Miners' Lamps Committee.—Mr. W. C. Bridgeman, the Secretary for Mines, has reappointed the Committee which was appointed by the Home Secretary last May to inquire and report on possible improvements in miners' lamps as regards safety and illumination and alterations which may be desirable in the present methods of testing and approving such lamps for the purposes of Sec 33 of the Coal Mines Act, 1911. The terms of reference to the Committee have been extended as follows:—Whether the present arrangements for maintaining such lamps in a safe and efficient condition at the mines are adequate, and, if not, what steps should be taken to improve them; and what steps should be taken to safeguard the general use by the workmen in a mine of safety lamps which give no indication of inflammable or noxious gases.—*The Times.*

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

2. "Electrical power transmission systems." A. M. Taylor. January 3rd.

26. "Control and inter-communication system for railway trains in fog, &c." M. R. Howard and A. W. Pizzey. January 3rd.

28. "Covers for electric switches." J. W. Sanderson. January 3rd.

92. "Manufacture of electro-plated articles." W. E. Bourfield. January 3rd.

95. "Telephone call recorder." S. J. Mavoine. January 3rd.

126. "Telephonographs." Telegraphon Ges. January 3rd.

160. "Preservation of electric motor from action of surrounding medium and ensuring lubrication and cooling of motor." R. Longue. January 3rd. (France, March 4th, 1920.)

163. "Electrical conductors, resistance bands, &c., for reproduction of sound waves." R. Mylo. January 3rd. (Germany, January 2nd, 1920.)

164. "Apparatus for reproduction of sound vibrations." R. Mylo. January 3rd. (Germany, January 2nd, 1920.)

185. "Electrically-controlled signals for railways." J. Bethenod. January 4th. (France, November 22nd, 1918.)

215. "Electric switches." S. F. Woodell. January 4th.

235. "Cab signal and train control system." M. H. Loughbridge. January 4th.

240. "Electro galvanising machine." Meaker Galvanising Co. and F. H. Rogers (Meaker Galvanising Co.). January 4th.

242. "Electric controller." G. M. Shearer and F. H. Taylor. January 4th.

263. "Transformers." J. B. Hansell and Metropolitan-Vickers Electrical Co., Ltd. January 4th.

265. "Vapour-electric current rectifying apparatus." A. S. Cachemaille (Westinghouse Lamp Co.) and Westinghouse Lamp Co. January 4th.

297. "Wireless signalling aerials." T. L. Eckersley. January 4th.

306. "Electric railways." Compagnie du Chemin de Fer de Paris a Orleans. January 4th. (France, August 3rd, 1917.)

324. "Manufacture of armature and stator coils or windings for electric motors." A. H. Hibbs. January 5th.

335. "Electric lanterns." J. Eaton and Elandem Co., Ltd. January 5th.

340. "Telephone systems." D. Macdonald. January 5th.

346. "Switchgear for controlling electric motors." P. S. Brook and J. A. Hirst. January 5th.

356. "Electric condensor." W. Dubilier. January 5th. (United States, January 18th, 1916.)

370. "Enclosed electric fuses." A. L. Eustice. January 5th. (United States, June 21st, 1918.)

371. "Fuses." A. L. Eustice. January 5th. (United States, September 3rd, 1918.)

372. "Fuse terminal attaching means." A. L. Eustice. January 5th. (United States, March 31st, 1919.)

377. "Electric signalling or alarm apparatus, &c." J. Wilson. January 5th.

400. "Electric switches." H. Edmunds. January 5th.

421. "Transmitting arrangement for submarine sound signals." Signal Ges. January 5th. (Germany, October 9th, 1914.)

424. "X-ray photography." N. E. Luboshey. January 5th.

431. "Electric relay devices." J. B. P. Brydon and S. Brydon. January 5th.

436. "Contact springs for switching apparatus." Siemens & Halske Akt.-Ges. January 5th. (Germany, May 29th, 1914.)

437. "Electric, &c., insulating materials." Siemens-Schuckertwerke. January 5th. (Germany, October 20th, 1917.)

438. "Operation of electro-magnetic couplings." Siemens-Schuckertwerke. January 5th. (Germany, December 12th, 1919.)

461. "Electric relays." N. W. McLachlan. January 5th.

466. "Combined resistance and cut-out." Thor Electric Safety Lamp Co., Ltd. January 5th.

493. "Electric switches, ceiling roses, plug and socket couplings, &c." A. Davis, Davis, Hudson & Co., and F. R. Hudson. January 6th.

504. "Electrical fittings." H. Columbine, G. Hargreaves, and A. T. Rooks. January 6th.

578. "Systems of electric motor control." British Thomson-Houston Co., Ltd., and N. Shuttleworth. January 6th.

603. "Electric switches." R. K. Mason. January 6th. (United States, July 8th, 1919.)

613. "Electrode for introducing medicaments into the skin." W. Froese. January 6th. (Germany, May 16th, 1919.)

638. "Wireless antenna systems." Ges.-fur Drahtlose Telegraphie. January 6th. (Germany, October 11th, 1919.)

639. "High and low frequency telephone systems." Ges.-fur Drahtlose Telegraphie. January 6th. (Germany, January 7th, 1920.)

652. "Means for regulating terminal voltage of electrical valve tubes." F. Schroter. January 6th. (Germany, September 1st, 1919.)

657. "Fusible electric cut-outs and distribution fuse boards." H. C. Hodges. January 6th.

668. "Polyphase transformers." Bergmann Elektricitats-Werke Akt.-Ges. January 6th. (Germany, October 22nd, 1917.)

669. "Conductors for electric machines." Bergmann Elektrictats-Werke Akt.-Ges. January 6th. (Germany, November 26th, 1917.)

670. "Conductors for electric machines." Bergmann Elektricitats-Werke Akt.-Ges. January 6th. (Germany, February 20th, 1914.)

691. "Receivers for electro-magnetic wave systems." H. J. J M. de Regnauld de Bellescize. January 7th. (France, October 10th, 1919.)

693. "Series field windings for continuous-current dynamo machines." H. E. Dance. January 7th.

723. "Electric ignition apparatus for internal combustion engines." H. W. F. Ireland and H. Lucas. January 7th.

730. "Electric exploration of interior of the earth." H. Lowy. January 7th. (Germany, March 27th, 1919.)

731. "Electro-magnetic clocks." C. J. V. Fery. January 7th. (France, January 8th, 1920.)

742. "Means for recording telephone messages." E. H. Kinnard. January 7th.

744. "Attachment for telephone mouthpieces." J. S. Burfield. January 7th.

760. "Step-down transformers." J. C. Savidge and E. L. Terrey. January 7th.

765. "Control of electric circuits." H. Edmunds. January 7th.

771. "Electric fuses." Metropolitan-Vickers Electrical Co., Ltd. January 7th. (United States, January 12th, 1920.)

787. "Electric pocket lamps." A. Luzy. January 7th. (France, August 4th, 1919.)

827. "Wireless and light signalling devices." A. C. Sarnmark. January 7th. (Sweden, December 1st, 1919.)

836. "Wireless phonographs, &c." E. C. Hanson. January 7th. (United States, June 3rd, 1918.)

842. "Electric head lights." Soc. Anon des Usines J. Gallay. January 7th. (Switzerland, October 9th, 1919.)

853. "Incandescent electric lamps." N. Wise. January 7th. (United States, February 7th, 1919.)

859. "Sparking plugs." F. L. Madler. January 7th. (Germany, June 3rd, 1919.)

880. "Electrical transmission arrangements for motor vehicles, &c." J. Sankey & Sons, Ltd., and W. A. Stevens. January 7th.

890. "Cable transmitters." F. L. Rogers. January 7th. (United States, May 5th, 1919.)

892. "Electric pocket magneto lamps, &c." F. E. V. Le Tellier. January 7th. (France, 10th, 1919.)

917. "Appliances for testing sparking plugs." H. L. Curzons. January 8th.

918. "Electrically-driven travelling, &c., cranes." G. F. D. Campbell, W. Heap, and J. Meredith. January 8th.

926. "Revolving nosepieces for gas and electric fittings." A. Raybould. January 8th.

932. "Arrangement of brushes for disk-shaped commutators." Krupp Akt.-Ges. January 7th. (Germany, January 17th, 1917.)

939. "Electric gas lamps with glow discharge." Studienges fur Elektriscke Leuchtrohren. January 8th. (Germany, May 3rd, 1918.)

941. "Sparking plug." F. Carpenter, W. Dix, and W. Woodrow. January 8th.

946. "Galvanic battery." E. Wilke. January 8th. (Austria, December 10th, 1919.)

950. "Apparatus for converting and/or transforming electric currents." J. E. Calverley and W. E. Highfield. January 8th.

958. "Frames for windings of electrical resistance or heating elements." Widerstand Akt.-Ges. für Elektro-Warme-Technik. January 8th. (Germany, September 13th, 1918.)

959. "Electrical resistances." H. Behn (né Eplinius). January 8th. (Germany, January 4th, 1916.)

963. "Electrical cooking apparatus." W. D. Wright. January 8th. (United States, February 5th, 1916.)

983. "Testing arrangements for telephone installations." Siemens and Halske Akt.-Ges. January 8th. (Germany, March 26th, 1918.)

985. "Insulating material for electric purposes." Siemens-Schuckertwerke. January 8th. (Germany, December 14th, 1917.)

986. "Insulating substances." Siemens-Schuckertwerke. January 8th. (Germany, January 8th, 1918.)

987. "Submarine telegraph, &c., cables." Siemens-Schuckertwerke. January 8th. (Germany, February 2nd, 1918.)

988. "Cables with uniform gradation of voltage drop." Siemens-Schuckertwerke. January 8th. (Germany, September 6th, 1919.)

989. "Arrangement for suppression of earth leakage current of high-voltage networks." Siemens-Schuckertwerke. January 8th. (Germany, May 25th, 1918.)

1,079. "Receiving systems for radio-dynamic energy." J. H. Hammond. January 8th. (United States, June 22nd, 1917.)

1,080. "Receiving systems for radio-dynamic energy." J. H. Hammond. January 8th. (United States, July 31st, 1917.)

1,081. "Receiving systems for radiant energy." J. H. Hammond. January 8th. (United States, April 25th, 1918.)

1,087. "Electric time transmitting apparatus." P. Frichard. January 8th. (France, July 13th, 1917.)

1,089. "Transmitters for signalling." A. W. Sarnmark. January 8th. (Sweden, December 1st, 1919.)

1,103. "Submarine sound receiving plant." Signal Ges. January 8th. (Germany, December 10th, 1914.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1914.

18,042. "Electrically-driven turret lathes and like machines." Kienzle. August 1st, 1913.

1919.

16,310. "Electric resistance for medical purposes." W. A. Montgomery. June 28th, 1919. (155,317.)

19,999. "Electric cable attachment for the sparking plugs of internal-combustion engines." H. F. Holworthy. May 14th, 1920. (155,327.)

20,029. "Circuits for amplifying electric currents." General Electric Co. and B. S. Gossling. August 14th, 1919. (155,328.)

20,043. "Aerial systems employed in wireless telegraphy and telephony." C. S. Franklin. August 14th, 1919. (155,330.)

22,263. "X-ray apparatus." British Thomson-Houston Co. (General Electric Co.). September 10th, 1919. (155,345.)

22,299. "Dynamo-electric machines." E. J. Harman and E. Le Bas. September 10th, 1919. (155,346.)

22,592. "Starting rheostats for electric motors." A. H. Buckley and R. A. Buckley. September 13th, 1918. (132,538.)

23,599. "Electric lamp for motor and other vehicles." S. Smith & Sons and P. O. Dorer. September 25th, 1919. (155,392.)

24,400. "Electric hand lamps." G. Suckling. October 6th, 1919. (155,402.)

24,750. "Locking device for electrical switches." J. A. Vincent. October 10th, 1919. (155,407.)

25,172. "Electric contact maker for railways." N. P. Roe. October 14th, 1919. (155,414.)

30,926. "Junction or connection boxes for electric conductors." R. S. O'Neil. December 10th, 1919. (155,449.)

32,794. "Electrolytic apparatus." I. H. Levin. December 31st, 1919. (155,457.)

1920.

1,840. "Electric induction furnaces." Compagnie Francaise des Metaux. February 7th, 1919. (138,604.)

3,217. "Electric furnaces." L. Taglialerri. February 2nd, 1920. (155,476.,

3,279. "Electric furnaces for the production of zinc." B. Rader and Aktieselskabet Zink. February 15th, 1919. (139,160.)

4,214. "Electrical apparatus for indicating and repeating movements at a distance." J. L. Routin. January 3rd, 1920. (Addition to 131,635.) (155,480.)

5,087. "Driving and transmission mechanism for electrically-operated lifts, swing bridges, and other heavy machinery." Waygood-Otis, Ltd. (Soc. Anon. Ateliers Otis-Fifre). February 19th, 1920. (Patent of addition not granted.) (155,484.)

8,694. "Means for measuring wattless power or wattless consumption in alternating current circuits." Landis & Gyr Akt.-Ges. March 25th, 1919. (Addition to 3,856/15.) (140,785.)

9,612. "Carrier or means for supporting electric lamp or other shades, reflectors, and the like." A. P. Rutherford. April 6th, 1920. (155,499.)

12,229. "Time controlled electric circuit controllers." G. L. Hall. May 3rd, 1920. (155,504.)

14,433. "Electric starting and regulating switches." G. O. Donovan. May 27th, 1920. (155,509.)

16,679. "Metal brushes for use in connection with electric switches for controlling train movements." N. P. Roe. June 21st, 1920. (155,516.)

16,682. "Electric contact breaker for railways." N. P. Roe. June 21st, 1920. (Addition to 155,414.) (155,518.)

16,683. "Bracket for attaching electric contact breaker to locomotives." N. P. Roe. June 21st, 1920. (155,519.)

16,834. "Electrical switches for liquid starters." Siemens-Schuckertwerke. August 30th, 1918. (145,507.)

17,226. "Methods and apparatus for use in submarine signalling." R. A. Fessenden. November 29th, 1918. (146,152.)

18,021. "Distant control of apparatus in accordance with the electrically-transmitted movements of a pointer or the like." F. Krupp Akt.-Ges. September 30th, 1916. (145,723.)

18,027. "Distant control of apparatus in accordance with the electrically transmitted movements of a pointer or the like." F. Krupp Akt.-Ges. May 18th, 1915. (145,729.)

18,248. "Distant control of apparatus in accordance with the electrically transmitted movements of a pointer or the like." F. Krupp Akt.-Ges. November 6th, 1916. (Addition to 145,729.) (146,315.)

19,107. "Voltage regulator." F. Munz. April 4th, 1919. (147,088.)

19,365. "Fire extinguishing process and device for burning transformers and similar apparatus." C. Graaff. December 31st, 1919. (155,524.)

20,406. "Arc lamps for searchlights." Optische Anstalt C.P. Goarz Akt.-Ges. October 14th, 1918. (148,451.)

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THE MAINTENANCE OF PROSPERITY.

DURING the period of greatly stimulated demand that followed upon the signing of the armistice, and which only now shows signs of abating, there has been unending discussion of the necessity for co-operation between employers and employed. This discussion has centred upon the question of production; some urged that the only way to regain prosperity was to increase production all the time, while others, fearing unemployment as a result of overproduction, urged restriction of output, ca' canny, and other methods which they thought would keep up employment and a high level of wages. The arguments for both sides have been repeated so many times, and we have dealt with the matter in our leading columns so often, that we feel justified in taking it for granted that they are familiar to the minds of our readers.

Many methods of stimulating production have been devised and put into operation, some with conspicuous success, others with less noteworthy results. To judge from the frequent references that have been made to it in the Press, as well as from the fact that it is still in operation, the Priestman system is one of the most successful. It will be remembered that, under this system, the management conferred with the men's representatives, and the conference determined a certain standard rate of output for the factory, in Messrs. Priestman's case measured in tons of finished machinery. For this output the standard Trade Union rate of wages appertaining to the district was paid. Messrs. Priestman Bros., Ltd., increased this rate by 10 per cent. to obtain for the system the goodwill of the employés, but this is not an inseparable part of the idea. The output being fixed, it is reviewed every four weeks by the management in collaboration with the Works Committee, and the standard of remuneration for the four weeks next ensuing is based upon the percentage difference between the actual rate of production and the standard rate. The same percentage is applied to the rate of pay of everyone in the concern, from the general manager downwards.

This system has already been adopted by over 100 firms, and information concerning it has been supplied to nearly 700. If the effects produced are as satisfactory as they appear to have been hitherto in Messrs. Priestman's own case, the spirit of goodwill and co-operation which should result will, no doubt, have considerable bearing on the course taken by industrial problems. As a stimulus to production, the value of a system which apportions the results of increased productivity cannot be over-estimated; and while demand is brisk and production can be completely absorbed, this value is probably equally apparent to both sides. It is when a slump is threatened that the value of a stimulus to production is apt to be regarded as having diminished, if not disappeared, and this by both sides. The firm dislikes selling at a cheap price the goods which have been manufactured during a period of high production costs. The fall in prices is regarded by the worker as the result of over-production, and he jumps at once to the wrong conclusion that a smaller supply would raise prices again.

The fact is, of course, that while the potential demand is there all the time, it cannot be gratified during periods of financial stringency unless prices are lowered to a sufficient extent to render it possible for buyers to afford to buy. It is a well-known law of commerce that profits tend to disappear. We had better reiterate, for the benefit of those who are liable to misinterpret the word "law," that in this case it does not mean a legislative enactment brought into being because somebody thought it desirable ; it means that observation of a sufficient number of cases in which this result has come about, has made it possible to state, with practical certainty of fulfilment, that the same result will always be arrived at when the same causes are in operation. Profits tend to disappear. If a novelty is placed on the market, and captures the public imagination, it sells freely for a time at a high price. The demand will then either fall off, being satiated, or something else having appealed more strongly to it ; or it will remain, in which case imitators will become active, offering similar goods and usually lowering prices a little in order to get a start in the market. The first article must then be made more attractive, either by the addition of extra features, or by a cheapening of the price. Even when a price ring is formed—a practice we believe we have heard of in other industries—the profits made are vulnerable by outside manufacturers, by decreasing efficiency brought about by over-confidence and by diminution of wholesome competition, and by the need for carrying the weight of the weaker members.

In view of this law, it becomes apparent that there is a constant need for the encouragement of output, almost regardless of the demands of the market. Production costs, whether of manufactured goods or of units of electricity, consist of running costs and overhead costs ; and the overhead costs, remaining reasonably constant in amount, decrease per article or per unit as the output of articles or units increases. If production be allowed to fall off, the overhead costs per article produced will increase, resulting in a further diminution of profit ; and this may easily go on to the point where production becomes impossible, and the cloud of bankruptcy appears on the horizon. The factory, to produce cheaply, must produce continuously, and in great volume. Now, if, during times of slack demand, it is necessary to put unusually large quantities of finished material into stock, clearly there will be an unusually large amount of capital locked up in the business, which may lower dividends—again a tendency, on the part of the profits, to disappear. A weak concern will probably not be able to provide the necessary extra capital, and, being faced with the two evils of increase of overhead charges or increase of capital, will go to the wall. This kind of thing operates in cycles, and is bound to be seen in the future as it has been in the past. Increased activity in the selling of the product is imperatively necessary, and this is the time for agents, middlemen, and all the class of wealth-handlers, so much distrusted and despised by Mr. Hecht, to show if they can be of service to the community or not. But, above all, it is necessary to produce economically, and to keep the strictest oversight on the costs. We have seen it stated that the necessity to-day is for production, to-morrow for sales. Let it not be forgotten, however, that production will be necessary to-morrow as well as to-day, to prepare for the day after to-morrow. In fact, production and sales must continually go hand in hand, and it is never safe, never has been safe, and never will be safe, to neglect either of them.

London's Atmosphere. On January 1st an article on the London atmosphere appeared in our esteemed contemporary *Country Life*, in which Dr. J. S. Owens stated some facts which are of vital interest to something like six million people living in or near London. He invented and has been using a simple automatic instrument for measuring the amount of impurity in the atmosphere of London at all hours of the day and night. Briefly, it may be described as an automatic filter operated by clockwork, which at short intervals filters two litres of air, the suspended impurities being retained and weighed. With this apparatus Dr. Owens is able to trace the impurities of London atmosphere directly to the imperfect combustion of coal, a subject to which we have frequently drawn attention. Fortunately for sleepers with their windows open, the atmospheric impurities are at their lowest between midnight and 5 a.m. When people begin to start their fires for steam raising, and later for heating, cooking, &c., there is a marked increase in the amount of soot and other unconsumed combustibles in the atmosphere. It appears to have been proved that the hours during which fires are being started are the hours during which the atmosphere is most heavily charged with dirt, and, of course, even if no more were contributed by firing-up during the day, the original charge would take a considerable time to fall and settle.

Dr. Owens calculated that in some of the recent London fogs no less than 200 to 300 tons of sooty matter were suspended over the city. If people doubt this figure they should consider the further calculation that there are about 80 tons of soot emitted from London chimneys every hour.

Dr. Owens points out the immense importance of the atmosphere to the human organism. Whereas a man eats about 2.7 lb. of food and drinks about 4.5 lb. of water in 24 hours, no less a quantity than 30 lb. of air passes through his lungs in the same time. Obviously if this air is heavily charged with impurities, the fact is of greater importance than many questions concerning food, which receive much more attention. Dr. Owens calculates that in 24 hours of even moderate fog, no less than 5 to 6 cwt. of sooty matter is received into the lungs of the London population. He also states an incontrovertible fact when he says that the right way to deal with the difficulty is to stop making smoke. As is usual and correct, he lays a good deal of stress upon the contribution of the domestic fire. He suggests the use of smokeless fuel, and there can be no doubt that the general adoption of low-temperature distillation and the use of partially carbonised coal, or what might be called "half coke," would go a long way towards reducing the smoke and economising the coal, both items of practical and enormous importance.

We would venture, however, to point out that a still better solution would be the universal adoption of electricity for lighting, warming, and cooking in the domestic sphere, and for power purposes in the industrial sphere. This would not only restore the atmosphere of London to its original purity, but it would save carting about the country enormous quantities of heavy mineral, and would solve at one stroke all questions of congestion on the railways. This matter is, as we know, receiving the attention of the Government, and we hope it is serious in its intention to do everything possible to facilitate the development of electricity supply.

The Electron. No phase of modern intellectual achievement appears to us more marvellous or inspiring than the astounding results which have been attained by the scientific men of all nations who have been engaged in the study of the electron during the past half-century. It was in 1881 that Prof. Crookes published an account of his experiments on "radiant matter," and his theory of a "fourth state of matter," in which, with the exercise of scientific imagination of the highest order, he foreshadowed the discoveries of the twentieth century. "Forty years on" we are thrilled and spellbound by Sir William Bragg's masterly exposition of the present state of knowledge on this most fascinating subject, and are amazed at the manual dexterity and mental insight with which the modern physicist has explored the ultra-infinitesimal constitution of the atom, analysed, weighed, and measured the speed of its constituents, and divined the nature and properties of the ultimate particle of negative electricity. All this has been done without ever seeing or touching the electron, for even the smallest atom has a radius of the order of 10^{-8} cm., while the shortest wave-length of visible light is 4×10^{-5} cm., and the radius of the electron, if it is spherical in form, is less than 10^{-13} cm. We can never hope to see an atom, no matter how powerful our microscope; still less, therefore, is the prospect of seeing an electron—yet our men of science, with the eye of imagination, have pursued it in its giddy flight, have marked its passage through the atom (which they think of as "a very empty affair"!), have seen it "chip" other electrons off their mother-atoms, and have learnt that it maintains a close relationship with electromagnetic waves, so that either "can always call up the other" in accordance with definite laws.

It is here, especially, that Sir William Bragg can speak with paternal authority, for it is to him, and to his distinguished son, that we mainly owe the discovery of the nature of X-rays and their application to the solution of the problem of crystalline structure, of which he so modestly gives a brief account in his lecture—one of the best of the Kelvin lectures that have been delivered before the Institution of Electrical Engineers. We feel that this admirable essay, couched in the most lucid terms, and capable of comprehension by the most unmathematical reader, should be in the hands of everyone who is interested in the study of electricity, and therefore we are reproducing it *in extenso;* it will form a landmark to which we shall look back, years hence, when the riddle of the positive nucleus of the atom has been solved.

International Symbols for Electrotechnics.

We have this week received from the general secretary of the International Electrotechnical Commission, Mr. C. le Maistre, Publication 27 (revised) on International Symbols, which has just been issued. The new Report differs but little from the original issue, the notes relating to enemy countries having been deleted, and symbols added for electric difference of potential (V) and magnetomotive force.

So long as the Institution of Electrical Engineers refrained from adopting the International symbols in its *Journal*, we did not feel called upon to introduce them into our pages. However, the Institution of late has been using the code, and the American publications have also come into line. We have, therefore, followed the same course, commencing with our first issue of this year. Frankly, we do not like some of the compound symbols, such as kWh, in which "lower-case" letters and capitals are mixed; nor can the linotype machine provide the bold-faced type which is specified for the unit symbols, so that the ordinary type used for the text has to be employed. The use of italic capitals for the symbols for quantities presents another difficulty, but this occurs only in formulæ, and is of little moment compared with the employment of Greek letters, which are not included in the linotype founts, and have to be inserted by hand.

The advantages of a uniform notation are so cogent, however, that it behoves us all to comply with the code of symbols as closely as possible.

Contributors may be interested to know that fractions in formulæ should always, if possible, be written with the solidus (/) instead of the horizontal bar, because the latter cannot be used with the linotype, and enormously increases the labour of setting by hand, owing to the special spacing that is necessary between the lines, and other technical difficulties. In using the solidus great care is desirable, to show clearly what terms are included in the numerator and the denominator of the fraction.

I.E.E. Improvements.

The informal meeting of the Institution of Electrical Engineers on Monday last, to discuss means of increasing the usefulness of the Institution, was notably successful; there was a large attendance of members, including a number of Members of Council, who doubtless came prepared for anything. As a matter of fact, the meeting was as harmonious as the regular informal meeting always are, and more so than some formal meetings that we have attended.

Criticism of the Council was almost wholly absent; in opening the discussion, the Chairman (Mr. Pooley), whose conduct of the proceedings was admirable, struck the keynote of helpfulness, and the high tone was maintained throughout. A long letter from Mr. Purse to the President was read, in exactly the same spirit, indicating his desire to promote the efficiency of the Institution in every possible way. The suggestions put forward by the various speakers offered little novelty; they included the status question, keeping the library open in the evening, joint meetings with other societies, provision for the discussion of commercial subjects, the development of the social side, support to the Engineers' Club, the provision of an electrical laboratory, closer touch with the public and the lay Press, popular lectures, exhibitions of apparatus, &c. At the conclusion of the discussion Mr. Atkinson reviewed the proposals in a sympathetic spirit.

While the meeting is not likely to have much effect on the course of events, it was noteworthy for the atmosphere of co-operation and cordiality with which it was imbued, and was well worth while if only for that reason.

A Suggestion for Small Electricity Undertakings.

It is not to be supposed, of course, that electricity supply undertakings in small country towns have very ample funds for the purpose of advertising or publicity campaigns. On the other hand, they have the advantage of being, if they like, in close personal touch with practically everything that is going on in their small areas. Consequently, there are indirect possibilities open to them that do not generally obtain in bigger towns. They can readily interest themselves, and often take a part, in public or semi-public movements to benefit or expand the trade of the town, or even do something themselves to initiate them.

For instance, there is the pressing question, in which the Government is interested, of reviving industries of all kinds in country towns. There are, though it does not seem to be very widely known, Development Commissioners for the very purpose, *inter alia*, of helping forward agricultural development and rural industries. The main procedure is to encourage local authorities, county councils, or associations to organise local efforts, and generally encourage and help forward co-operative developments. And it is no bare benediction that the Commissioners give, but hard cash in the shape of grants, where they approve, of course, for such purposes of propaganda. Now, all this is to the benefit of the local electricity undertakings. Would it not be worth the while of some of the small country undertakings to try to stir up their local Councils to make some such move, and get the support of the Development Commissioners? It might result in considerable good to the town and, in a subsidiary degree, to the undertaking.

Let us cite, as a small example, the Agricultural Organisation Society, which receives a grant from the Development Fund, and has helped in the establishment of the Swanwick Basket Factory in Hampshire. This is a co-operative factory jointly promoted by the Fruit Growers' Association, and started work in 1914. The various strawberry growers of the district decided to co-operate and make their own fruit baskets, and the venture has turned out to be eminently successful. The aspen logs are sawn down, the peeling machines strip down the wood to the ribbons of veneer, the guillotine cuts these to length, the baskets are woven and shaped and then finished in a wire stitching machine. Here, then, is a factory of direct benefit to an undertaking both for power and lighting, and entirely due to organisation—or, in the first place, brains and initiative. There must be plenty of opportunities up and down the country for similar developments. The whole question is one of stirring up local effort. When local interest is once aroused, help is always forthcoming from the Agricultural Organisation Society, if it is in its line, or some other Society, or, as we mentioned before, the local authorities themselves could take the whole matter in hand and get all their expenses for organising and so on paid out of the Development Fund if they satisfied the Commissioners that they were helping forward rural industries.

ON STATUTORY EARTHING: SOME CRITICISMS.

By S. LEES.

In the official Memorandum on the Home Office Electricity Regulations (*vide* Factory and Workshops Acts), it is provided by Regulation 21 that: "Where necessary to prevent *danger* adequate precautions shall be taken either by *earthing* or by other suitable means to prevent any metal other than the *conductor* from becoming electrically charged."

Admittedly one of the most important of the thirty-odd articles in the Memorandum, it is probably not an exaggeration to assert that more irregularities occur in its daily observance than with the rest of the whole code, for a really efficiently and properly earthed system seems to be becoming somewhat of a rarity, and an installation complying with the letter and spirit of Regulation 21 certainly commands due appreciation when met with.

Almost, if not quite, the most elementary item of the journeyman electrician's mental stock-in-trade, it seems somewhat curious that the important measure referred to should be, apparently, so little understood, since commonsense rather than profound electrical knowledge is manifestly the one quality most required in performing this important and almost invariably simply achieved statutory requirement. And commonsense applied here means just the ability to discern and discriminate between essentials and non-essentials as, for instance, the difference between water main and water service pipe; to distinguish between water and steam (including heating) or other dissimilar pipes; or to determine the street and service sides of a water supply system, and to avoid mistaking gas barrel and compo. for water piping. Further, to detect points of potential, as well as of actual, weakness in any system liable to cause interruption of electrical continuity, such as packed pipe joints and couplings of various kinds, valves, cocks, meters, and other apparatus. Neither is it wise to assume that all possibly is in order with an earth wire which may be continuous and visible up to the point of its entry into the ground; nor should too much be taken for granted because the said earth wire may resist a strong pull against uprooting.

In connecting massive apparatus of relatively small bulk as, for example, a generator or motor frame, transformer case, &c., with earth, to ensure a cable or strip connection thereto having a 100 per cent. conductivity throughout is a simple proposition to any tradesman worthy of the name. The position, however, becomes somewhat different and perhaps more difficult when, say, considering an overhead travelling-crane equipment, or in dealing with an installation of metal conduit. Here, every tubular or other purely mechanical joint or special fitting which exists in the system may be viewed as a potential source of electrical weakness; a defective coupling next to the earth conductor proper may conceivably quite easily break the contunuity, and thus insulate the whole system from earth. Were it even necessary it would still be found impracticable to bond all such points separately in an efficient manner, hence the extreme importance of providing that all tubing and fittings in a conduit system shall be sound and properly attached both electrically and mechanically, so as to ensure a practical 100 per cent. continuity throughout.

It cannot be gainsaid that even with the screwed conduit system the greatest care is necessary when installing, especially in attaching fittings, as contrary to common notions a threaded joint does not always produce sound electrical contact although such a joint may be, mechanically speaking, quite above suspicion, the natural tendency of the V-screw thread pair having properly formed and finished surfaces being to *slide* and not to *cut*. The truth of this fact may be demonstrated in a practical manner by joining together a piece of common steel conduit tubing and an ordinary fitting—bend, elbow, coupling, tee-piece, &c. The tubing should preferably be cut in a sound die, and an unpicked stock fitting (one of the kind enamelled inside and out) used for this test. On unscrewing, the threaded surfaces of the tube and fitting will almost invariably be found to be highly polished and lustrous, due to the enormous frictional or rubbing effect produced during the process having driven the enamel into the pores of the metal and formed an extremely hard and burnished coating of a high insulating value on the threaded surfaces. Sometimes with badly cut threads choked with enamel a false sense of security is given owing to the superfluous enamel binding the surfaces and being mistaken for a tight thread. Such a joint obviously is worse than useless as an electrical bond, hence, as previously remarked, the extreme importance of ensuring that all joints and connections be properly and soundly made. "Ohms at the terminals with infinity on the tubing means midnight oil and nervous breakdown." As is well known, a turn or two with a good tap will invariably clear a dirty threaded fitting, and formerly this precaution was but rarely neglected in installing screwed barrel. One feels that this commendable practice might with advantage be revived to-day. The writer has experience of numerous instances where "earthed" conduit runs have been completely severed owing to overheating and arcing at defective joints caused by the development of earth faults. The commercial impracticability of applying a "drop" test as a means of detecting unsound joints of the kind mentioned is obvious, nor is it necessary. With the slip-joint (so-called) and non-screwed systems the difficulty of ensuring continuity is intensified, and notwithstanding the many ingenious attempts made in the past, the solution of this problem appears to be as far off as ever. Tubing of this class, moreover, has a somewhat limited field, and it would not be very surprising if in the near future the further use of conduit the chief advantage of which is that of cheapness were abandoned. So much for continuity.

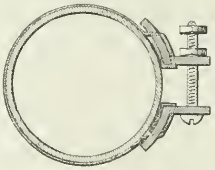

Fig. 1.

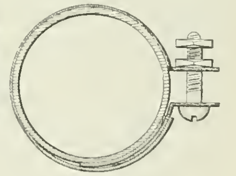

Fig. 2.

The conventional methods of attaching earth devices are, generally speaking, unsatisfactory. Of various types, and mostly proprietary, these fittings invariably depend primarily on the contact effected by clasping a circular metal clip or band around the metal conduit, the earth conductor proper being attached to the clip or band by means of an ordinary bolt and nut or set-screw, and in some cases by a wedge device. For commercial considerations doubtless some such fittings are stated to be of a universal type, inasmuch as the heavier component parts of the clip are of a uniform size and non-adjustable, whilst the flexible member, which is capable of being extended or reduced to suit different sizes of pipe, grips the conduit; these are claimed to fit all standard sizes of conduit. One example of this type which has a fairly wide vogue makes electrical contact with approximately three-fourths of the circumference of the tubing to which it may be attached, at its maximum adjustment. In the design of this contrivance no consideration appears to have been given to the relation between capacity of tubing and earth conductor; presumably it being intended to connect two or more clips in parallel. Again, at about half a dozen points joints occur making local contact only with the flexible band, which depends for its ultimate tightness on compression by a single 3/16-in. screw, the earth wire also being connected by the same screw. As already remarked, this device depends primarily on circumferential contact between the adjustable flexible member and the conduit, which is wholly inadequate; this serious disadvantage might be compensated to some extent at least by a proper proportioning of the size of clip to capacity of conduit, provided a sufficient area of truly faced and clean contact were assured on the external surface of the conduit. In actual practice, however, that is but rarely the case, rather the reverse is the fact. It may be urged that meticulous accuracy is unnecessary, but the electrician has to remember that clearance is not for electrical contacts, but for engine cylinders. For checking contact surfaces of earth clip connections an ordinary fitter's tapered feeler-gauge is a very useful substitute for the more conventional milli-voltmeter and far cheaper. Fig. 1 illustrates the device just described. Such a relatively thin and narrow band of soft copper strained in position will naturally stretch, and eventually work loose, thereby rendering the connection useless. The form of clip shown at fig. 2 is limited in its application, for obvious reasons, to the smaller sizes of tubing, and in addition to being mechanically weak has most of the disadvantages of its relation pictured in fig. 1. The common plain clip, fig. 3, although of a robust pattern, requires to be very accurately made and carefully fitted in order to ensure efficient electrical contact; very often local or point contact only is effected, as a result of erratic filing or scraping of the surface of the conduit. Under unfavourable atmospheric conditions such a connection rapidly deteriorates, and is soon rendered useless. The form of split clip shown at fig. 4, although somewhat easier to fit than its predecessor, possesses the same inherent disadvantages, and as usually made of cast brass is liable to fail through over-strain at the lugs. With both of the latter types of clip it is manifestly necessary to carry stocks of as many sizes of clips as tubes—an expensive disadvantage. A contrivance sketched on the lines shown at fig. 5 is often used in telephone and bell practice, but when applied to power and lighting circuits is an abomination, and its use should be condemned. It seems rather curious, by the way, that water supply authorities should countenance the use, or rather the abuse, of such a crude and damaging contraption on their property. A type of earthing grip which is somewhat of an innovation is illustrated at fig. 6. The method of connecting the earth conductor to the grip socket is novel, and good contact is effected. To the writer the weak points in its design lie in the small area of contact obtained between the earth wire and the surface of the conduit, as the pressure required to flatten a solid or even a stranded cable to any appreciable extent would be enormous, and in the commercial sample inspected the grip would probably give way at points A if unduly strained. Stranded cable should be used in preference to solid wire, as better contact would thereby be effected, and the risk of damaging the grip and screws avoided. The screws perform the dual function of securing the grip and also of locking the earth conductor to the conduit; it is not inconceivable that the conductor, especially if a solid wire, may shear off inside the bore, or the grip may work loose, and the earth wire would in that eventuality probably get disconnected. There are also several patented earthing systems in which special perforated or slotted metal strip is entwined around the tubing and fastened into position by means of screws, the strip forming the dual function of clip and conductor to earth. The strip systems are not extensively used; of relatively low carrying capacity, in addition to mechanical weakness the necessity of joints is a bar to their adoption to any great extent. All the devices described in the foregoing depend absolutely on the conduit surfaces being of sufficient area, truly faced and clean, and are subject to the various troubles arising from imperfect or local contact and, in the writer's opinion, are unsatisfactory for armoured cables. One might continue thus indefinitely, but it will be sufficient to indicate that the different forms of devices illustrated are representative of the commercial earthing fittings in present-day use.

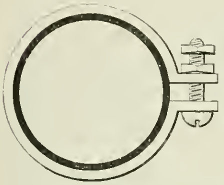
Fig. 3.

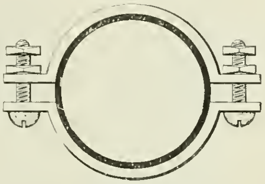
Fig. 4.

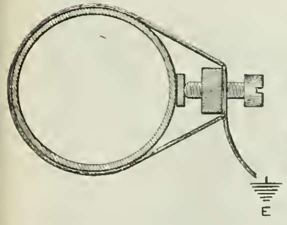

Fig. 5.

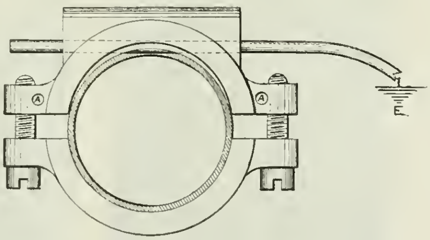

Fig. 6.

(To be concluded.)

MARTIN'S ROTOR BALANCING MACHINE.

The apparatus described herewith was designed by Mr. W. H. Martin, and is a product of Messrs. F. A. Pullen and Co., for the purpose of affording a quick, safe, and inexpensive method of balancing rotary bodies, and it gives very accurate results. In an existing machine the sensitiveness of the balance is such that when, for instance, balancing a rotor of 10,000 kg. it will easily show a variation of balance of 1 kg. cm. by sliding a weight of 1 kg. along the beam. This corresponds to a deviation of the centre of gravity of the rotor in a horizontal direction off the axis of 0·0005 mm., or approximately one-fifty-thousandth of an inch.

To express the above result in a more concrete way: when for example, balancing a 10-ton Zoelly rotor of 6 ft. diameter, an overweight of 10 grammes (one-third oz.) on its circumference, or one-millionth part of the rotor's weight, can be readily detected. It is always possible to detect, locate, and correct an "out-of-balance" moment of 1 in.-lb. present in a rotor or such-like body.

Another advantage of the apparatus is that it indicates the correct plane in which this overweight lies and its moment would act, a feature that is unique and greatly increases the accuracy of the results obtained. These results are obtained without rotation, as it is merely necessary to turn the body to six or eight fixed positions, and when actually balancing no rotation takes place. The method is not affected by the body's inertia, neither is there any fear of an "angle of lag" upsetting the result.

The machine, figs. 1 and 2, consists of two main portions arranged to support the shaft of the rotor to be balanced. At one end the shaft is hung in a universally-jointed stirrup, fig. 3, and at the other in a bearing which is mounted on the short arm of a steelyard lever, figs. 2 and 4.

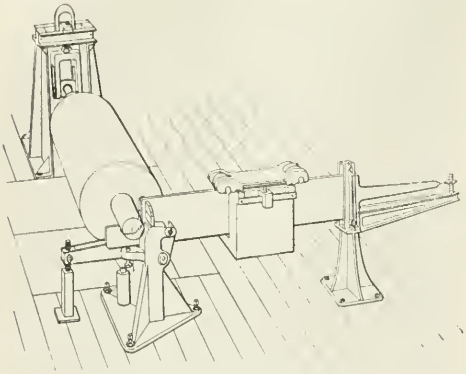

Fig. 1.—Martin's Rotor Balance.

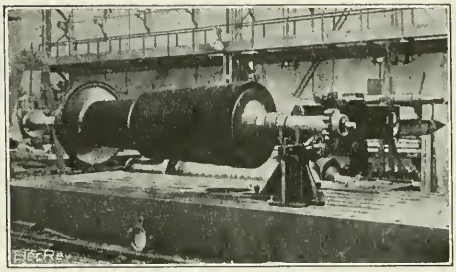

Fig. 2.—A 7-ton Turbine Rotor on Balance.

Having placed the rotor to be balanced in the bearings, the main weight of the steelyard is adjusted so as to bring the arm into equilibrium. The rotor is then turned a few degrees and the arm again adjusted by moving the jockey weight; this adjustment is recorded. The rotor is then turned through another section, and the necessary adjustment again made by means of the jockey weight, and so the process is continued for a complete revolution. The results are plotted to a horizontal base, and the sine curve obtained shows a maximum and minimum which indicate the points at which the centre of gravity is furthest from, and nearest to, the supporting point of the balance. By multiplying the jockey weight by its displacement, a moment is derived from which the eccentricity of the centre of gravity and the necessary correction are obtained. Table I gives some actual results that have been obtained with a large balance.

That this type of balancing apparatus is also suitable for extremely small and accurate work is shown by Table II, which result was obtained on a small size machine by Dr. Archibald Barr (Regius Professor of Glasgow University), at his range-finder works, at Glasgow.

Recently the excessive vibration set up in a power-house and neighbouring buildings by the unbalanced armature of a 450-h.p. steam-driven dynamo set was entirely remedied, after balancing on the above-described machine.

On all built-up turbines, such as the Zoelly & Curtis types, first the shaft and then each disk put on is successively balanced; the final balance obtained will then be without any disturbing couple, and many times more accurate than any result obtainable by other methods. In a drum-type turbine, such as the Parsons rotor, the overweight is taken out partly at each end in relation to the position of the centre of gravity, the sum of this moment being equal to the total moment of over-weight. Reduction gear wheels can also be balanced by this machine, and for bodies which are of relatively large radial and small axial dimensions, a mandrel (in itself balanced) to take such parts can be used on the machine. The machine could also be used for standardising rotary parts.

TABLE I.

Rotary bodies balanced.	Weight, kg.	Out-of-balance moment found, kg. cm.	Weight removed (dependent on the radius), kg.	Corresponding correction of rotor's c. of g., mm.
H.p. turbine rotor...	2,678	3·75	0·208	0·014
L.p. turbine " ...	5,370	6·8	0·23	0·0108
H.p. turbine " ...	6,792	36	1·35	0·053
L.p. turbine " ...	9,103	13·2	0·244	0·0145
H.p. turbine " ...	6,781	21·7	0·8	0·032
L.p. turbine " ...	9,216	34·1	0·695	0·037
H.p. turbine " ...	7,200	10·8	1·391	0·015
L.p. turbine " ...	9,203	58·9	1·1	0·064

TABLE II.

Rotary body balanced.	Kg.	Kg. cm.	Kg.	Mm.
Gyro wheel 5¼ in. diameter for gyro static compass.	2·973	0·00036	0·000054 (54 milli-grammes)	0·00121 (about 1/20,000 in.)

In his patent specification the inventor claims a precision in determining the eccentricity of the centre of gravity ten times as great as that attainable with the methods hitherto employed, such as that of rotation at a high speed.

Messrs. Yarrow & Co., of Scotstoun, after investigating the matter, have adopted one of these machines for their own works. Similarly, the Royal Shipbuilding and Engineering Co. "De Schelde," of Flushing, Holland, is using such a machine with great satisfaction, and various other firms are considering the adoption of the apparatus.

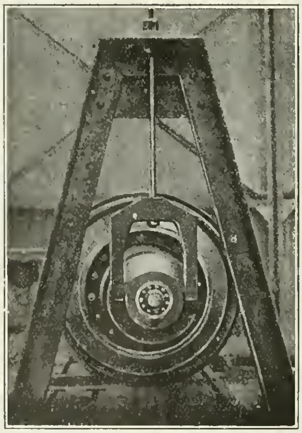

Fig. 3.—Universally-jointed Stirrup.

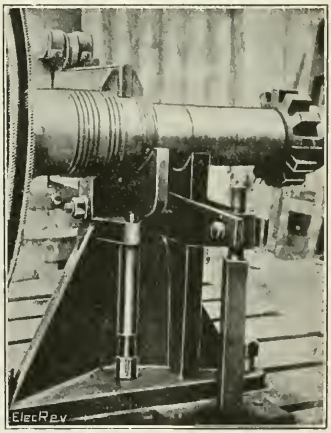

Fig. 4.—Balancing Beam Bearing.

THE NATIONAL INDUSTRIAL COUNCIL FOR THE ELECTRICITY SUPPLY INDUSTRY.

Proposed Reconstruction.

By T. W. COLE,
Joint Secretary, No. 9 (Home Counties) District Council.

Some little time ago, at one of the meetings of the Home Counties Council, Mr. Hesketh, of Folkestone, presented a report in which he suggested that steps should be taken by which each District Council might be represented directly on the National Industrial Council. We discussed the matter, and, like most people faced with a new proposal, saw the difficulties much more than the advantages, and so for the moment held our hand. But gradually we became aware that the same feeling as to the need of direct representation on the National Council was becoming universal. This widespread feeling all over the country crystallised eventually in a definite resolution to the effect that, when the time came round again to nominate the members of the National Council, direct representation should be secured. This resolution was drafted by the employers' side of No. 3 District Council, and first submitted to the employers' side of the District Councils at a meeting held at the Ministry of Labour on January 6th. I confess that at that meeting, as an early speaker in the debate, I opposed the resolution. But the meeting generally was all out for it, and very cogent arguments indeed in support were forthcoming, and the resolution was carried. The next day there was a further meeting at the same place, at which the employés' side of each of the 13 District Councils was officially represented, and also the National Council by 10 of the 12 members. The "constitution of the National Council" was the first motion on the agenda, and ran as follows (the same resolution as on the preceding day):—

"That it be a recommendation of the National Council that the National Council should be composed of 26 representatives on each side; that the allocation of seats on the employers' side should be 13 for the companies and 13 for the local authorities; that the company organisations in electing their representatives should endeavour to secure that a representative is elected from each district; that the local authority representatives on the National Council should be one from each District Council and should be elected by and from local authority representatives on the District Councils."

The minutes of this meeting triumphantly record that the resolution was "carried unanimously." So much for the views of the employers' side. Then came the task of submitting the resolution to the trade union side at the combined meeting, held on January 20th, at Montague House. Unfortunately, the trade union sides of the District Councils had not had the resolution submitted to them, and so had to face the resolution appearing on the agenda paper quite unprepared. Further, although the resolution implies that the trade union side of the National Council shall be selected from the District Councils, there are no specific words to this effect. Mr. Rowan, in a most admirable speech, led the opposition from the point of view of the trade unions, but there was evidently a good deal of division of opinion on the trade union side, and a strong feeling was expressed that it should have had an opportunity of discussing the matter before coming to the conference. My own Council, the Home Counties Council, however, was blameless on this point, as we had already come to agreement on the matter in full council of both sides, and were prepared to vote in favour of the resolution accordingly. But none of the other District Councils appeared to be in such a position, so a registration of the votes of the individual Councils was out of the question, and the motion was followed by merely a personal "show of hands." After all, it was too much, perhaps, to expect the perplexed and unprepared trade union representatives to vote off-hand, and commit themselves on such a serious proposition. The "show of hands," needless to say, counted against the proposition. The conferences, however, have been most useful, as every District Council has heard all sides discussed, and should now be in a position to deal confidently with the question at an early meeting of its full council. The next step, therefore, for the District Councils is, presumably, to take a vote as we of the Home Counties Council did, of both sides. Bearing in mind the "unanimous" carrying of the resolution by the employers' side of the District Councils at the meeting on Jan. 7th, already mentioned, it would look as though it were only the trade union side, at least mainly, that remained to be convinced. Anyhow, the task now for each District Council is to discuss the matter in full council, and take a vote on the matter. When this is done, therefore, and the votes of the 13 District Councils are collected, the matter will formally be in order for action, if any, to be taken. Until such definite vote is forthcoming, of course, despite conferences and so forth, there would be no grounds to justify the Minister of Labour approving any proposal.

Now as to the proposed change in the constitution of the National Council. First of all taking the employers' side, the change does not necessarily mean a change in the personnel, but merely an addition of new members. For instance, Alderman Beaumont sits on the present National Council because he was nominated thereto by the I.M.E.A. in virtue of his valuable services on No. 10 District Council. In the reconstituted National Council he will sit there because he will be nominated by No. 10 Council in virtue of precisely the same services. Mr. Bailey sits on the present National Council at the nomination of the Conference of Chief Officials. He would still sit there by exactly the same nomination, but would be understood also to represent No. 10 Council, if No. 10 Council concurs, which may be "taken for granted." Mr. Woodhouse would also sit as a nominee of the Power Companies' Association, with merely the almost theoretical addition that he also represented Yorkshire District Council. The same applies, of course, *mutatis mutandis*, to the other members. In fact, if we might adopt a terpsichorean simile, there are 13 District Councils as wall-flowers, and the present members of the National Council will be told to "set to partners." Of course only part will be thus temporarily united, and there will still be a balance of "wall-flowers" for which new "partners" must be elected. And the only "reconstitution" is that these surplus spinsters, so to speak, should be provided with partners. The three Company Employers' Associations would still retain their nominating powers, but in concert with the District Councils, and surely the most punctilious purist could not take exception to such an innocent *ménage à trois*. The case of the municipal representatives is even simpler, since the I.M.E.A. drops out altogether and each member is elected by his District Council "on the spot."

There is one point also which is universally taken for granted by all the reformers unanimously, and that is that the present chairman, Alderman Walker, continues in office; the whole new scheme presupposes that. We are not afraid of the size of the Council interfering with its work or effectiveness provided Alderman Walker is in the chair.

The chief argument advanced against the increased National Council, and we admit that it has a certain force, is that it will be like "the old lady who lived in a shoe." But even this old lady manipulated her troubles successfully—and the difficulty of numbers is not insuperable. No. 10 District Council has found a very businesslike way of dealing with such a case by appointing an Executive Committee, the full Council meeting, I believe, once a month, and the Executive once a week. *Mutatis mutandis*, something of this kind could obviously be done by the National Council.

Now as to the trade union side: I speak with diffidence here. (I am a *nouveau riche* as regards my trade union lore. In ante-Whitley days, or at any rate, in *ante-bellum* times, many of us had only a bowing acquaintance with trade unions. During the war "intimacy ripens.) Anyhow, it does seem to me that trade unions have everything to gain and nothing to lose by regional representation on the National Council. It is certainly in principle more democratic that those who form the higher court, so to speak, should be elected by the same union representatives whose interests are being dealt with. The trade union representative on the District Council ought not to be supposed merely to keep his nose down on to merely local matters in an isolated kind of way, but to treat these in a broad spirit and in right relationship with the broad lines of policy dictated by the wider interests of the industry nationally. But how is he to do this, if he is told to keep to his mere local business, and leave all these bigger matters to be dealt with by "headquarters? In respect of these matters for which he is responsible, he ought to be there representatively himself. Further, his unintermittent experience of the detail work of the District Council specially fits him to deal adequately with the work of the National Council. To be able to see the job right through either personally or representatively would add enormously to his interest in it, and incline him to put his best into the work of the Whitley scheme to the benefit of all concerned. The present is the unique opportunity for the District trade union representatives to declare: "We are going to be in it, all the time, all the way through."

Again, and this is a point on which I think all constructively-minded members will agree, both employers' side and trade unionists, by making the National Council directly representative of the District Councils, the whole scheme becomes organically complete. It becomes one machine, structurally sound. Not only is each District Council vitally connected with the National Council, but, through the National Council, the District Councils become welded together into an organic whole. At present we are all so many isolated units, each going on its own way merrily, without any regard to the good of the whole. This is not our fault, but the fault of the organisation, for, barring eavesdropping, we have no means of even knowing what any other is doing.

Finally, the proposed reconstitution will make the whole scheme more highly Whitleyised. The Whitley report says: "*The National Industrial Council should not be regarded as complete in itself;* what is needed is a triple organisation—in the workshops, the districts, and nationally. Moreover, it is essential that each of these stages should proceed on a common principle, and that *the greatest measure of common action between them should be secured.*" In another report, it urges "each of these three forms of organisation (*i.e.*, Works Committees, District Councils, and National Council) being *linked up* with the others so as to constitute an organisation covering the whole of the trade."

It is to secure such "linking-up," and to prevent the National Council being "regarded as complete in itself," that the reconstitution is proposed. *Fiat referendum.*

Architecture Exhibition at Ghent.—The International Architecture Exhibition, organised under the auspices of the Government, will be opened at Ghent on April 30th in the Palais des Fêtes. The scope of the Exhibition will be a very wide one, as not only will it deal with architecture properly so-called, but also with everything concerned with the modern arrangements of houses and offices. Thus, furniture, pianos, carpets and hangings, heating and lighting apparatus, the newest ideas for bathrooms and the most modern electrical appliances will all find a place in the Exhibition *Reuter's Trade Service* (Brussels).

LEGAL.

Morrow v. Stepney Borough Council Appeal.

In the Court of Appeal, before the Master of the Rolls and Lords Justices Warrington and Scrutton, on January 19th, the case of Morrow *v.* the Stepney Corporation was heard upon the defendants' appeal from a judgment of Mr. Justice P. O. Lawrence, granting an injunction restraining the defendants from discharging grit and ashes from the chimney stacks of their works so as to cause a nuisance to the plaintiff, who carried on business as a mast, oar, and scull maker in Brightlingsea Place, Limehouse. Mr. Justice Lawrence also awarded the plaintiff £50 as general damages for the discomfort he had suffered and the costs of the action.

The action was reported in our issue of June 15th, 1920.

Mr. Jenkins, K.C., in support of the appeal, said it was really brought for the purpose of taking the case to the House of Lords. Mr. Justice Lawrence had found as a fact that a nuisance was caused to the plaintiff. Defendants contested that at the trial; but he was not prepared to ask their lordships to review the judge's findings of fact. But the important point of law which the defendants wanted decided was whether, having regard to the defendants' statutory position, they had not the right to do what they had done, and whether or not the plaintiff's only remedy was compensation. Another point for consideration was whether the learned judge had exercised his decision rightly in granting the injunction. The operation of the injunction had been suspended pending the present appeal. If the injunction was granted it would no doubt inflict considerable hardship on a great number of persons.

Without calling upon counsel for the respondents, their lordships held that they could not interfere with the judgment of Mr. Justice Lawrence, and dismissed the appeal with costs.

Electrical Industries, Ltd.

In the Companies Winding-up Court, on January 19th, Mr. Justice Astbury made an order for the compulsory winding-up of Electrical Industries, Ltd. Mr. Bischof, for the petitioners, R. Johnston & Co., Ltd., said they were judgment creditors for £375. No notice of opposition had been received, and the company did not appear.

CORRESPONDENCE.

Letters received by us after* 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Life of Metallic-filament Lamps.

Referring to "Dudlux's" letter of the 14th inst., I should like to state that I experience similar results with metallic-filament lamps. Occasionally one gets a lamp which burns for about 500 hours, but this is decidedly the exception to the rule.

Generally speaking, the average life is about 200 hours for ordinary metal lamps, and 100 hours for "half-watt" types. In the first place, "½-watt" lamps were installed to replace large arc lamps, with a view to reducing current consumption. However, far from being economical, the high cost of renewals more than balances the running costs of the arc lamps.

One is rather loath to have to resort to the ancient carbon lamp, but apparently there is nothing else for it.

J. W. H.

January 19th, 1921.

A 100 per cent. Load Factor.

I should like through the medium of your journal to ask the attention of electricity supply engineers to the question of quoting special rates for appliances of fixed capacity working continuously day and night.

Some years ago an interesting device for storing energy in the form of hot water was introduced, and a good many supply undertakings did at that time quote low rates for the energy taken by this apparatus, using no meter and sealing the connections.

Recently a good deal of attention has been given again to appliances of this class, but inventors are being discouraged by the reluctance of supply undertakings to quote special rates for such supplies.

It is, I believe, argued that because the 100 per cent. load factor apparatus operates across the peak it does not justify cut prices for energy.

It must be remembered, however, that these appliances would be used to a great extent on parts of the mains network where loading is at present intermittent, and the load factor on the cables low. Moreover, in most stations, the actual peak occurs in the winter time, and lasts for a very short period, and a rate might be calculated to take into consideration the overlapping of this short peak.

For example, if 8d. a unit is the price for supply taken on the peak, and 1d. a unit would be profitable for, say, a

23-hours' supply taken off the peak, it is obvious that an all-round figure of 1½d. would meet the requirements and probably encourage a very desirable load of this kind.

The matter should receive sympathetic attention because the water heating problem is largely bound up with the storage of electrical energy on the consumer's premises in the form of heat. Moreover, there is indication to-day of further interesting inventions for heating, these probably await for their development only the encouragement of the supply engineer in the form of suitable tariffs.

It would be interesting if you could obtain the views of engineers on this subject.

J. W. Beauchamp,
Director and Secretary,
Brit. Electrical Development Association, Inc.

London,
January 18th, 1921.

An Engineers' Club for London.

It is extremely encouraging to see the efforts that are now being made by Mr. Hill and his colleagues to form an Engineers' Club in London, linked up with other proposed Engineers' Clubs in provincial cities, including naturally the pioneer of them all at Manchester.

Considering the fact that our city is justly acclaimed as the centre of the majority of the world's human activities, and that civilisation in its material expression is mainly the work of engineers, there should be no special pleading required to obtain a generous moral, intellectual, and material support for this enterprise.

It is, therefore, to be hoped that engineers will get into touch with Mr. Hill's provisional committee at the earliest possible moment to ensure that the scheme may be launched with the least possible delay, and that in the near future we may have the finest club in this country available for recreation, social intercourse, and professional discussion, together with feeding and sleeping facilities on a level with those to be found at a first-rate hotel.

This scheme should interest not merely the 3,000 engineers in the city who are called for, but at least 30,000, and perhaps many more.

Raymond J. Mitchell,
A.M.I.E.E., A.M.I.Min.E., &c.

London.
January 18th, 1921.

[Our correspondent has accurately defined the institution which the promoters aim to set up. It is going to be a very big thing—if those who wish it to exist will give the scheme their support *now*.—Eds. Elec. Rev.]

The Telephone "Ramp."

Your leader of the 14th appears to inflict an unmerited injustice upon many readers, telephone subscribers, and would-be victims, especially those who were too young in 1911 to be interested.

How can the Post Office penny be compared with any other? If so, when did the Post Office telephones and telegraphs make a profit? The Postmaster-General says they cannot develop the system until manufacturers deliver the goods; we may ask ourselves, therefore, what will replace the present penny when his department really begins to spend?

All the present official statements are interesting, if alone for the careful avoidance of the only issue that does matter, and that is: When is the department to be run on business lines?

Telephony.

January 18th, 1921.

Cost Sheets.

Referring to the article by Mr. Clegg in your current issue, dealing with cost keeping in an electricity supply undertaking, I should like to inquire if the author is quite satisfied that sufficient detail is shown. Surely lumping together all work on engines, boilers, &c., is not good enough.

Costs, to be of practical use, so as to enable the engineer properly to control works costs, must be shown in more detail. For example, some boilers may be hand-fired, others fitted with automatic stokers, whilst others burn oil fuel, or even powdered fuel. Is it not necessary to show the actual cost of cleaning, repairs, and maintenance of brickwork done on each? The chief should be able to see that the cost of repairs to those boilers having auto-stokers is perhaps three times as much as for the hand-fired boilers, or that repairs to brickwork on those consuming oil or powdered fuel may be a very serious item. Again, perhaps turbines (and the necessary auxiliaries) by different makers are installed. Comparative costs of repairs and maintenance of each set should be available, not only for the sake of keeping a tight hold of costs, but also for future guidance.

At the present day, works costs are a very serious item indeed, and I think should be so arranged that the chief can at any time see all spots of enlarged, increasing, or unnecessary expenditure, so that the necessary steps may immediately be taken at the time those spots appear, to check their growth.

J. H. Whyman,

London.
January 18th, 1921.

The Constitution of the National Council.

I attended on Thursday last, January 20th, a joint conference of representatives of the District Councils and the National Industrial Council for the Electricity Supply Industry, and was a very interested observer, not joining in the discussions.

The principal item upon the employers' agenda was the question of the constitution of the National Council. This occupied some time, and eventually the proposals submitted were defeated, not, I believe, because the trade union delegates from the various District Councils were against direct representation upon the National Council, but mainly because the principle had not been discussed by the District Councils, and I would ask for this matter to be seriously considered by them.

On this question of principle I am definitely at one with the employers' representatives, as I think that both sides of the National Council should be drawn from the representatives of the various District Councils, thus co-ordinating each district and providing the members of the National Council with full information of what exactly is being done in each district. The question of numbers could be settled afterwards; what I am concerned about is the principle involved.

There is no doubt that the present National Council is an anomaly, and as far as the District Councils are concerned, entirely undemocratic. On the other hand, nothing could make the present Whitley scheme more constructively sound than to join up all the various District Councils in one body, resulting in a National Council directly representative of each District Council, to say nothing of the intelligent interest created in the District Councils in having one of their number to see the job right through.

At present each District Council makes recommendations and then is left quite in the dark until the arbitrary verdict of the absolute and independent National Council arrives, the National Council on its own side being equally in the dark as to the general tone of feeling in the District Councils except as much as can be conveyed by correspondence.

There for the moment I will leave it, but I would express the wish that the subject shall be considered by the District Councils, and a vote on the question be taken, and representations made to the National Council as to their wishes in the matter.

We had, too, the amusing experience of a chief engineer moving a resolution to the effect that the wireman's rate of wages was too high. He was supported by other chief engineers, amongst whom I noted one who is employed by a Labour Council in London. I am wondering if he was voicing the opinion of his Council, and shall certainly have to take steps to see that a resolution is tabled before his Electricity Committee about his rate of wage, which I think is certainly excessive, whatever he may think about the wiremen's. The resolution was not carried, not that it would have made any difference if it had, but we certainly know some of our friends. Look out for reprisals!

The Conference generally was a step forward, but I trust that next time the agenda will be prepared and submitted to both sides some days before the conference takes place.

W. J. Webb,
Secretary of Trade Union Side of Nos. 9 and 10 Areas D.J.I.C.'s for the Electricity Supply Industry.

London.
January 24th, 1921.

[An article on this subject appears elsewhere in this issue.—Eds. Elec. Rev.]

German Competition in the Electrical Trade.

The twin subjects of German competition and unemployment and their relation one to the other are naturally very much to the fore just now.

The question for decision is: "Is it right or wise and in the interests of the nation as a whole that we should purchase freely German manufactured goods?"

In endeavouring to find an answer to this question, there are, to my mind, two things to be first considered:—

1. Germany's object in dumping these goods on us, and
2. The present conditions which make it possible for her to do so.

(1) Most of us know what Germany's object was, and still is, and those who don't know will find out by reference to your leading article.

With regard to (2), we have to remember that Germany didn't win the war, at least we are told that she didn't (how she would have dealt with competition if she had won may be left to the imagination, but it is more than likely she would have dealt with it on the lines of the boy with the apple—"there wouldn't have been no competition").

Not having won, however, and being taxed, therefore, at about half the rate we Britishers are, she finds the rate of exchange so much in her favour that she is able to dump her manufactured goods on us at a price below our cost of production, and she no doubt sees visions of being able at one fell swoop to accomplish that which before the war took her many years of effort and sacrifice.

I shall, no doubt, be reminded that Germany has a big load of debt to carry. True, but you can't pay and owe as well, and as Mr. Allam has pointed out in his very able letter, Germany has no intention of paying; but if she does eventually pay, and has in the mean time been able to get the control of the electrical industry, which she has, I believe, set out for, we might easily be worse off than we were before the war.

How far this German competition increases unemployment I am unable to say, but it cannot be denied that it is responsible for some of the increase in unemployment. If it be a fact that at the commencement of the present trade slump the British manufacturers of electrical accessories had not more than sufficient business in hand to keep their workpeople fully employed, then it follows that every order given to Germany for this class of goods creates or increases unemployment in this country.

If German competition is as good a thing as some people try to make out, by all means let us foster it, even if by doing so we become merely a nation of shopkeepers; but let us do so with our eyes open, remembering, as Mr. Allam says, what happened during the war, and how many of our lads paid the penalty of the folly we should propose to perpetuate. It would be as well also not to shut our ears to the, at present, comparatively quiet cry of our own unemployed.

The question, as one of your correspondents remarks, "calls for clear thinking and action."

T. Gladdy.

Birmingham.
January 18th, 1921.

Reliable Electric Irons.

Our attention has been drawn to the account of the performance of an electric iron as reported in your January 7th issue. This is most interesting, but the performance is, of course, only a repetition of many such which have occurred accidentally. We have known instances of an iron burning a hole through an expensive table, and, not satisfied with that, falling on to the floor, and commencing to make its way into the apartment underneath. In one such case, the contractor claimed it as a triumph for his flex, and considered the iron had done no more than he expected it to do.

Most types of modern electric irons would, of course, stand more than this, but the notice referred to reminds us of a series of tests we made some years ago on our "Smoothwell" irons to determine the best form of element.

One of the irons, No. 602, 6 lb. weight, 485 W, was switched on the Birmingham 220-V mains on January 22nd, 1912, and taken off in July, 1913. During this period the iron was in circuit night and day, except that on every week day it was switched off for one hour to prove our claim that the "Premier" waved wire element is not strained by alternate heating and cooling. This alternate test is, of course, much more severe on the iron generally than a continuous one.

By the end of the period, the iron had been in circuit well over 12,000 hours, and had consumed 6,000 B.O.T. units, and as it was still in perfect electrical order, it was thought unnecessary to go to any further expense on energy in the effort to break it down.

The face of the iron showed a dull red glow in the dark, and it was often used as a cigar lighter, for which purpose it was quite efficient, but it also scorched one's face at the same time.

We might mention that two other irons of the same type as the above, but with elements made in different ways, lasted 2,509 hours and 482 hours respectively.

Premier Electric Heaters, Ltd.

Birmingham.
January 21st, 1921.

A Generator Problem.

Referring to "Wireman's" sketch, the machine appears to be a simple compound wound generator, with separately excited shunt field. I imagine the "compound winding" referred to by "Wireman," in his previous correspondence, is the "series winding." I would suggest that "Wireman" test the polarity of his field coils to ascertain if they are alternatively N. and S., and at the same time make certain that the series coils are not opposing the shunt. This may be done with a pocket compass, the generator being run, first, as a shunt machine (with the series coils disconnected), and then as a series machine with an exterior load, and shunt coils disconnected. Should any alteration be necessary, care should be taken when reconnecting to the supply, to keep the direction of current through the shunt circuit the same as when testing. On the other hand, a "drop test" on the field coils and armature may reveal a fault which prevents the machine from delivering the rated output.

C. A. Besley.

Cardiff.
January 23rd, 1921.

Shop Displays.

I am surprised at the personal abuse by Mr. Tate in your issue of the 14th inst. If this is the only assistance he can give to electrical shopkeepers in their endeavour to get protection against the unfair methods of the wholesalers and lamp firms, we prefer to be without it. As he writes as the secretary of the E.C.A., I presume the Executive of the Association are the sponsors.

I certainly had hoped the E.C.A. would have come into the correspondence with the desire to help, but events prove differently.

During the last few weeks I have called on some electrical shops, and only in one instance did I find the shopkeeper had been a member of the E.C.A., but had resigned some years back, as the benefit he derived was an occasional book.

The E.C.A. claims to be a useful body, and doubtless it is, but judging from the tone of the secretary's letter, the shopkeeper is not for its consideration; perhaps Mr. Tate would give the number, if not the names, of the electrical shopkeepers who are on the Executive, and also the dates of the meetings when matters are discussed, as is done by other trade bodies.

Mr. Tate's paragraph re the public is entirely wrong, as how the public are concerned in a matter which appears only in the trade journal is beyond my comprehension.

We shopkeepers want an Electrical Shopkeepers' Alliance, and now is the moment; the wholesalers are employing travellers to call on hotels and other large users to filch the trade that should come to them through us; something must be done, or we may find it necessary to assist the foreigner, in order to attain protection.

Retailer.

January 20th, 1921.

P.S.—It seems very evident from the discussion that there are many unfair things done to injure retailers of electrical goods, and that the trade requires organisation to put it on an equal basis with other retail trades. Will those interested write to me, care of the Editors, so that an informal discussion can be held on the matter with a view to taking steps to improve the position?

Referring to the letter of Mr. Cohen, of Messrs. Watson, Marsh & Co. (Hampstead), Ltd., I do not think it necessary to reply to the inaccuracies contained in the same, except to state that amongst many letters received from his firm, I notice one dated September 10th, 1919, which contains the following words:—

"We desire to thank you for your courtesy and *attention* in the several matters dealt with."

Readers will draw their own deductions from the tone of his letters as to the value of Mr. Cohen's repudiations.

Leonard G. Tate,
General Secretary,
Electrical Contractors' Association (Inc.).

London.
January 25th, 1921.

Home Lighting Economies.

Two of your correspondents refer to my recent warning against the fire risk incurred in the connection of 6-volt shunt circuits (with "6-volt" insulation) to a 250-volt or even a 100-volt house installation, and point to the success of their own economy circuits and freedom from accident. The installations of "W. H. R." and Mr. Fowler Clark differ, however, in an important detail from that described by "Voltman"; for while they have taken the precaution of connecting the bell-push and the cotton-covered wiring to the pole which is normally at earth potential, "Voltman" has connected his at a switch, and switches are (or should be) in the outer or unearthed wire.

But the so-called "neutral" of a three-wire system is by no means always at or near the earth potential; in some systems the negative line is normally earthed, and in most others the full voltage of one side is found occasionally between the neutral and earth. "W. H. R.'s" fuses (which it is hoped are of the 250-volt pattern) may afford some protection, but as they will be virtually in parallel when they are subjected to an earth current, the value of this protection must be discounted.

"W. H. R.'s" diagram does not indicate whether it is possible to break the S.P. main connection at the neutral; if so, and there is an earth on the bell, &c., circuit, the whole of the main current will take this earth and *none of the fuses will be blown*, the current being limited to normal by the high-voltage lamps and other consuming devices.

Mr. Fowler Clark mentions the additional risk of the accumulator terminals, and I think enough has been said to justify my warning, that any conductor which is connected to a lighting circuit is liable in ordinary use to be subjected to the maximum pressure on that circuit, and that such conductors should therefore be treated accordingly as regards situation, insulation, and protection. In practice, I believe that this necessity will be found to counteract the economy, and that the true economy, without the risk, is more likely to be found in Mr. Fowler Clark's suggestion for series running.

E. R.

January 24th, 1921.

Indicating Wattmeter in Remote Position.

Can any of your readers suggest the least costly method of solving the following problem?

"A" and "B" are two generating stations situated about two miles apart. The owners of "A" have contracted with the owners of "B" to take a supply of electrical energy amounting to from 300 kW to 400 kW, on the three-phase system at 6,600 volts, 50 periods.

About half-way between "A" and "B" it is proposed to loop the main cable (only one cable is to be laid) into a sub-station within the area supplied by the owners of "A," from which a demand of 100 kW may have to be met, so that the supply to be taken will be delivered in part to the intermediate sub-station and the remainder to station "A."

It is required to provide means for giving a continuous indication at "A" of the total demand in kilowatts being made by system "A" upon generating station "B."

How can this best be done?

January 22nd, 1921. **Inquirer.**

Charging Batteries for Motor Cars.

I have recently been investigating various methods employed in motor garages for charging accumulators, and I have not yet come across a single system which is efficient or flexible.

In an ordinary garage there are usually 10 to 12 batteries on charge, and these batteries are usually 6, 8, and 12 V. It is not efficient to charge all these batteries in series, as they usually all require different charging rates, as for instance, new cells will require a prolonged charge at about 4 A, while the cells which have been in operation for some time may take from 10 to 12 A.

I am anxious to know if any other correspondents can advise me of some firm which makes charging boards with the resistance so arranged as to give different charging rates. These boards could be used either in conjunction with a motor generator set, or else with a d.c. supply from the town mains.

I am sure if anyone got out such a standard set, it would be taken up by all the up-to-date garages.

January 19th, 1921. **Rootes Ltd.**

Terminal Glands that ought not to be used in Connection with Electric Furnaces.

All who have Glover's interesting calendar see before them, for the remainder of this week, photographs of an atrocity in the design of an electrical joint.

The problem is to connect 24 37/12's from transformer to furnace.

The castings are out of all proportion to the work they are called on to do; and, if water colling is necessary, the water has to come and return through flexible pipe.

The pictures clearly show that the weight is not hung on the bars so as to avoid uselessly damaging twisting stresses. Compare the size of the flange joint with the size of the connection to the three bars in the same circuit.

The other ends of these particular flexibles have no such casting to crush them out of reasonable shape, and no water cooling device, and are no larger than the connection at the end of the bars.

Surely there is no necessity for such absence of thought in design.

Theodore Stevens.

London.
January 20th, 1921.

[Some letters have been held over.—Eds. Elec. Rev.]

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Tandem Resistance.

It is the practice in every modern kinema theatre to-day to install at least two bioscope machines, the object being to change over from one film to another with as little delay as possible, and by the installation of a tandem resistance in circuit with the two arcs, the change over in current from one arc to the other is hardly perceptible as the current is transferred or regulated from one machine to the other without any break in the picture. The current is graduated to produce a dissolving effect on the screen during the change over. The tandem resistance also prevents overloading the generator. A new type of resistance, fig. 1, introduced by Messrs. Austin Walters & Son, of Gaythorn Works, Little Peter Street, Manchester, has several advantages over the fixed brush contact type, by having each contact brush adjustable, so that the gradual change-over can be obtained without having to first bring the regulator over to the full current stud (unless actually working on full output), and to bring the other section of the regulator on the corresponding low current stud on the other resistance, which is necessary on the fixed brush type. In this resistance each section of the regulator is adjustable and interlocking, so that whatever the actual working current, the adjustment can be made instantly to regulate either arc to obtain a gradual, smooth change-over. In the event of the motor generator failing, it is necessary in the majority of cases, unless a duplicate set is installed, to change over on to the corporation or supply company's pressure, which is usually 400 or 500 volts, through a large resistance frame. The tandem resistance is left in circuit, but the one section being used on the arc is cut out. This has to be done alternately on each machine as used, otherwise the finer wire section of the tandem resistance would be burnt out. This contingency is provided for by the ability to put the regulator into such a position that both parts of the tandem resistance are practically cut out.

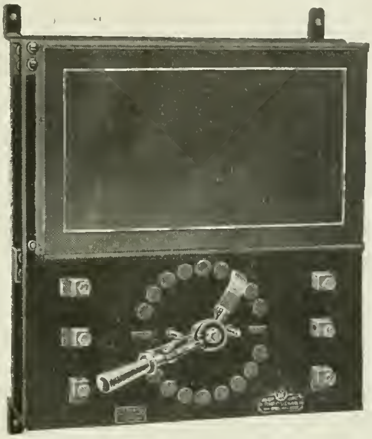

Fig. 1.—A New Tandem Resistance.

A "Mechanical Fuse."

The accompanying sketch, fig. 2, shows, diagrammatically, the arrangement of a "mechanical fuse" used on a very large plate mill of the latest design in Canada. A is the main mill motor shaft carrying the flywheel, and continuing on to the pinion housing; B is the outer bearing at motor end of shaft; C is a crosshead free to move endwise but normally held by the two tie bolts E; D is a bracket machined to permit the crosshead C to move in an endwise direction only. In the event of breakage of the portion of the main shaft adjacent to the pinion housing and of the fracture following the usual diagonal form, a heavy end thrust is put upon the main shaft, which causes the fracture of the "fuse" bolts, at the reduced portion shown at F on the sketch; this permits the shaft to move endwise sufficiently for the fractured ends to clear each other, so saving additional damage due to the momentum of the flywheel and rotor. At the same time the endwise movement operates a switch cutting off the supply of current to the motor. The amount of end movement is limited by a collar on the main shaft, which is not ordinarily in contact with the face of the bearing.

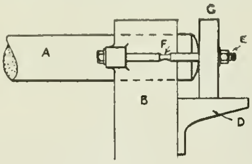

Fig. 2.—Safety Device on Mill Shaft.

Strange Radium Stories.—The *Berliner Tageblatt* narrates a curious history of certain dealings in radium, according to the *Observer*. It is noteworthy that during the war and after the war, the stock of radium in Germany was greatly lessened, and it is regarded as certain that in the form of radium, whole fortunes were conveyed abroad and concealed. When in the years 1917 and 1918 the sun of war profiteering was at its zenith, a demand for radium arose which was even greater than that for platinum and gold. Offers to buy "at highest prices" were to be found in quantities in medical and other professional publications. For many doctors and researchers who had got into difficulties owing to the rapid fall in the value of money it was a great temptation to acquire a large fortune by a legal sale of the radium in their possession, and this, indeed, appears to have been done to a large extent.

BUSINESS NOTES.

Bankruptcy Proceedings.—*Re* Sydney Aston Mersey Rose, 79, Elgin Mansions, W., electrical engineer.—At the London Bankruptcy Court, on January 18th, the bankrupt applied to Mr. Registrar Mellor for an order of discharge from bankruptcy proceedings instituted by a creditor in October, 1913. Mr. Walter Boyle, Official Receiver, reported that the provable debts amounted to £2,014, whilst the assets, valued by the bankrupt at £2,553, had only realised £12. The applicant, when a child, was taken from this country to Australia, and there eventually became an electrical engineer in Melbourne, where he contracted a debt of several thousands of pounds to a Mrs. Oitner, who had financed his business. In 1907 he left Mrs. Oitner in charge of the business and returned to England to dispose of his interest in a patent electrical self-registering device which he had invented for recording hits on a rifle target. He first sold his rights for £2,000 in shares to a syndicate, which resold to a company for £17,000, but as subscription failed, the company went into voluntary liquidation, and in February, 1912, he purchased the patent from the liquidator for £100, but only received £35. The bankrupt next secured the services of an outside stockbroker, Mr. W. H. Tottie, who procured the promotion and flotation in March, 1912, of the Rose Automatic Target Co., Ltd., with a nominal capital of £35,000, to which he (bankrupt) sold the British and Colonial rights and 30 per cent. of the foreign rights for £2,000 cash and £14,000 in shares; he had received £500 cash, the balance being absorbed in Mr. Tottie's expenses and remuneration, and his shares were divided between Mr. Tottie and his company promoters, certain disappointed shareholders of the defunct company, his wife, and his personal creditors. The bankrupt acted as technical adviser to the company from March to June, 1913, when, owing to disputes with the company, his services came to an end. The company was still in existence. The bankrupt attributed his failure to lack of income and the long delay in floating his patent as a successful undertaking. The only offence reported was the insufficiency of assets to equal 10s. in the £ on the amount of the liabilities, and the discharge was granted subject to a suspension of three months.

I. J. Hodson and B. H. Newman (Hodson & Newman), electrical engineers, 85, Queen Street, Exeter.—First and final dividend of 4s. 2½d. in the £, payable, February 4th, at the Official Receiver's office, 9, Bedford Circus, Exeter.

W. Drysdale, electrician, 24, Paxton Street, Barrow-in-Furness. Receiving order made January 14th, on debtor's own petition. First meeting, January 26th. Public examination, February 11th, both at Barrow.

J. S. Denley (Denley & Co.), electrician and cycle dealer, 69, Regent Street, Cheltenham.—Receiving order made January 17th, on debtor's own petition. First meeting, February 3rd; public examination, February 3rd; both at Cheltenham.

J. W. Gladwin, electrical engineer, 81, Burcot Road, and 1a, Meersbrook Park Road, Sheffield.—Receiving order made on January 21st, on debtor's own petition.

G. F. Kiveron, electrical engineer, late of 38, Shrewsbury Road, Sheffield.—Last day for proofs for dividend, February 9th. Trustee, Mr. L. C. Johnson, Official Receiver's Offices, Figtree Lane, Sheffield.

Company Liquidations.—Llanrwst Electricity Supply Co., Ltd.—A petition for the winding up has been presented to the County Court of Carnarvonshire, by Mr. P. Dawe, of 11, Banister Road, Southampton, and will be heard by the Court at Blaenau Festiniog on February 15th.

W. S. Laycock, Ltd.—A petition for the winding up has been presented by Messrs. Bagshawe & Co., Ltd., of Dunstable Works, Dunstable, and Mr. C. H. Beauchamp, trading as the Thornton Equipment Co., of Peventon, Rettendon Common, Chelmsford, and will be heard by the High Court on February 1st.

Leyburn Electric Supply Co., Ltd.—Winding up voluntarily, owing to the sale of the company to Mr. P. Dobson, of Leyburn, who has been appointed liquidator.

Peel-Conner Telephone Works, Ltd.—Winding up voluntarily. Liquidator, Mr. J. Fraser, 31, Copthall Avenue, E.C. A meeting of creditors was called for January 26th.

Dissolutions of Partnership.—Bailey & Smart, electrical engineers, 17 and 19, Cross Street, Oldham.—Mr. E. J. Bailey and Mr. W. N. Smart have dissolved partnership. Mr. W. N. Smart will attend to debts.

Johnson & Ridsdale, electrical engineers, 27, Upper North Street, Leeds.—Messrs. C. W. Johnson and J. C. Ridsdale have dissolved partnership. Debts, &c., of the late firm will be paid by Mr. Johnson, who is carrying on the business under his own name.

Trade Announcements.—Messrs. Ward & Goldstone, Ltd., have removed into their new premises at Frederick Road, Pendleton, Manchester, and all communications should now be addressed there. New telephone numbers:—"442 to 447 Pendleton" (private branch exchange).

Messrs. G. S. Peckham & Co., 4 and 5, New Compton Street, Charing Cross Road, London, W.C. 2, have been appointed London and South of England agents for the Reliance Lift and Engineering Co., Ltd., of Sentinel Ironworks, Bradford, for the sale of their passenger and goods lifts, &c.

The Hatcham Manufacturing Co., Ltd., 314, Gray's Inn Road, W.C. 1, has now an additional telephone line—"Museum 5895."

Messrs. R. B. Hand & Co., Ltd., 63, High Holborn, W.C. 1, have been appointed sole distributing agents for the British Isles for Messrs. R. G. Haskins Co., of Chicago, specialising in labour-saving devices, such as portable electrical drills, grinders, &c.

Messrs. Higgs & Hill, Ltd., of South Lambeth Road, S.W. 8, having learned that a rumour is afoot to the effect that their electrical engineering department is about to be closed, inform us that such a statement is wholly unfounded. They are busy with many important contracts for the Government and private clients, fully maintaining their prestige as electrical engineers in the building trade.

Messrs. Electrical Utilities, Ltd., of London, have appointed Mr. A. C. Borthwick as their representative for the whole of Scotland. Inquiries should be addressed to him at 149, St. Vincent Street, Glasgow (Telephone, Central 1126).

Messrs. A. Hartley & Co. have commenced business as electrical engineers at 37, Standish Street, Burnley, and they desire to receive priced catalogues and lists of all classes of electrical goods.

Catalogues and Lists.—Midland Dynamo Co., Ltd., 64, Belgrave Gate, Leicester.—Two fully-detailed and priced stock-lists of "Parkinson" and "Brook" a.c. motors.

Messrs. Burton, Griffiths & Co., Ltd., Ludgate Square, Ludgate Hill, E.C. 4.—An illustrated and priced leaflet of "R.G.L." stocks and dies; also a leaflet illustrating "Columbian" sledge-tested vices.

Messrs. Alfred Herbert, Ltd., Coventry.—A booklet containing grinding-wheel selection charts to aid in the choice of proper material for specific work.

Hart Accumulator Co., Ltd., Marshgate Lane, Stratford, E. 15.—An illustrated and priced leaflet dealing with "Hart" high-pressure accumulator batteries.

The Aster Engineering Co. (1913), Ltd., Wembley, Middlesex.—A number of leaflets dealing with "Aster" engines and generators for all purposes—house-lighting, welding, pumping, transport, &c. The pamphlets are fully illustrated, and price-lists are also supplied.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Installation Leaflet No. P 2,322: "Colliery Electrification," an illustrated description of a fan and haulage installation at a Durham colliery.

Messrs. R. O'Brien & Co., 66, Mosley Street, Manchester.—An artistically-produced catalogue of "Luna" glass-lighting fittings of many types; also a separate price list of these.

Messrs. Rayner & Heald, Ltd., Duke Street, Derby.—Stock-lists of two and three-phase induction motors—squirrel-cage and slip-ring; priced.

The Westinghouse Morse Co., Ltd., Letchworth, Herts.—An illustrated catalogue (W.M. 121) showing the construction and principles of the Westinghouse Morse rocker-joint chain drive. The details are lucidly explained, and prices of standard types are given.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C. 2. List No. 314.—A catalogue of domestic electrical cooking and heating apparatus, illustrating and describing irons, kettles, cookers, toasters, vacuum cleaners, &c. List No. 316:—"High efficiency lighting," a well-illustrated booklet of reflectors, lanterns and fittings for gasfilled lamps. Both lists are fully priced.

Messrs. Malcolm & Allan, Ltd., Goschen Buildings, 12, Henrietta Street, Strand, W.C. 2.—Stock lists of d.c. and a.c. motors, giving full particulars.

Messrs. L. G. Hawkins & Co., 116, Charing Cross Road, W.C. 2.—"The Electrical Link," the first number of a little publication which is to be published monthly with the object of assisting dealers in "Universal" electrical appliances. Various points regarding these appliances are picked out for emphasis by salesmen.

Catalogues Wanted.—Messrs. Whitakers (Engineers), Ltd., of Horsforth, Leeds, wish to receive catalogues from makers of crane motors and switchgear.

Messrs. Reginald Long & Partners, consulting engineers and factory equipment specialists, of 19, Southampton Buildings, Chancery Lane, W.C. 2, wish to receive catalogues and price lists from manufacturers of electrical and mechanical apparatus.

The Public Works Department, Kenya Colony, are desirous of receiving catalogues dealing with the electrical and mechanical trades. For particulars, see our advertisement pages to-day.

German Contracts.—This note, taken from the Toronto *Electrical News*, speaks for itself:—

"'Contracts worth £200,000 have recently gone to a German firm of electrical machinery manufacturers because their prices were so much lower than those of their English rivals.'

"The above item appeared in a Toronto evening paper, and, though probably unintentionally, it gives the impression that this refers to a Canadian purchase. As a matter of fact, it is taken from an English paper, and has reference to equipment bought there. This is bad enough, as it is a bad example for the Mother Country to be setting her children, but presumably they know their own business best over there. The point we are anxious to emphasise, however, is that it was not a Canadian order that was given to a German firm, and it will probably be some time yet before we shall consider it in the best interests of the Empire to follow such a course."

Book Notices.—"Contact," the Journal of the National Association of Supervising Electricians. Vol. II, No. 3.—The January issue includes a commentary on the settlement of the Penistone dispute, "The Development of Telephone Switching," "Progress in Lighting" (illustrated), &c.

"Wireless Telegraphy and Telephony." By L. B. Turner. Pp. x + 195, figs. 119. Price 20s. net. Cambridge: University Press.

"The English Electric Journal." Vol. I, No. 5. Pp. 56.—Included in this number of the journal are a description of the Willans Works, Rugby (illustrated), "Electricity in the Tin Industry" (illustrated), "Fuses," &c.

"The Metropolitan-Vickers Gazette." Vol. V, No. 93. Pp. 23.—The December issue contains articles on "The Individual Drive and Control of Machine Tools" (illustrated), "Non-Stranded Copper Conductors for C.C. and A.C. Service," with curves, and an illustrated description of a rotary converter installation at the Summer Lane Station of the Birmingham Corporation.

"Modern High-Speed Influence Machines." By V. E. Johnson. Pp. viii + 278, figs. 93. London: E. & F. N. Spon, Ltd. Price 14s. net.

"Winning the Public." By S. M. Kennedy. Pp. vi + 168; five illustrations. Price 15s. "The Thermionic Valve." By H. J. Van Der Bijl. Pp. xx + 392; 232 figs. Price 30s. London: McGraw-Hill Publishing Co.

"Memoirs of the College of Science, Kyoto Imperial University." Vol. III, No. 11; Vol. IV, Nos. 1 to 6. Kyoto: The University. Vol. IV, No. 3, includes a paper on "Brush and Glow Discharges of Electricity and the Formation of Spark"; No. 4 contains a number of papers on the electrical study of the structure of various elements; and No. 6 includes "Electrolytic Reduction of Monthone."

"De la Suisse à la Mer." Edition Spéciale de la revue "Schweizerland." September, 1920.—This special issue (in French) is devoted exclusively to the discussion of schemes for the opening up of the Rhine and other rivers to Swiss commerce, and the institution of a direct economic exchange between London and Basle. Mr. Gelpke deals with the subject from the technical point of view. The development of waterways towards Italy is discussed by Dr. Rusca, and navigation on the Rhône is presented by M. Savoie-Petitpierre. In addition to this, we have received a translation of Mr. Gelpke's article, and also two translated reprints of articles by the same author dealing with the navigation of the Rhine. This literature may be obtained through the Swiss Legation, 32, Queen Anne Street, Cavenish Square, W. 1.

"Cheap Steam." Vol. V, No. 1. January, 1921. Little Hulton, Bolton: Ed. Bennis & Co., Ltd. 1s., post free.—Included in this issue are articles upon "Induced Draught Fans," "Corrosion of Economiser Tubes," "Safe Storage of Coal," &c.

"Exact Data on the Performance of Steam Boiler Plants, No, 4, Average Figures for the Performance of some Different Types of Steam Boilers. By David Brownlie, B.Sc., &c. Reprinted from *Engineering* (14 pp.). London: Brownlie & Green. Ltd. Price 2s.

Branch Factories Overseas.—The question of setting up branch factories in the Overseas Dominions and in foreign countries has been discussed in these columns on various occasions in the past. Attention has been drawn particularly to the advantages of this policy with regard to Canada, where United States manufacturers are securing a strong footing behind the tariff wall. The fact must be faced that the new countries overseas, British and otherwise, are more and more taking up the idea of establishing their own manufacturing industries, and while the old-established industries of Great Britain need not doubt their capacity to hold their own against the newcomers, it is, perhaps, as well to recognise the value of establishing branches on the spot, so as to get in during the early stages of local development. A Perth (Western Australia) correspondent of *The Times Trade Supplement* refers to the fact that the "Australian Producers' Wholesale Federation" has just set up an office in London. During his visit to this country its representative approached Bradford spinners with a view to persuading them to establish branches in the Commonwealth. It is stated that a well-known manufacturer will visit Western Australia and confer with the Government on the question of starting the industry in the State.—*Bulletin* of the F.B.I.

A Social Club.—Mr. W. M. Williamson, who recently held a very fine Electrical Exhibition at Electric House, 184, Peckham Rye, as reported in our columns, has given his old premises at 104, Peckham Rye, to his workmen for a Social Club. The premises are his own freehold, and his action shows a spirit of good fellowship which is worthy of imitation. The premises were opened by the brothers Williamson on Monday last, and between 40 and 50 of the employés were present. An excellent programme had been arranged by Mr. Milne. The premises consist of card-room, committee room, billiard room, and reading room, and facilities for refreshment have been provided. The firm has furnished the premises throughout, and provided a billiard-table, card-tables, &c. Mr. A. H. Harris is secretary, and the working committee is composed of members of the outside staff.

Rubber Growers' Association Competition.—We are informed that the result of the prize competition promoted by the Rubber Growers' Association (Inc.), of London, for ideas and suggestions for extending uses, or encouraging new uses, for rubber, which closed on December 31st, 1920, will not be known for some three or six months, dependent on the amount of experimental work necessary. It is interesting to note that over 2,000 entries have been received by the chartered accountants who were entrusted with the audit of the scheme, and it is hoped that valuable results may be obtained.

Calendar.—The Sunbeam Electric Co., of 63, Lancaster Avenue, Manchester, has sent us a wall calendar. A coloured print shows the surrender of the German Fleet (November 21st, 1918), monthly date slips for 1921 appearing below it.

Lead.—Messrs. G. Cawson & Co., reporting under date January 22nd, state:—"The consumptive demand shows no improvement, although electrical works are buying to cover their prompt and also forward requirements. They evidently look on prices as favourable."

Messrs. James Forster & Co. say:—"Consumers have bought very little, and that only for immediate wants; there has been no business for export to speak of, and speculation for the time being is having a rest. On the other hand, available imports this month are so far inadequate to meet pressing demands, so much so, that actual trade requirements have had to be supplied from warehouse, and such lead as is expected to arrive this month is already earmarked. Our experience is that not a few consumers are very short of supplies."

British Industries Fair.—*The Times* states that during the British Industries Fair, to be held at the White City from February 21st to March 4th, a number of official foreign commercial missions will be invited to England. These missions will be drawn from various European and other neighbouring countries, and will consist, in some cases, of the Ministers of Commerce, and in all cases of representatives of important commercial organisations. They will visit the Fairs at London and Birmingham.

The Sun Company's Dinner.—To celebrate the firm's "coming of age," the directors of the Sun Electrical Co., Ltd., entertained their staff and agents to dinner at the Holborn Restaurant on January 22nd. Mr. A. G. Beaver, managing director, occupied the chair, and the dinner was an excellent one in every respect, all arrangements being admirably carried out.

After dinner a number of vocalists and entertainers provided a programme in which art and humour were very evenly balanced. Signor Sanda, who was received with enthusiasm, rendered numbers from *Rigoletto* and *I Pagliacci*, and Mr. Arthur Hill displayed talents in a number of directions, ventriloquial and otherwise. Space, unfortunately, forbids a detailed account of the other items, which were all very good.

The toast list commenced, of course, with "The King." Mr. W. J. Rogers, secretary, proposed the toast of "The Directors" in a speech which praised their efforts and their personalities. Mr. W. R. Rawlings, in reply, facetiously stated that the secretary had hardly done justice to his (Mr. Rawlings's) good points, but, at the same time, hadn't dwelt too long on his bad ones. Mr. R. Tweedy Smith, who also replied, referred to the tightness of money and the circumstances under which a great number of firms had been forced to liquidate their stocks at considerable loss. The Sun Co. had bought cautiously, and did not intend to be caught in the general catastrophe.

Mr. A. G. Beaver, in proposing "The Staff and Agents," recalled the very early days of the company, when the staff was a small one of about a dozen members. To-day there were about 150, and they were not stopping at that figure. He spoke of the acquisition of the Charing Cross Road premises, and announced that negotiations had been completed with Messrs. Crosse & Blackwell for the purchase of property at the rear of those premises. A considerable sum of money was to be spent in adapting these to the needs of the company. Mr. Beaver referred to the versatility of Mr. Morton, who had aided the firm in several totally different ways. Mr. C. H. Phillips responded for the staff in a brief but witty speech. Major Huxley, on behalf of the agents, said that an agent's lot was not a happy one, but much encouragement was to be derived from the "Sun" calendar, with its more or less appropriate texts.

Mr. E. R. Morton proposed the toast of "The Press," and said that the recent agitation for the publication of net sales statistics had shown up the electrical Press in a very favourable light, and some of the figures had surprised him. Mr. J. H. Cosens briefly responded.

Mr. H. C. Weekes is to be congratulated on his management of affairs. The Press, instead of sitting in splendid isolation, had the pleasure of the company of a number of the ladies of the staff.

Land Values Duties.—Mr. W. R. Fairbrother, income-tax specialist, writes to point out that under the Finance Act, 1920, all the assessments to Land Values Duties that have been made under the Finance (1909-10) Act, 1910, have been discharged, and where duties have been paid already under any such assessments such duties can be recovered if a claim is made within six calendar months of the passing of the 1920 Act. This period will expire on February 4th next, so that all claims should strictly be in before the end of the present month. The various duties which can be recovered are as follows:—Increment Value Duty (including annual Increment Value Duty), Reversion Duty and Undeveloped Land Duty imposed by Part I of the Finance (1909-10) Act, 1910, but do not include Mineral Rights Duty.

Review of 1920.—The Federation of British Industries has issued a Financial Review of 1920, in which are included useful tables and curves showing the fluctuations in the rates of foreign exchange and the price movements of the raw materials of industry. It has been prepared by Messrs. J. S. M. Ward, B.A., F.S.S., and N. E. Crump, F.S.S.

New Belgian Company.—La Société de la Centrale Electrique de la Vallée de la Houille is the name of a new company which has lately been formed in Brussels, with a capital of 1,000,000 fr.

Tramway Industry Court of Inquiry.—The Secretary of the Ministry of Labour announces that arrangements have been made for the Court of Inquiry in connection with the wages dispute in the tramway industry to be held at St. Ermin's Hotel, Caxton Street, Westminster, S.W. 1. The inquiry opened on Wednesday, January 26th, at 10.30 a.m., and was held in public.

For Sale.—Farnworth Urban District Council invites offers for one two-flued Lancashire boiler, feed pumps, &c.; Messrs. Eadon & Lockwood will offer by auction, on March 8th and following days, at H.M. Factory, Langwith, Derbyshire, chemical and electrical power plant and engineers' tools, electrical and other stores, &c.; by direction of the Disposal Board, Ministry of Munitions, Messrs. Eadon & Lockwood will sell by auction, on February 15th, 16th and 17th, at the R.A.O.D., Chilwell, Notts., about 1,350 miles of electric wire and cable, cab-tire cable, instrument and telephone wire, also generating sets, &c.; Messrs. Bradshaw, Brown & Co. will sell by auction, on March 1st and following days, at H.M. Stores (Depôt 303), Wallis Road, Hackney Wick, N.E., a quantity of plant and machinery, including d.c. motors, ammeters, voltmeters, and various electrical sundries. For particulars, see our advertisement pages to-day.

Battersea Borough Council Electricity Department invites offers for two Parsons turbines, complete with ejector condenser, each coupled to a Parsons 750-kW d.c. generator; and one Willans engine, with condenser, coupled to a Mather & Platt 324-kW d.c. generator. Brighton Corporation Electricity Department has for disposal one triple-expansion Willans engine, direct-coupled to a Crompton 440-kW multipolar dynamo; also two engines of similar type, but without dynamos.

Electric Testing Apparatus for Garage Use.—Messrs. Hewletts, Ltd., of Parker Street Works, Hucknall, near Nottingham, have recently brought out two sets of apparatus specially designed for the use of motor-garage proprietors who undertake magneto repairs and remagnetising. One of the sets takes the form of a portable magnetiser to be used in conjunction with a 4-V accumulator. The polarity of the magnets is found by holding the magnet near the coils of the instrument and pressing a button; if the magnet is drawn towards the coils, it may be inserted in that position, but if repelled, it must be reversed. With the magnets in the coil, the button is pressed repeatedly for a few seconds. Special pole-pieces are used when the magnets are of unusual size, the pieces being placed inside the coils and the magnet put on them, when the same procedure is gone through.

The second set consists of a special apparatus for testing for faults in high and low-tension windings, magnetos, armatures, slip-rings, sparking plugs, &c. By means of this instrument, in which a 4-V accumulator is also used, a magneto can be thoroughly tested without dismantling. If there is no spark, or only a feeble one, the magneto is taken down, when each part can be tested individually. Coils can only be checked for faults, and, provided the very complete instructions which are issued by the makers are followed, there should be no risk of failure or damage.

A B.T.-H. Dinner.—The annual dinner of the B.T.-H. Co. Testing Department will be held on February 18th, Mr. A. S. Kettle in the chair. The committee trusts that all past members of the department will endeavour to attend. Application for tickets (10s. 6d. approximately) should be sent to Mr. A. V. Scratchley, c/o Testing Department, B.T.-H. Co., Rugby.

Advertising by Film.—Educational Films Co., Ltd., 76, Wardour Street, London, W. 1, call our attention to a method of advertising which has as yet been used only in a very restricted way, but which has great possibilities, and is especially applicable to a business which appeals to a special buyer rather than to the general public; this is advertisement by means of the film. For all manner of machinery the film is unexcelled as an advertising and selling medium. Details of construction and motion can be studied and explained by the film sometimes better than by the actual machine itself. The use of animated diagrams is particularly valuable in this respect.

The great difficulty hitherto experienced has been for the manufacturer to show the film to a public he wishes to reach. Private projecting theatres have been established in 12 of the largest industrial towns in the British Isles. When the film is once made, copies can be reproduced very cheaply, and if one of these is deposited in each of the towns, it can be shown at the convenience of the prospective buyer. For instance, a representative in Glasgow could arrange, at his convenience, for one or a dozen buyers to see the film. In very many cases it is impossible for a representative to carry with him the actual machine he wishes to sell; yet, armed with a portable projector and a film, he can show on any office wall, and in any country, a moving picture which will bring out more clearly than any explanation of his, the work, advantages, and selling points of the machine in which he is interested.

German Canals.—A decision has been reached that the canals of all the German States shall come under the control of the Central Government as from April 1st of this year, thereby fulfilling the provisions of the German Constitution that all means of communication shall be controlled by the Empire.—*The Times.*

Annual Dinner.—The annual dinner of the staff of Messrs. Rashleigh Phipps & Co., Ltd., 147, Oxford Street, W., took place on Saturday evening last at "The Feathers," Westminster, under the chairmanship of the founder of the firm. There was a large attendance, and the subsequent entertainment provided by "home talent" resulted in a most enjoyable evening.

Trade Disputes.—The total number of trade disputes, involving stoppages of work, reported as beginning in December, was 34. In addition, 65 disputes which began before December were still in progress at the beginning of that month. The total number of workpeople involved in all disputes in progress in December was about 72,000, as compared with 1,138,000 in the previous month (when about 1,100,000 workpeople were on strike in the coal-mining industry) and 110,000 in December, 1919. Of the total number involved, the majority were accounted for by two disputes, one affecting 45,000 coal miners in the Rhondda district, who stopped work with a view to securing the reinstatement of certain workpeople who had been discharged, and the other affecting 10,000 workpeople in shipyards throughout Great Britain, owing to a strike of joiners and carpenters against a proposed reduction in wages. The estimated aggregate duration of all disputes during the month was about 429,000 working days, as compared with 3,631,000 days in November, 1920, when the coal strike was in progress, and 1,808,000 days in December, 1919, when iron-founders in most districts were on strike throughout the month.—*Morning Post.*

Inquiries.—The makers of the "Klimax" parallel arc for lantern and kinema purposes are asked for. A reader asks for the maker's name, or where he can find a technical description, of an instrument suitable for measuring and recording atmospheric electricity. The names of manufacturers of ironclad switchgear bearing the mark D. E. W. inside a diamond, are asked for.

American Trade with Germany.—The monthly statement of the Department of Commerce shows that American trade with Germany continues to increase. Exports in November were valued at $35,061,009, as compared with $23,044,142 in the same month a year ago, while imports from Germany totalled $7,557,688, as compared with $3,212,831 in November, 1919.—*Reuter's Trade Service* (Washington).

German Activity in Montevideo. — Engineer Arent, Councillor in the Ministry of Posts, Telegraphs, and Telephones of Germany, arrived at Montevideo at the end of 1920, in the course of a tour he is making of the South American Continent for the purpose of obtaining information regarding telegraph and telephone working in the principal cities. The Uruguayan Postal authorities are offering every facility to Herr Arent.—*Review of the River Plate.*

Applications for British Trade-Marks.—Appended is a summary of the recent applications for British trade-marks in respect of productions connected with the electrical trades and industries:—

Persephone. No. 409,164. Class 8. Telephones and telephonic apparatus. Thos. Macready Down, 65, Gloucester Road, Kew Gardens, S.W. October 27th. 1920.

Limpet (lettering and design). No. 408,369. Class 13. Magnetic hand lamps, John Tweedie, trading as Wm. Barton & Sons, 11, Forrest Road, Edinburgh. October 2nd, 1920.

Ozon. No. 408,677. Class 13. Electric lamps (ordinary). Wm. Lennard, 3, Love Lane, Eastcheap, London, E.C. October 13th, 1920.

Star and Tree (design). No. 408,535. Class 50. Electrical accessories made of wood. Otto F. Ahlmann, ET, 35, St. John Street, London, E.C. October 8th, 1920.

Westinghouse (lettering and design). No. 407,700. Class 8. Secondary batteries. Westinghouse Union Battery Co., Swissvale, Penn., U.S.A. September 8th, 1920.

Pantostat. No. 409,390. Class 8. Electric transformers. Wm. E. Schall, trading as Schall & Son, 71 and 75, New Cavendish Street, London, W. October 3rd, 1920.

Dormo. No. 408,481. Class 6. Electric motors and dynamos. Arthur A. Lyon, trading as Arthur Lyon & Co., 36, Victoria Street, Westminster, S.W. October 7th, 1920.

T.M.C. (lettering and designs). No. 409,425. Class 13. Trembler blades for ignition coils and tungsten contacts. Tungsten Manufacturing Co., Ltd., Thanet House, 231-2, Strand, London, W.C. October 22nd, 1920.

Eclair (lettering and design). No. 407,148. Class 50. Insulating materials and preparations for electrical purposes. John W. Shaw, Ltd., 90, Broughton Lane, Strangeways, Manchester. August 21st, 1920.

Brussels Patent Office.—A central Patent Office is to be set up at Brussels for the registration of patent applications, supply of copies of patents, and other like services. The Belgian capital has been chosen, as it is the seat of the International Bibliographical Institute, with an extensive library and perfect organisation. The Allied countries only may make use of the office.

The Swiss Electrical Industry.—The Swiss electrical industry is stated to be at the present time very prosperous, especially with regard to the Spanish market. A Swiss house has just secured an order from the Sociedad Productora de Fuerzas Motrices, which is a branch of the Energia Electrica de Cataluna, for the supply complete of two hydro-electric installations for the central stations which that company is now engaged in equipping.

New Belgian Companies.—There has been formed at Antwerp the Société l'Electro Moteur, with a capital of 1,200,000 fr., for the manufacture of dynamos, motors, and electric elevators. Its offices are at 237, Chaussée Saint Bernard.

Under the style of Société Continentale de l'Accumulateur Edison, a company has been embodied at Brussels (79, Rue Royale) with a capital of 1,200,000 fr.

LIGHTING AND POWER NOTES.

Accrington.—Supply Delayed.—At Church Council, on January 20th, complaints were made that, although Accrington had signed an agreement to supply electricity, nothing had been done for five months. The chairman said there was difficulty in obtaining the requisite materials, and the Accrington electrical engineer was not to blame in the matter.

Australia.—Sydney.—At a meeting of the City Council it was stated that unless increased rates were sanctioned by the Government, the loss on the working of the electricity department would reach £200,000 in 12 months. The city electrical engineer said that new plant and buildings, costing about £530,000, were required. It was agreed to proceed with the ordering of the new plant.

Water Power.—The Electricity Committee of the Municipal Council suggests that the Government be approached with a view to reports being obtained from Messrs. de Burgh & William Corin on the proposal to establish hydro-electric works on the Colo River, with particular reference to the power available in horse-power or kilowatts, assuming—(*a*) a 24-hour demand per day; and (*b*) a 12-hour demand per day; and also the cost of providing electrical equipment for the scheme.

The Electricity Committee of the Municipal Council publishes a report by the city electrical engineer, with regard to a visit to Melbourne and Adelaide, in connection with a conference of Engineers and Managers of Electricity Supply Undertakings from different States of the Commonwealth. The engineer states that he is pleased to be able to report that the result of the conference with the members of the Postmaster-General's Department has been better than the city electrical engineer hoped. The statutory regulations of the Postmaster-General's Department affecting the crossing of telephone and telegraph lines by electricity supply wires have, in the past, been interpreted by the Postmaster-General's officers in such a way as to cause the City Council of Sydney (for instance) to spend large sums each year which, in his opinion, might have been saved without materially affecting the working of the lines. As a result of the conference it is proposed to alter the statutory regulations, and also to issue instructions to the local officers of the Postmaster-General's Department, which alterations and instructions will enable the Electricity Department to carry out the same amount of work in the way of laying services and extending mains which it is at present carrying out at a cost of several thousand pounds per annum less than it has been paying in the past.

The Kiewa Scheme.—The Victorian Electricity Commissioners consider that the present demand for electricity in the State does not justify any immediate action with regard to the proposed Kiewa hydro-electric scheme. Apart from this, however they think that the whole of their attention should be devoted to the development of the Morwell scheme for the utilisation of brown coal for the generation of electricity. The Kiewa scheme, which is estimated to cost £890,000, will be a useful adjunct to the Morwell project when the latter is working.

Barrow. — Water-Power Report, &c. — The Town Council has agreed to the electrical engineer and the surveyor preparing a report upon the proposed utilisation of the River Leven at Backbarrow for the development of electricity. Should Barrow require further power immediately, Messrs. Vickers, Ltd., can supply it from their new power station at Buccleuch Dock. A confidential report was considered, last week, upon the financial aspect of developing the town's electrical undertaking, prepared by the treasurer. It was decided to become a member of the joint electricity authority for the district, the Corporation representatives to report upon developments to the Council before committing it to any schemes entailing financial obligations.

Bingley.—Bulk Supply Award.—Mr. S. E. Fedden, City electrical engineer, Sheffield, was recently appointed to investigate the complaint of the Bingley Council that the bulk supply from Keighley Corporation was inefficient, and that the agreement was not being carried out satisfactorily. In his award Mr. Fedden says that after hearing both parties he has come to the following conclusions:—The interruptions and breakdowns have been mainly due to neglect on the part of the Keighley Electricity Department, and only in a lesser degree to that of the Bingley Electricity Department. The Keighley Corporation has not done everything reasonably possible to restore the supply after the occurrence of an interruption or breakdown. The costs of the arbitration are to be borne to the extent of four-fifths by Keighley, and the remainder by Bingley.

Birmingham.—Report on Extensions.—In view of the Council's decision at the last meeting to defer placing the contracts for the large extension scheme approved on June 8th last, until the general financial position has improved, the Electric Supply Committee has presented a report to the Council, confining its investigation to the question of devising temporary measures to mitigate the adverse effect of delaying the larger extensions.

There are three directions in which the Committee now seeks the authority of the Council to proceed, on the understanding that the cost of doing so is defrayed temporarily from the department's internal resources until such time as it is possible for the Finance Committee to report that capital funds are available, viz.:—

1. It is proposed to install a 5,000-kW turbo-alternator set, with condensing plant, switchgear, foundations, water-tube boilers with the necessary economisers, chimneys, &c., the approximate cost of which would be £120,000. This plant would be installed in the building now under construction at Nechells.

2. A sum of £30,000 is urgently required for normal extensions of the distribution system, to which to a large extent the department is already committed. These extensions of mains are works that proceed from week to week as part of the ordinary development of the undertaking, and are necessary in order to make supplies of electrical energy from the new generating plant available in those portions of the district where they are required.

3. The third portion of the work to proceed with which authority is now sought is that of piling the ground for the foundations for the deferred building extension. This work of piling takes considerable time, and is, of course, an essential preliminary to the building extension. The estimated cost of doing it now is £20,000, and the Committee advises that its execution at the present time will avoid a delay of approximately six months when the time comes for proceeding with the extension scheme as a whole.

The total estimated cost of these works is thus £170,000, of which sum £108,000 forms part of the large extension sanctioned by the Council last June. The Committee recommends that it be authorised to proceed forthwith with the works referred to.

Blackburn.—New Station.—The action of the Corporation in facilitating the laying of mains from the new generating station at Whitebirk, in order to find employment for men out of work, will considerably hasten the scheme, and it is expected that before next winter both Great Harwood and Rishton will have a supply of electricity. Some delay may be occasioned in obtaining the necessary cable, but when this is available the work will be pushed forward. Considerable progress is being made with the construction of the buildings, the erection of which was commenced in May of last year.

Continental.—Russia.—A Berlin message states that the Soviet Government has promulgated a decree that all persons under 55 years of age who have had experience in cable works, electric lamp factories, power stations, &c., are to be mobilised. The avowed object of the decree is to proceed with the previously-announced electrification of the country.

Holland.—The proposed scheme for the full electrification of the Province of Limburg is estimated to cost Fl. 1,350,000. The intention is to run an overhead high-voltage line from a power station to be erected near the "Emma" State coal mine to another station in the Swalmen district. The undertaking will probably be carried out under the same conditions as the Hoensbroek-Maastricht line, which supplies South Limburg, the State granting a concession to the province, which will entrust the carrying-out and working of the scheme to the Stroomverkoop Maatschappij. A heavier cable, however, will be used and the distance between the standards will be increased to 250 m. The route will be from the Emma Mine, through Amstenrade, Oersbeek, Schinnen, Mundengeleen, Sittard, Broek-Sittard, Nieuwstad Susteren, Echt, Maasbracht, Montfort, Linne, St. Odelierberg, Melich Herchenbosch, and Maasneel, to Swalmen.—*Economic Review.*

Jugo-Slavia. — Efforts are being made to develop manufacturing industries, and considerable activity is noticeable in various centres. In this connection the American Consul at Belgrade states that the hydro-electric plant at Zelina Vir, Croatia, is nearly completed. The buildings have all been constructed, and the machines are actually *en route.* The plant, at high water, will furnish 2,000 h.p., and at low water about 1,200 h.p., and will be able to supply power for the lighting of all the towns and villages of the *arrondissement* of Gorski, and still have reserve power for industrial purposes.

The Société Industrielle de Sminje, Dalmatia, which was formed in 1916 in order to utilise the water power of the Cettina river, which is estimated at 30,000 h.p., is now continuing its work, which was interrupted by the war. It is expected that the plant will soon be in full operation.

Dover.—Kentish Coal.—The calorific value of the Kentish coal supplied to the electricity works is stated by the electrical engineer to be 15 per cent. above that of the Yorkshire coal usually employed. A special underfeed stoker is necessary, however, but a saving of over £115 has been effected in four weeks.

Dundalk.—Extensions.—Mr. P. A. Spalding, electrical engineer to the Urban Council, in his report on the proposed extension of buildings and plant, at an estimated cost of £20,000, points out that, while present conditions are against such a scheme, the work must be undertaken with the least possible delay. A considerable proportion of the new output will be required to satisfy the greatly-increased demand of the Great Northern Railway (Ireland) local works, and it is reasonable to assume that the railway company will contribute a due share towards the proposed capital outlay. The highest figure calculated gives a price of approximately 2·5d. per unit. Mr. Spalding does not think, having regard to the high costs, that the company would consider 2½d. per unit excessive, especially as 1·8d. per unit was agreed to for the year 1919, when the average price of fuel oil was less than £7 per ton, as against £12 now. There is, the report adds, still plenty of scope for electrical development in Dundalk, mostly for power and heating purposes.

Electricity Districts.—North-West Midlands.—The Electricity Commissioners have extended the period for the receipt of representations regarding this district to March 31st next.

South-West Midlands.—The time for the receipt of representations regarding this district has been extended from Jan. 31st to March 31st.

At a Conference of Worcestershire authorities, last week, in regard to proposals concerning the formation of an electricity area, Mr. Willis Bund (Chairman of the County Council) said he was told that the Commissioners did not intend to allow, except in exceptional circumstances, any schemes to be set up in the areas they had mapped out. He thought they should ask the Commissioners if they were likely to assent to the formation of a separate area in a part of the proposed South-West Midlands area. Evesham, Droitwich, Malvern, and Pershore intimated that they did not support the Worcester proposal. It was agreed to make the inquiry on the lines suggested.

London and Home Counties.—The local inquiry which is to be held in connection with the provisionally delimited London and Home Counties Electricity District is to take place in June next.

Godmanchester.—Hydro-Electric Scheme Abandoned.—On the ground of the cost being prohibitive, the Town Council has declined to consider a proposal to utilise the water power from the old mill race for the purpose of generating electricity.

Iceland.—Hydro-Electric Survey.—A message from Reykjavik to the *Berlingske Tidende* says that the Islandske Ingenior-Forening has requested the Government and the Alting to institute investigations with regard to the possibility of establishing an industry in Iceland, using the waterfalls as the motive power. The construction of a railway to the south part of the island is also recommended, and the Government is also asked to appoint a commission to go into the matter. The Forening also requests the Government to receive eventual applications for a concession to construct a large hydro-electric station.—*Reuter's Trade Service* (Copenhagen).

Ilkley.—Extensions.—The Council is applying to the Electricity Commissioners for a reconsideration of their decision with regard to extensions some time ago. The Council received sanction to install a 170-kW set, but desired also to extend the power-station buildings to permit of the early installation of an additional 200-kW set. The Commissioners refused to sanction this, and suggested that any further power required should be obtained from Keighley Corporation. Inquiries made it evident that a bulk supply from Keighley would be more costly than the installation of new generating plant, and the Electricity Commissioners are being informed of this.

Larne.—Battery Room Destroyed.—A battery room forming part of the power station of the Larne Electric Light and Power Co. has been destroyed by fire. From these batteries the local shipyards derived their supply. The building was a wooden erection, and the damage to the battery is estimated at £20,000.

Leeds.—Work for Unemployed.—Various schemes are suggested for providing work for the unemployed, the necessary Government approval and grants having been applied for in each case by the General Purposes Committee of the Corporation. The schemes include a proposal for extensions of electricity mains. There is yet no definite scheme in this matter, but the Electricity Committee has signified its preparedness to expedite main laying in order to absorb labour.

Llandudno.—Bulk Supply.—The Electricity Committee has been instructed to negotiate with the North Wales Power Co. for a bulk supply to Llandudno. The Power Co.'s scheme to be presented to the Electricity Commissioners has received the Council's approval.

London.—St. Marylebone.—The Electric Supply Committee recommends that the special rate of 1½d. per unit charged for all electricity supplied to St. Dunstan's Hostel for blinded soldiers and sailors, Regent's Park, be increased to 2d. per unit. It is stated that the consumption at the Hostel amounts to 100,000 units per annum.

Battersea.—The agreement for a bulk supply of electricity from the Fulham Borough Council, made in 1915, contained clauses relating to fluctuations in the price of coal, but no provision was made for wages increases. In these conditions the Fulham Borough Council has forwarded a claim for £2,600 to the Battersea Electricity Committee. The Committee recommends that Fulham be offered £750.

Woolwich.—The Electricity Commissioners have written to the London County Council stating that a scheme of extensions, estimated to cost in the aggregate £230,000, has been submitted by the Woolwich Borough Council for approval. The immediate work to be undertaken will cost £60,000, the new plant comprising a 5,000-kW turbo-alternator with condensing plant, and a 33,000-V feeder cable to Erith, &c. The letter asks if the London County Council has any observations to offer regarding the sanctioning of a loan of £60,000. The Finance Committee recommends that the following reply be sent to the Commissioners :—From the point of view of the general financial position of the borough, the application of the Woolwich Metropolitan Borough Council for sanction to the borrowing of such a large sum as £230,000 for electricity purposes is a matter for serious consideration by the Electricity Commissioners, and that the Council, while expressing no opinion as to the merits of the scheme, assumes that the Commissioners are satisfied that the expenditure to be incurred will result in an early improvement in the present unsatisfactory financial condition of the undertaking ; that the Council is of opinion that the debt outstanding upon any superseded plant should be repaid, and the Borough Council required to enter into an arrangement with the London County Council with regard to the liquidation of any loans outstanding on any plant which is to be superseded by reason of the further extension of plant now proposed to be sanctioned by the Commissioners on similar lines to the arrangement previously made with the Borough Council.

Mexborough.—Bulk Supply.—The Urban Council has decided to accept the terms for a bulk supply of power from the Yorkshire Electric Power Co. An alternative proposal to ask Rotherham Corporation for a bulk supply was withdrawn.

Newmill.—Lighting Scheme Abandoned.—In view of the difficulties encountered in connection with the proposed electric light scheme, the Urban District Council has decided to abandon the project.

New Zealand. — Taumarunui Scheme. — H.M. Trade Commissioner at Wellington has informed the Department of Overseas Trade that the Borough Council of Taumarunui, a rising township on the main trunk line from Wellington to Auckland, has recently adopted a proposal to develop electrical energy from the Wanganui River for use for power and lighting purposes. The works are estimated to cost £44,000, and a poll of ratepayers is to be taken as soon as possible to secure powers to raise a loan for the purpose.

Portsmouth.—Loan Sanctioned.—The Electric Light Committee has received the sanction of the Electricity Commissioners to a loan of £91,000 for additional plant, &c.

Rochdale.—Loan.—The Town Council has been recommended by the Gas and Electricity Committees to apply for sanction to the borrowing of £106,000 to meet the cost of installing plant to deal with the bulk supply of electricity from the Lancashire Electric Power Co. About a third of this amount has already been spent. The remainder is required for work already authorised, such as the installation of transformers and other arrangements for distribution.

Skegness.—Electricity Supply Scheme.—Mr. C. H. Wordingham's report on an electricity supply scheme for the town was discussed by the Council on January 13th. The report gave the total cost of an installation as £44,500, with annual capital charges amounting to £4,070. It was stated that a profit of about £100 per annum could be expected from a total revenue of £6,600. A member of the Council pointed out that at the present time there were 11 small private installations in the town, but the owners of these were ready to dismantle them if a town supply became available. The Council finally decided to apply for a further extension of the time allowed for the carrying out of the compulsory provisions of the Lighting Order.

Southend-on-Sea.—Proposed Extensions.—The Town Council is to consider at a special meeting a scheme for extending the plant at the electricity works, at an estimated cost of £300,000.

TRAMWAY AND RAILWAY NOTES.

Aberdeen. — Electricity Works Railway. — The Town Council is applying for a provisional order to enable it to construct a street railway between the electricity works and the Caledonian railway. The Aberdeen Harbour Board is of the opinion that such an order would prejudicially affect its interests and requires modification. In order to secure a *locus standi* in the matter, a formal objection is being lodged by the Board.

Australia.—Melbourne.—The electrification of the Melbourne suburban railways was commenced in 1912, and it was stated that the work would be completed by 1917. As the electrification is still proceeding, the Railway Commissioners have been subjected to a great deal of criticism. They point out, however, that the outbreak of war completely disorganised a number of important contracts, and material had thereby been held up. Two large generators are still awaited for the Newport power station, and in addition to these, the equipment for ten or more sub-stations has not yet been delivered. Commenting upon this, the Melbourne *Age* says :—"It can no longer be pleaded that the British manufacturers are unable to undertake the work ; business is so dull with them that they are dismissing their hands ; and even if it were otherwise, a great deal of the work could be undertaken in Australia. During the two years that have passed since the close of the war, very little progress has been made. The completion of the scheme is already three years overdue, and at the present rate of progress a further three years is almost certain to elapse before the public will receive the services they were led to believe would be available for them in 1917."

Barnoldswick.—Order Cancelled.—As no definite progress has been made with the construction of a light railway between Barnoldswick and Gisburn, it has been removed from the Light Railway Commissioners' list.—*Lancashire Post.*

Belfast.—New Cars, &c.—Eight of the new tramcars ordered by the Belfast Corporation have now arrived in the city, and have been put into commission on the ordinary service. Fifty cars are being purchased, and it is expected that the whole of them will be delivered within the next six months. In accordance with the resolution passed at the last monthly meeting of the Corporation, application has been made to the Ministry of Transport for permission to increase the minimum fare to 2d., but the authority for making this change has not yet been received. Although the proposal is to fix the minimum fare at 1½d., there is a possibility that in the near future the charge will be increased to 2d. A large deficit is anticipated at the end of the present financial year, and in addition to that, the Corporation is faced by a heavy outlay on the reconstruction of the tramway track, which has received very little attention during the last six years, owing to the call for economy during the war and since. It is estimated that this work, if carried out all over the system, would cost about £2,000,000.

Birmingham. — Railless System Investigation. — Faced with the prospect of heavy expenditure on the renewal of the track of the tramways, the Corporation has sent a deputation to Bradford to see the railless trolley car system in operation there.

Continental.—France.—The Société des Transports en Commune de la Region Parisienne, which has been granted a concession for the working of the various surface tramway undertakings expropriated by the Council of the Departement de la Seine as from January 1st, 1921, recently offered for subscription 120,000 shares of 500 fr., composing the capital of the company. The concession is for a period of 30 years, although the Council has the option every six years of taking over the combined undertaking on giving two years' notice.

Halifax.—Control of Tramways.—The matter of the control of the Halifax tramways, which has excited keen controversy between the Tramways Committee and the Town Council, and has led to the resignations of the chairman and vice-chairman of the Tramways Committee and the chairman of the Tramways Sub-Committee, does not seem to be quite settled even yet. Although the Town Council, after a former rejection, eventually accepted only one of the three recommendations of the Committee —that of transferring control of the tramway track from the Highways Committee to the Tramways Committee—further delay is promised now in meeting the urgent need for track renewal by a resolution passed by the Highways Committee, on January 17th, recommending that the transfer of control should not take place until the end of the present year.

Leeds.—Daily Deficit.—The returns presented at a meeting of the Tramways Committee of the Leeds Corporation showed that during last month there was still an average deficit of £49 per day on this undertaking, which shows a substantial decrease on the loss of £111 per day for the nine months ended December 29th last. The total deficit for this latter period was £30,495, representing a loss of nearly 1d. per car-mile. The question of again increasing the fares, which was considered at the last meeting of the Committee, was again discussed, and it was finally decided to hold the matter over.—*Leeds Mercury.*

Metropolitan Railway Co.—The Minister of Transport has extended the times of the Metropolitan Railway Acts of 1911, 1912, and 1913, for the completion of certain railways, until August, 1922.

Salford.—Tramway Passes Illegal.—The Tramways Committee has rescinded its resolution to grant free travelling passes to members of the Council, the town clerk having expressed the opinion that the resolution is illegal.—*Daily Dispatch.*

South Shields.—New Cars.—Five new double-decked electric cars have been delivered by the English Electric Co., Ltd., of Preston, to the Corporation. Each vehicle accommodates 82 passengers, and will cost £3,300.

TELEGRAPH AND TELEPHONE NOTES.

Cuba.—New Telephone Cables.—Direct telephonic communication between the United States and Cuba is to be provided by the Cuban-American Telephone and Telegraph Co., a permit for the landing of three telephone cables from Havana at Key West (Florida) having been granted the company on January 4th, by the State Department. The laying of the cables is expected to be completed in the Spring, and they will be approximately 100 miles in length, or longer than any submarine telephone cables yet laid. Of the three talking circuits to be provided, one will be connected directly with New York. A second circuit will pass through the Jacksonville (Flo.) central office for service to Western States, and the third will connect the Key West exchange for calls to and from points in the south. The construction of the cables, already completed, presented entirely new engineering problems, due to the depth of the waters to be traversed.—*Reuter's Trade Service* (Washington).

Foreign Telegrams.—Rate Revision.—It is announced in the *London Gazette* that the rates per word for telegrams to the undermentioned places are now as shown below :—Timor (Dilly), 4s. 1d. ; Chatham Islands, 3s. 2d. ; Makatea Island (Pomoton Archipelago), 4s. 8d. ; Greece, 6d. ; Greek Islands (except Corfu, Crete, Euboca, and Poros, 6d.), 6½d.

Imperial Telegraphy.—A deputation representing the Newspaper Proprietors' Association, the Newspaper Conference, the Empire Press Union, and the Press Agencies, waited upon the Postmaster-General (Mr. A. H. Illingworth), last week, to emphasise the need for improvements in communication by cable and wireless. According to the *Morning Post*, Viscount Burnham, introducing the deputation, said that Press rates for telegrams existed in name only, the deferred rate across the Atlantic was useless, there were great delays, and it was particularly desired that the wireless policy of the Government should be known. The Postmaster-General replied that good progress was being made in providing wireless communication around the British Empire. The service to Cairo it was hoped to get working by next May. That was the first part of the Imperial chain. It would go on to Nairobi, and then to Windhoek in South-West Africa, where the German station was being improved upon. India, Singapore, Hong-Kong, and Australia would be included in the circuit, and the various Dominion Governments concerned were being consulted in the matter. There would also be wireless communication with Sweden, Norway, Denmark, Germany, Poland, Czecho-Slovakia, Austria and Hungary, Jugo-Slavia, Italy, Holland, and Belgium. The Marconi Co.'s service would cover Spain, Italy, France, Nova Scotia, and New Jersey. A Committee was sitting to consider on what terms licences should be given to private enterprises. The question of providing facilities for receiving news sent by the Press from the Naval station in America provided by the United States Government was being considered. Within the Dominions the Government would control the wireless services. It was proposed that the Post Office, when given a message, should exercise the option of sending it either by wireless or cable if the method of transmission was not defined by the sender. He welcomed the formation of a Committee representative of the Press, the Stock Exchange, the Baltic Exchange, Lloyd's, and other big cable users, which would be able to consult and advise the Government.

Telephone Rates.—New Trunk Rates Postponed.—The Post Office announced on the 24th inst. that it had been decided to defer the new rates for trunk calls from February 1st to April 1st. The new tariff does not affect anyone, except new subscribers, before April 1st ; the agreements of existing subscribers are being terminated by due notice which will expire at various dates not earlier than April 1st, and there will, therefore, be full opportunity for discussion in Parliament before the new rates are applied.

United States.—Cable Dispute.—The Federal Court has granted a temporary injunction against the Western Union Cable Co. from landing its Brazil-Barbsdoes cable at Miami (Florida), from using three cables between Key West (Florida) and Havana for the transmission of messages between the United States and Brazil, and from splicing a line from Barbadoes to Cuba.—*Reuter's Trade Service* (New York).

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Aberdeen.—February 21st. Corporation Waterworks Department. Electrically-driven pumping machinery. Specifications, £5 (returnable), from Water Engineer's Office, 41½, Union Street, Aberdeen.

February 21st. Electricity Department. Temporary and permanent coal conveyors and shoots in connection with the reconstruction of the boiler house at Ferryhill. (January 21st.)

Algeria.—The Post and Telegraph authorities in Algiers have just invited tenders for the supply of a large quantity of high-conductivity bronze and copper wire.

Australia.—Melbourne.—March 2nd and 9th. Victorian Railways. Reactances and condensers (for power signalling), electric crabs and equipment for cranes. Copies of the specifications can be seen at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

March 31st. Electricity Commissioners. Plant for the Morwell power scheme. Telephone wire and pin-type insulators. (January 14th.)

Adelaide. — February 23rd. P.M.G.'s Department. Electric lamps, as per Schedule 561. (January 21st.)

Sydney.—March 21st. P.M.G.'s Department. Telephone and telegraph apparatus, testing instruments and switchboard parts, Schedule 814. (See this issue.)

Perth, W.A.—March 29th. P.M.G.'s Department. Telegraph accumulators, Schedule 333. (January 21st.)

April 5th. P.M.G.'s Department. Accumulators, &c., for Eucla, W.A. (See this issue.)

Belfast. — February 26th. Tramways Committee. —Tramway stores, including electrical accessories, cable, lamps, carbon brushes, &c. (See this issue.)

France.—Paris.—February 17th. The supply and installation of a multiple commutator table at the Central Telephonic Bureau in the Boulevard Raspail. Particulars from the Direction de l'Exploitation Téléphonique, 4e Bureau, 103, Rue de Grenelle, Paris.

February 4th. The French State Railway authorities, 43, Rue de Rome, Paris.—The supply and erection of a number of low-pressure switchboards required in connection with the upkeep of train electric lighting equipments at the railway works at Batignolles, Sotteville, Rennes and Saintes. Particulars can be obtained from the Service Electrique at the above address.

Great Yarmouth.—February 11th. Electricity Department. Supply and erection of h p. switchgear. (January 21st.)

London.—L.C.C. — January 31st. Electric wiring installation at the Bethnal Green Weights and Measures Office and Coroner's Court, comprising about 87 switch points and 89 lighting points. (January 14th.)

H.M. Office of Works. February 1st. Six months' supply of switches, fuses and fuseboards. (January 21st.)

Battersea.—February 9th. Electricity Department. E.h.p. and d.c. switchgear for two 450-kW converters. (See this issue.)

Lurgan.—January 29th. Urban District Council. Four-core l.p. lead-covered and armoured cables. (January 14th.)

Manchester.—February 14th. Electricity Department. 33,000-V trunk feeder, pilot and telephone cables. (January 21st.)

February 15th. Tramways Committee. Tramway stores, including meters, cable, lamps, bells, insulators, &c. (See this issue.)

Middlesbrough.—February 9th. Corporation. Double line of tramways from Albert Road to Linthorpe Road. Particulars from Mr. S. E. Burgess, Borough Engineer, Municipal Buildings.

New Zealand. — Wellington. — March 1st. Public Works Tender Board. Seven 4,000-kVA single-phase transformers, with accessories, for Lake Coleridge electric power scheme. Particulars from the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

March 5th. Government Railway Department. Two overhead travelling cranes. Specifications can be seen at the Department of Overseas Trade (Engineering Section), 35, Old Queen Street, S.W.1.

Rosyth.—January 30th. Electric lighting work at Park Road School. Deposit, £1 1s. Mr. R. H. Motion, architect, Union Bank Chambers, Dunfermline.

South Africa. — Pretoria.—March 10th. Municipal Council. One 20-ton overhead crane, six boilers (350-lb. working pressure), three 3,000-kW steam turbo-generators with condensing plant, five 750-kW converters. Further particulars can be obtained from Mr. T. C. Wolley-Dod, general manager, electric lighting department. Specifications (five guineas) from the town clerk.

February 16th. One 1,000-kW rotary converter with transformers and switchgear. Specifications of the above may be consulted on application to the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

Spain.—Tenders have recently been invited by the municipal authorities of Jerez de los Caballeros (Province of Badajoz) for the concession for the supply of electricity for lighting and power purposes in the town during a period of eight years. The municipal authorities of Puente Genil (Province of Cordoba) have also called for tenders for a similar concession, the duration in this case, however, being only six years.

Uruguay.—Monte Video.—March 29th. State Power House. Single and three-phase meters. Copy of the specification (in Spanish), conditions of tender and a list of spares to be provided (also of a similar call for tenders for 500 d.c. meters for the provinces), can be seen at the Department of Overseas Trade (Room 48), 35, Old Queen Street, S.W.1.

February 21st. State Power House. Electrical accessories, including plug fuses, branching blocks, cut-outs, keys and switches. A copy of the Spanish text and the blue prints can be seen at the Department of Overseas Trade, 35, Old Queen Street, S.W. 1.

CLOSED.

Barnes.—Urban District Council. English Electric Co., Ltd., interconnecting cables for coupling up alternator and switchboard, rotary converter, and transformer, &c.

Glasgow. — Electricity Committee. Recommended. English Electric Co., Ltd., electric battery locomotive, to be used on the railway sidings at Dalmarnock, £3,920.

Government Contracts.—New Contracts placed during December, 1920:—

Admiralty (Contract and Purchase Department).

Batteries for 9-in. torches.—Ever Ready Co. (Great Britain), Ltd.
Coil winding machines.—Nevilles, Ltd.
Conduit tubing and accessories.—Barton & Sons, Ltd.; J. Birch & Sons, Ltd.; Brotherton, Ediswan Tubes & Conduits, Ltd.
Micanite and insulating materials.—Ioco Proofing Co., Ltd.; Micanite & Insulators, Ltd.; J. North Hardy & Co., Ltd.; R. Whiffen.
Motors and motor-generator set.—Brush Electrical Engineering Co., Ltd.
200-kW motor generator, &c.—W. H. Allen, Son & Co., Ltd.
Selector switchboard and panels.—Park Royal Engineering Co., Ltd.

War Office.

Distributing boards.—General Electric Co., Ltd.
Electric lamps.—English Electric & Siemens Supplies, Ltd.; General Electric Co., Ltd.
Pack sets.—Marconi Wireless Telegraph Co.
Rotary transformers.—Newton Bros (Derby), Ltd.

Air Ministry.

Electric wiring, Donibristle.—S. Dixon & Sons, Ltd.
Generators.—Evershed & Vignoles, Ltd.
Ignition vibrators.—H. W. Sullivan.

Post Office.

Telegraph apparatus.—Siemens Bros. & Co., Ltd.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; British L.M. Ericsson Manufacturing Co., Ltd.; International Electric Co., Ltd.; Phœnix Telephone and Electric Works, Ltd.; Siemens Bros. & Co., Ltd.; Sterling Telephone and Electric Co., Ltd.; Western Electric Co., Ltd.
Electric light cable.—Hackbridge Cable Co., Ltd.
Submarine cable.—Telegraph Construction & Maintenance Co., Ltd.
Telegraph and telephone cable.—Macintosh Cable Co., Ltd.; New Gutta-Percha Co., Ltd.
Condensers.—Telegraph Condenser Co., Ltd.
Earth clips.—Farmer & Co.
Cords for telephones.—Phœnix Telephone & Electric Works, Ltd.
Ducts.—Doulton & Co., Ltd.
Insulators.—Bullers, Ltd.
Indicator lamps.—General Electric Co., Ltd.
Laying conduits.—Preston-Blackpool (Section II): W. Dobson. Harrow (Headstone Road): G. J. Anderson. Hornsey (Coleridge Road): J. Abrahams, Ltd. London-Bristol-Newport (S.W. Section VI) and Manchester (Piccadilly and Newton Street, pneumatic tubes): E. E. Jeavons & Co., Ltd. North-Eastern Post Office engineering district: W. Irwin & Co. North Wales Post Office engineering district: Hodge Bros. (Contractors), Ltd. Walthamstow (Palmerton Road): W. & C. French. Wandsworth Common (Trinity Road) and Norwood (Vermont Road): J. Mowlem & Co., Ltd.
Manufacture, supply, drawing-in and jointing of cable.—Hampstead-Hendon Junction: Johnson & Phillips, Ltd, Hull-Grimsby: W. T. Glover & Co., Ltd. Paisley-Greenock: British Insulated & Helsby Cables, Ltd.
Earth plates.—Farringdon Works & H. Pontifex & Sons, Ltd.
Charging sets.—A. Lyon & Co.
Telephones.—Western Electric Co., Ltd.
Telephone exchange equipment.—Bromley and Walthamstow: Western Electric Co., Ltd. Luton: Peel-Conner Telephone Works, Ltd.; subcontractors for batteries, Tudor Accumulator Co., Ltd., for charging sets, Crompton & Co.
Electric light wire.—Macintosh Cable Co., Ltd.
V.I.R. wire.—W. Geipel & Co., Hackbridge Cable Co., Ltd.

High Commissioner for India.

Telephone apparatus.—Peel Conner Telephone Works, Ltd.
Carbon brushes.—Morgan Crucible Co., Ltd.
Cable.—General Electric Co., Ltd.; W. T. Glover & Co., Ltd.; Johnson & Phillips, Ltd.; Peel Conner Telephone Works, Ltd.
Cells.—Chloride Electrical Storage Co., Ltd.; Edison Accumulators, Ltd.
Sections for cells.—Tudor Accumulator Co.
Dynamos.—J. Stone & Co., Ltd.
Welding equipment.—Metro.-Vickers Electrical Export Co.
Electric fans.—Crompton & Co., Ltd.; General Electric Co., Ltd.; J. Stone & Co., Ltd.; Veritys, Ltd.
Fuses.—W. T. Henley's Telegraph Works Co., Ltd.
Generating sets, &c.—Lancashire Dynamo & Motor Co., Ltd.
Lamp holders.—Edison Swan Electrical Co., Ltd.
Meters.—Reason Manufacturing Co., Ltd.
Protectors, &c.—Peel Conner Telephone Works, Ltd.
Salammoniac.—Brunner, Mond & Co., Ltd.
Switchboards.—Kartret Engineering Co., Ltd.; Peel Conner Telephone Works, Ltd.
Copper wire.—T. Bolton & Sons, Ltd.; W. T. Glover & Co., Ltd.; London Electric Wire Co. & Smiths, Ltd.
Iron wire.—Dorman, Long & Co., Ltd.; R. Johnson & Nephew; Rylands Bros.; Whitecross Co., Ltd.
Fuse wires.—General Electric Co., Ltd.

Crown Agents for the Colonies.

Battery.—Premier Accumulator Co.
Battery materials.—Siemens Bros. & Co., Ltd.
Cable.—W. T. Henley's Telegraph Works Co., Ltd.; Hooper's Telegraph and India-Rubber Works, Ltd.
Cable joint boxes.—W. T. Henley's Telegraph Works Co., Ltd.
Electric light fittings.—Chloride Electrical Storage Co., Ltd.
Electric light fittings for train.—Mather & Platt, Ltd.
Electric welding plant.—Metro.-Vickers Electric Export Co., Ltd.
Insulators.—Bullers, Ltd.
Joint boxes.—Siemens Bros. & Co., Ltd.
Lamps.—Edison Swan Electric Co., Ltd.
Telegraph ironwork.—Siemens Bros. & Co., Ltd.
Telegraph line material.—Bullers, Ltd.; Siemens Bros. & Co., Ltd
Telephone materials.—British L.M. Ericsson Manufacturing Co., Ltd
Telephone sets.—Peel-Conner Telephone Works, Ltd.
Insulated wire.—Hooper's Telegraph & India-Rubber Works, Ltd.
H.D. copper wire.—R. Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd

Department of Agriculture and Technical Instruction for Ireland.

Electric lighting work at the Department's Ulster Dairy School, Cookstown.—Ferguson & Bruty, Ltd.

Public Works, Dublin.

Belfast.—Plumbing, gasfitting and electrical works and supplies: A. Stevenson.

London.—L.C.C. Establishment Committee. Electric motors required in connection with the electrical work at the new County Hall:—

Crompton & Co., Ltd. (accepted)	**£10,231**
Veritys, Ltd.	11,094
Electromotors, Ltd.	12,254
General Electric Co., Ltd.	14,285

Newport.—Isle of Wight.—Town Council. Isle of Wight Electric Light Co.—Electric light installation, new houses, from £11 1s. to £14 17s. per house.

St. Dunstan's Massage Clinic.—We have received from the authorities of St. Dunstan's Hostel for Blinded Soldiers and Sailors particulars of a massage clinic recently opened at 18, Christopher Street, Finsbury Square, E.C. 2. Everything is managed on the most modern lines, the equipment including faradic, galvanic, radiant heat and other apparatus. The efficiency of the *masseurs*, who are all blinded soldiers, with a sighted *masseuse* in charge, is vouched for by a number of eminent medical men. We are also informed that many blinded soldier *masseurs* have set up clinics of their own in various parts of London; a list of these is obtainable from St. Dunstan's.

A Kinema Improvement.—Captain Raymond Phillips, who was in charge of the inspection of optical instruments and range-finders in the Irish military command during the war, has invented a new means of projecting kinema pictures. He gave a *Daily Mail* representative a demonstration of his method of stereoscopic projection recently. Projecting moving pictures in the ordinary way, he makes them zig-zag on to a series of specially-prepared mirrors and through a prism before they reach the screen. In this way pictures become markedly more detailed and less "blurry"; 2 ft. to 3 ft. "deeper," and steadier.

FORTHCOMING EVENTS.

Edinburgh Electrical Society.—Friday, January 28th. At the Philosophical Institute. At 8 p.m. Papers on "Electrical Wonders in Guernsey," by Mr. E. C. Catford.

Physical Society of London.—Friday, January 28th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary meeting.

Association of Engineers-in-Charge.—Saturday, January 29th. At St. Bride's Institute, Bride Lane, E.C. At 7 p.m. Discussion on "The Association and its Future Activities." To be opened by Mr. A. E. Penn.

Manchester Association of Engineers.—Saturday, January 29th. At the Memorial Hall, Albert Square. At 7 p.m. Paper on "Cast Iron *v.* Semi-Steel," by Mr. E. Wheeler.

Institution of Electrical Engineers.—Informal Meeting.—Monday, January 31st. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Discussion on "Possible Economies in House Wiring." To be opened by Mr. L. Milne.

(**East Midland Sub-Centre**).—Tuesday, February 1st. At the Technical College, Derby. At 7 p.m. Paper on "Recent Developments in Wireless Telegraphy and Telephony," by Mr. W. O. Ridley.

Manchester Wireless Society.—Wednesday, February 2nd. At 7.30 p.m. Paper on "The History of the Telephone," by Mr. A. Marr.

Paisley Association of Engineers.—Wednesday, February 2nd. At the Y.M.C.A. Buildings, 25, High Street. At 7.30 p.m. Paper on "Wireless Telegraphy and Telephony," by Mr. D. McKay.

Royal Society of Arts.—Wednesday, February 2nd. At John Street, Adelphi, W.C. At 8 p.m. Paper on "Oil Burning Methods in Various Parts of the World," by Mr. A. F. Bailie.

Chemical Society.—Thursday, February 3rd. At Burlington House, Piccadilly, W. At 8 p.m. Informal meeting.

Chelmsford Engineering Society.—Thursday, February 3rd. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Some Useful Metal-testing Machines," by Mr. H. S. Primrose.

Royal Institution of Great Britain.—Friday, February 4th. At Albemarle Street, W.1. At 9 p.m. Lecture on "The Electrical Expression of Human Emotion," by Dr. A. D. Waller, F.R.S.

NOTES.

The "Electrical Review" Index.—The Index to Vol. LXXXVII of the Electrical Review is now ready, and will be supplied for 6d., post free, on application to the Publisher, Electrical Review, 4, Ludgate Hill, E.C. 4.

Cheap Power.—A correspondent to *Power* recently drew attention to a circular issued by a "wind motor" company. This would appear to be another of those schemes for obtaining power for nothing which crop up every now and again. The idea is to employ the natural draught given by a 250-ft. chimney shaft to drive an air turbine fixed in the base of the shaft. To meet with any quota of success the draught would surely have to be an "unnatural" one. The correspondent states that a recent test showed the output of the turbine (11 ft. in diameter) to be 47 h.p. at 80 r.p.m., but he adds: "I was fortunate enough to meet a man who happened to see the test, and he informed me that there was a brisk coke fire burning in the base of the stack during the run."

Service Notes.—Warrant Electrician T. Barham has been appointed to the battleship *Benbow*; Warrant Electrician T. R. Hopkins to the battleship *Erin*, for group of reserve ships; Warrant Electrician W. Sweany, to Greenwich; Warrant Electrician A. C. Cornhill, to battleship *Colossus*, for group of reserve ships; Warrant Electrician J. Belcher, to the battleship *Warspite*, from the 19th inst.; Warrant Telegraphist S. W. Francis has been posted to the *Pembroke*, depôt ship at Chatham, for service with the Signal School, Chatham; Commissioned Telegraphist Walter Turnbull has been appointed to the charge of the wireless station at Ascension—the lonely island in the South Atlantic lying between the Coast of Brazil and the West Coast of Africa, 1,450 miles off the latter.

Finsbury Old Students' Association.—A dinner was held, on January 20th, at the Grand Hotel, Manchester, by a number of Old Finsbury Students, for the purpose of forming a local section of the Finsbury Technical College Old Students' Association. Mr. Eustace Thomas occupied the chair, and was supported by Prof. Miles Walker, Messrs. A. P. M. Fleming, A. G. Livesey, Linch, and other prominent local old students. After the dinner and the formal business of establishing the section, a short musical programme was rendered. The Hon. Local Secretary is Mr. H. F. Coucher, 9, Cartwright Road, Chorlton-cum-Hardy.

Automobile Exhibition at Basle.—An International Automobile Exhibition is to be held at Basle from May 28th to June 8th. The Committee of Organisation has sent us a booklet of rules and regulations in connection with the Exhibition. We note that a total area of 20,000 sq. metres has been taken over by the Basle section of the Swiss Automobile Club, and exhibits are to be classified under nine heads, including passenger and touring automobiles, lorries, motor cycles, accessories, &c. The booklet and further details may be obtained from the Swiss Legation, 32, Queen Anne Street, Cavendish Square, W.

Electrolytic Copper Production in Sweden.—Some weeks ago we referred to the situation of the A. B. Elektrolytverken, which company was formed in 1918 by some of the largest Swedish consumers of copper and owners of copper ore deposits, for the production of electrolytic copper, so as to meet the most pressing requirements in this respect. *Svenska Dagbladet* now announces that as it has been impossible to obtain increased guarantees for the company's loan, the shareholders have unanimously decided to liquidate the company.

The Electrical Trades Benevolent Institution.—A meeting was held at the Engineers' Club, Manchester, in December last, to discuss the advisability of forming a local Advisory Committee, at the instance of Mr. Farthing, who expressed regret at the fact that little was known in Manchester with regard to the objects of the Benevolent Institution. As the result of the discussion, a meeting was held on January 10th at which Mr. Hawes, the secretary, gave an address outlining the objects and organisation of the Institution, and the method of conducting local Advisory Committees. The meeting then elected Mr. J. A. Robertson as chairman; Mr. J. H. Farthing, vice-chairman; Mr. W. J. Smith, secretary; and Messrs. Phillips, Scott, Shaw, Walker, Quanz, Hall, and Kirkham, as members of Committee. It was agreed that the representatives of local electrical associations should be added to the Committee.

As mentioned elsewhere in this issue, the Benevolent Institution is this year going to carry on an energetic campaign for the purpose of establishing the fund on a sound basis; in this the Executive Committee will be very greatly helped by the local Advisory Committees, and in view of the density of population, electrically speaking, of the Manchester area, it cannot be doubted that the new Advisory Committee will be in a position to "make things hum." We must confess to some surprise on learning that a district so important and wide-awake as this not only had no Advisory Committee, but actually knew very little about the Benevolent Institution. Now that it has come forward to bear its share of the burden, we confidently look to Manchester to put all previous achievements in the shade. Up to now the fund has with difficulty been jacked up to a beggarly £12,000 or so; we expect Manchester to put on £20,000 more in the first year, without starting a rivet or blowing a single fuse. The fund ought to pass the £50,000 mark this year, if the electrical industry does justice to its lofty ideals. Let "Service" be the watchword!

We will gladly assist the movement by all means within our power.

The Royal Air Force.—The Inspector of Recruiting, R.A.F., states that there is still a large number of vacancies in this arm of the Service for skilled men of a number of trades. The list includes electricians, wireless operators and mechanics, instrument makers, engine drivers, &c. Everything is being done to make the life attractive, and a man joining the Force will certainly not be wasting his time.

Awards for War Inventions.—According to the *Daily Chronicle*, in the first report of the Royal Commission on Awards to Inventors, just issued, it is stated that among the awards already made are the following:—

Messrs. Gwynnes, Ltd. (engines for aeroplanes) ...	£110,375
Capt. W. S. Tucker (hot wire microphone)	4,000
Lieut. R. F. Power (aerial target)	2,345
Dr. E. Prassone and Major Luigi Avorio (kite balloons)	4,500
Messrs. Sopwith (synchronising gear)...	3,950
Dr. Hele-Shaw (pneumatic clutch)	3,000
Messrs. Vandervell and Mr. A. H. Midgeley ("Allways" fuses)	14,000
Mr. H. H. R. Green (electrically-controlled switches)	7,500
Messrs. Hobson, Ltd. (carburettors)	35,031
Late Dr. E. Russell-Clarke (improvements in wireless telegraphy and aircraft devices)	8,000
Major A. C. Fuller ("Fullerphone")	3,500 & 1,250

Fatalities.—On January 19th, Henry Tonge, of Westhoughton, was going to work when he became entangled with some electric wires, dislocated during a storm, with fatal results.

A case described by the coroner as "extremely puzzling" was investigated at Palmer's Green last week. A 16-year-old schoolboy, Eric Walter Bishop, was, according to the *Evening News*, found dead in a bath at his home, and an electric heater was found in the bath. Dr. Spilsbury said death was due to syncope from disease of the heart muscles, as part of the condition of status lymphaticus. Death followed some shock, but he was unable to say what that shock was. An expert said that if the boy had been sitting in the water and dipped the heater when the current was switched on he would have had a shock, the strength of which would depend upon the conductivity of the water. He thought the chances that the boy got such a shock were very remote. The coroner returned a verdict in accordance with Dr. Spilsbury's evidence.

Exhibitions in the Netherlands East Indies, 1921.—British manufacturers and exporters who seek to develop trade in the Netherlands East Indies, should be interested in the announcement that the Second Netherlands East Indies Fair is to be held at Bandoeng (Java) from September 19th to October 9th of this year. The fair will be international in character, and will offer manufacturers an opportunity of exhibiting wares of all kinds to a vast number of potential buyers in the East. Everything that pertains to industry, commerce and agriculture will be represented at the Fair, and a Motor Vehicle and Tractor Exhibition will be held simultaneously in the same town. Preliminary arrangements are well forward, and a booklet setting forth all details is being prepared by the British Chamber of Commerce for the Netherlands East Indies, to whom, at 38, Dover Street, London, W. 1, all inquiries in connection with this Fair and the concurrent exhibition should be addressed.

Radium Ore in Madagascar.—It is announced in Paris that radium ore has been found on an island of Madagascar of such a quality that one gramme of metal can be extracted from 10 tons of ore.

Birmingham University.—The General Electric Co., Ltd., has contributed £1,000 in answer to the appeal of the University of Birmingham.

Dinner.—Portsmouth members of the Electrical Power Engineers' Association and the Electricity Supply Commercial Association held their first annual dinner at Kimbells Restaurant, last Saturday evening. About 60, including wives and friends, sat down. Mr. B. Handley, acting engineer and manager, Portsmouth Corporation Electricity Supply, presided, and was supported by Councillor A. Hemingway, of the Portsmouth Electric Lighting Committee. Visiting members from Brighton, Southampton, &c., were present. After dinner an impromptu programme of songs, toasts, &c., was contributed. Mr. P. L. Weir, acting station superintendent, Portsmouth electricity works, organised the gathering.

Appointments Vacant.—Electricity accounts and ledger clerk, for the Hackney Borough Council Electricity Department; mains foreman (116s.), for the County Borough of Newport Electricity Department; shift engineer, for the Manchester Corporation Electricity Department. (See our advertisement pages to-day.)

Overhead Arc Welding.—Mr. O. H. Eschholz, recently contributed an article to the *Electrical World* on the above subject. He states that under the extreme condition of overhead welding, when the force of gravity is opposing the transfer of metal, greater manipulative skill is required than when gravity partly or completely assists, as in vertical or downward welding. To convey the globule which forms on the end of the wire electrode to the plate, the lifting force must exceed the retaining forces of gravity, cohesion and surface tension at the wire perimeter. Gravity is diminished by keeping the globule on the electrode as small as possible. Experience has shown that the presence of iron oxide, iron carbide, manganese, &c., in the electrode decreases surface tension and cohesion. These last forces may also be diminished by the use of small diameter electrodes.

The cycle of deposition in the case of overhead welding seems to be as follows:—The metal at each terminal is liquified upon the arc being struck; the molten electrode assumes a spherical form due to surface tension; this globule is enlarged with continued application of energy until its upper surface is brought into contact with the overhead pool, thereby short-circuiting the arc stream, and causing the lifting forces to act upon it; forces of surface tension and adhesion at the contact area cause the globule to spread over the plate surface; as the metal spreads, the area in contact with the plate, and therefore the lifting forces, are increased, causing an acceleration in metal transfer; these forces act until the globule is lifted off the end of the electrode, when the short-circuit is broken, and the arc re-established.

It is preferable to select candidates for overhead work from competent downward welders. The training is graduated from vertical welding, through increasing angles, until finally the overhead position is reached. The special characteristics of the arc are fully explained, and the phenomena of metal transfer demonstrated. Overhead butt joints are prepared in a similar manner to ordinary butt joints being scarfed from 60° to 90°, with a "free distance" of from $\frac{1}{16}$ in. to $\frac{3}{32}$ in. The successful welding of an overhead butt joint is chiefly dependent upon the completeness with which the initial layer fuses together the apex of the joint.

INSTITUTION NOTES.

Institution of Electrical Engineers.—South Midland Territorial Centre.—The annual dinner of the Centre took place at the Grand Hotel, Birmingham, on Friday last, and was very largely attended. Mr. F. Forrest, chairman of the Centre, presided. After the loyal toast, the toast of "The Institution of Electrical Engineers" was proposed by the chairman, who, speaking of the increased membership, expressed the hope that the time would come when any person who desired to attain to a position of responsibility in his profession would have to prove the soundness of his knowledge and the extent of his training by becoming a member of the Institution. In responding, Mr. Ll. B. Atkinson, president, observed that this was a "jubilee" of the Institution, in that it was the fiftieth session. The membership was over 9,000, and was larger than that of any other Institution. The increase last year was the greatest for any one year. There were more than 1,000 new students in the Institution. Could anything speak more forcefully of the confidence engineers had in electricity? The question of raising the status of engineers by some mode of registration had been raised by the Bill of the Institution of Civil Engineers last year, and would not be allowed to drop; it might be desirable to have a discussion on the subject in London. The relations between the great engineering institutions were most cordial; the time was perhaps not ripe yet for their joint accommodation in one large building, but the Institution had given a lead in the establishment of local centres, and that lead was followed by other Institutions. The question that occurred to him was whether these local Institutions might find some common roof, library, and meeting ground, so that the great expense that attached to the provision of these facilities might be shared and made easier in local centres where otherwise it might be impossible. The toast of "The Electrical Industry" was proposed by Mr. Gilbert C. Vyle (managing director, Messrs. Averys, Ltd.), who urged the importance of manufacturers and factors buying, as far as possible, in this country. He was afraid the fetish of cheapness was again gaining influence. It seemed to him utterly futile, for the sake of the difference in money value, to pay the foreigners' wages. He hoped those in this country who were placing contracts for electrical gear would look at the quality of the stuff, and not decide altogether upon the question of price. Amalgamations might do much good by specialising manufacture and reducing competition, but they must not make profits at the expense of the customer; the profits must be derived from internal economics and shared with the user. If they obtained cheap power, they would get uses for electrical gear all over the country, and he had hopes of the hydro-electric schemes coming to fruition. In reply, Mr. P. J. Pybus (joint managing director, English Electric Co., Ltd.) commented upon the slowness with which schemes for the electrification of railways were being handled in this country. It would be a great step forward if the Government, working with responsible business men, endeavoured to find some means for alleviating unemployment by undertaking really useful works.

Mr. N. B. Rosher, O.B.E., proposed "Kindred Societies and Guests," and mentioned that it was proposed to hold a joint meeting of civil, mechanical, and electrical engineers in Birmingham to discuss the Severn barrage scheme. Mr. J. D. Watson responded.

A musical entertainment followed, and brought a very successful evening to an end.

The annual dinner of the Institution will be held on March 3rd, at the Hotel Cecil, at 7 for 7.30 p.m. Mr Ll. B. Atkinson will preside.

Liverpool Students' Sub-Centre.—A joint meeting of the Institution with the Liverpool University Engineering Society will be held on February 3rd, at 7 p.m., at the Laboratories of Applied Electricity, when Mr. J. A. Robertson, M.I.E.E., will lecture on "Lord Kelvin: His Life and Work."

Students' Section.—A joint visit of the North-Eastern Students' Section of the Institution of Electrical Engineers and the Junior Institution of Engineers to the Heaton Works of Messrs. C. A. Parsons & Co., Ltd., took place on January 15th. Upwards of 100 members availed themselves of the opportunity, and the tour of the works was carried out in a most thorough manner, a definite time having been allowed each party in the various shops.

Belfast Association of Engineers.—On January 27th, Mr. Richard P. Terry read a paper on "The Mechanical Handling and Conveying of Material," dealing very fully with the advantages and disadvantages of various systems.

Brighton Electric Traction and Radio Club.—This club was formed recently for the exchange of views and reading of papers upon the subjects suggested by its title. The radio section will cover "wired" telegraphy and telephony.

Liverpool Engineering Society.—At a meeting of the Society, held on January 19th, Prof. W. Mason, D.Sc., read a paper on "Impact Testing," describing a number of methods.

The Royal Institution.—On Saturday, February 12th, Prof. A. Fowler commences a course of three lectures on "Spectroscopy." The Friday evening discourse on February 4th will be delivered by Dr. A. D. Waller, on "The Electrical Expression of Human Emotion."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

The claim of Mr. A. P. Rutherford, late burgh engineer at Leith, against the Edinburgh Council, is for £6,500, not £500, as stated in this column last week.

At the English Electric Co.'s Ordnance Works, Coventry, last Saturday, Mr. F. H. Mence, of the small tools department, was presented with a clock on his leaving to take up business on his own account.

Falkirk Corporation has increased the salary of the electrical engineer to £650 per annum.

Halifax Tramways Committee has accepted the resignations of the chairman (Alderman C. F. Spencer), the vice-chairman (Alderman A. Broadley), and the chairman of the Sub-Committee (Mr. R. Stirk), which were tendered recently as a protest against the Town Council's refusal, on two occasions, to accept the Tramways Committee's recommendations with regard to the appointment of a general manager. The Committee has appointed the Mayor (Alderman T. Hey) as chairman *pro tem.*, the other vacant offices being left over. The Committee decided to advertise for a general tramways manager, in accordance with the demand of the Town Council, and to recommend the Town Council to grant an honorarium to Mr. J. D. Caird, traffic manager, who has been too ill to attend to duty for some time, instead of the annual grant for three years which was previously recommended, and refused by the Council.

Mr R. L. Acland, M.I.E.E., has joined the staff of Agricultural and General Engineers, Ltd., of Central House, Kingsway, W.C. 2, in charge of their electrical interests in the North of England, including the Garrett electrical vehicle.

The *Board of Trade Journal* announces that Mr G. T. Milne, H.M. Trade Commissioner, stationed at headquarters, will be leaving early in February for Trinidad, where he will act temporarily as H.M. Trade Commissioner in the British West Indies during the absence of Mr. A. J. Pavitt from his post. Mr. Milne will be glad to meet any representatives of firms who may wish to see him regarding any matter affecting their interests in the West Indies at the Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W. 1, by appointment.

Obituary.—Capt. J. Adams.—We regret to announce that Capt. J. Adams, of the new cable steamer *Lord Kelvin*, met with a fatal accident at Halifax, Nova Scotia, on New Year's Day. He was formerly in charge of the Anglo-American Co.'s cable steamer *Minia*, and was associated with the latter steamer for over 25 years. He was motoring back to his home when, on passing over a level crossing, an express train smashed into the car, killing both the occupants instantaneously. He leaves a widow and two children.

Wills.—The late Mr. Theodore Newton Vail, president of the American Telegraph and Telephone Co. and other concerns, left property in excess of £1,000,000 in value, of which £46,456 was the gross value of the estate in the United Kingdom. Considerable amounts were bequeathed to universities, technical colleges and institutes in the U.S.A.

Mr. Franklin Hilton, M.I.C.E., M.I.M.E., chairman of Browett, Lindley & Co., left £30,398 net, and £33,392 gross, personalty.

NEW COMPANIES REGISTERED.

Santon, Ltd. (172,731).—Private company. Registered January 21st. Capital, £4,000 in £1 shares. To take over the business of electrical engineers carried on by H. C. Sanders, J. F. Fulton, R. C. Taylor and C. W. Buckley at 34, Bridge Street, Newport, as the "Santon Engineering Co." The first directors are: H. C. Sanders, 34, Bridge Street, Newport, Mon.; J. F. Fulton, 40, Bryngwyn Road, Newport, Mon.; R. C. Taylor, 22, Bryngwyn Road, Newport, Mon.; C. W. Buckley, 19, Stockton Road, Newport, Mon. Secretary: R. C. Taylor. Registered office: 34, Bridge Street, Newport, Mon.

Scottish Electric Lamp Repairing Co., Ltd. (11,582).—Private company. Registered in Edinburgh January 17th. Capital, £15,000 in £1 shares. To acquire a licence granted or to be granted by the Allies Electric Lamp Repairing Co., Ltd., London, to use certain patents, machinery and appliances, and to carry on the business of manufacturers, importers, exporters, repairers and fitters of and dealers in electric lamps, &c. The subscribers (each with one share) are: C. Cochran, 55, West Regent Street, Glasgow, solicitor; Jessie Allan, 55, West Regent Street, Glasgow, typist. The first directors are: W. Crawford, Alma, Potterhill Avenue, Paisley; and J. M. Scott-Maxwell, Baillieston House, Baillieston. Registered office: Abercorn Lamp Works, Niddry Street, Paisley.

Ozonair Flour Mill Ventilating Co., Ltd. (172,619).—Private company. Registered January 15th. Capital, £1,200 in £1 shares. To carry on the business of manufacturers of ventilating installations, &c. The subscribers (each with one share) are: H. Audsley, 15, Belmont Terrace, Crackenedge, Dewsbury, clerk; C. Halstead, Ash Villa, Belle Vue Road, Sandal, Wakefield, clerk. The first directors are to be appointed by the subscribers. Ozonair, Ltd., may appoint one director during the continuance of the licence granted to the company. Solicitor: W. H. Kingswell, 36, Wood Street, Wakefield.

Unique, Ltd. (172,640).—Private company. Registered January 17th. Capital, £500 in £1 shares. To carry on the business of manufacturers of and dealers in lamp shades, electric and gas globes and fittings, &c. The permanent directors are: D. A. Abrahams, Maitland Cottage, Earlham Grove, Forest Gate, Essex; H. F. Kean, 50, Northumberland Avenue, Wanstead, Essex. Secretary: H. F. Kean. Registered office: 25, Shaftesbury Avenue, W.C.

Rail Welding Co., Ltd. (172,636).—Private company. Registered January 17th. Capital, £30,000 in £1 shares (10,000 10 per cent. cumulative preference). To take over the business of a rail welder carried on by E. Jacob at 119, Victoria Street, Westminster, and at Upper Kennington Lane, S.E., as the "Rail Welding Co." The first directors are: E. Jacob, 11, Chalcot Gardens, N.W.; F. S. A. Lowndes, 9, Barton Street, Westminster; A. P. Strohmenger, Canal Court, Sunningdale, Berks. Registered office: 119, Victoria Street, Westminster, S.W. 1.

Aladdin Lamps (Midlands), Ltd. (172,644).—Private company. Registered January 18th. Capital, £35,000 in £1 shares (25,000 preference). To take over the business of electric lamp manufacturers and agents carried on by the New Process Electric Lamp Co., Ltd., at Sherborne Street, Birmingham, and elsewhere, including the benefit of an agreement with the Aladdin Renew Electric Lamp Corporation, Ltd., of a licence thereby to be granted with the right to purchase a certain electric installation and plant of Trelco Works, Ladywood, Birmingham, &c. The first directors are: S. Coxon, 20, Calton Avenue, Wavertree, Liverpool; W. A. Williams, Whinmoor, Jubilee Road, Formby; J. T. Jones, 67, Lord Street, Liverpool. Qualification, £100. Registered office: Sherborne Street, Birmingham.

Tully Gas Plants, Ltd. (172,091).—Registered January 19th. Capital, £150,000 in £1 shares (100,000 8 per cent. cumulative participating preference shares and 50,000 ordinary). To acquire the undertaking, assets and liabilities of Bale and Hardy, Ltd., and to carry on the business of contractors, electricians, electrical and gas engineers, founders, smiths, &c. Purchase consideration, £43,650, payable in shares. The first directors are: C. B. Tully, Grey House, Carlton-on-Trent, Newark; P. P. Sandford, 8, Phillimore Gardens, Kensington, W. 8; J. W. Tully, 39, Penywern Road, Earl's Court, S.W.; Lt.-Col. H. Thorpe, Coddington Moor, Newark. Minimum cash subscription, seven shares. Qualification (except first directors), £100. Remuneration, £100 each per annum (chairman, £125), free of income tax. Solicitor: G. E. Bruce Millar, Pomeroy House, 28a, Basinghall Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

H. W. Smith & Co. (1920), Ltd.—Mortgage dated December 9th, 1920, to secure all moneys due or to become due from company to Lloyd's Bank, Ltd., not exceeding £50,000 charged on certain freehold premises at Lydbrook Junction, Glos.

Patex, Ltd.—Issue on December 30th, 1920, of £650 debentures part of a series. (Previously issued, £1,100.)

Yorkshire Cable Co., Ltd.—Debenture dated December 23rd, 1920, to secure all moneys which the mortgagees may be called upon to pay under a guarantee to company's bankers, not exceeding £7,000.

East Anglian Electricity, Ltd.—Particulars of £10,000 second mortgage debentures authorised January 4th, 1921; whole amount issued; charged on company's undertaking and property, present and future, including uncalled capital.

Minehead Electric Supply Co., Ltd.—Trust deed dated December 31st, 1920, to secure £12,000 debenture stock charged on leasehold property at Alcombe, Somerset, and company's other assets present and future, including uncalled capital. Trustees: H. D. Leather, East Parade Chambers, Leeds; F. Rishdon, Williton, Somerset.

Park Royal Engineering Works, Ltd.—Satisfaction to the extent of £2,000 on November 23rd, 1920, of second mortgage debenture authorised May 10th, 1915, securing any moneys up to £2,000 which may be paid under a guarantee to the company's bankers.

Marsh Bros. (Electricians), Ltd.—Mortgage dated December 31st, 1920, to secure all moneys due or to become due from company to London Joint City and Midland Bank, Ltd., charged on the Sheffield Electrical Works.

Ebonestos Insulators, Ltd.—Particulars of £20,000 debentures authorised January 11th, 1921; whole amount issued; charged on company's undertaking and property, present and future, including uncalled capital.

Engineering Equipment Co. (1919), Ltd.—Issue on January 6th, 1921, of £500 debentures, part of a series already registered.

Hudson's Electrical Engineering Co., Ltd.—Particulars of £2,000 debentures authorised December 30th, 1920; whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital.

Wigan Electro-Metallurgical Works, Ltd.—Debenture dated December 20th, 1920, to secure £186 10s., charged on company's undertaking and property, including uncalled capital. Holders: British Thermit Co., Ltd., 49-51, The Albany, Old Hall Street, Liverpool. Particulars of £18,000 debentures, authorised by resolution of even date, also filed, whole amount issued, charged on above mentioned property.

Siemens Brothers & Co., Ltd.—Satisfaction to the extent of £23,400 on January 1st, 1921, of debenture stock dated January 15th, 1918, securing £1,330,000.

Westminster Electric Supply Corporation, Ltd.—Satisfaction in full on March 1st, 1920, of debentures dated March 1st and March 29th, 1898, securing £250,000.

Pritchett and Gold and Electrical Power Storage Co., Ltd.—Satisfaction in full on December 31st, 1920, of debentures dated November 14th, 1916, securing £10,000.

Nairobi Electric Power and Lighting Co., Ltd.—Satisfaction to the extent of £1,000 on December 31st, 1920, of debentures dated September 10th, 1913, and July 26th, 1915, securing £20,000.

CITY NOTES.

Adelaide Electric Supply Co., Ltd.

The annual meeting was held on January 19th at Winchester House, E.C., Mr. J. B. Braithwaite, M.I.E.E., presiding. The chairman said that on the whole they had reason to congratulate themselves upon the result of the working of the company for the past year in view of the exceptional conditions in Adelaide as in other parts of Australia. The year opened with the great seamen's strike, which was settled just at the beginning of their financial year. That was followed by the marine engineers' strike, which caused restrictions to be issued by the authorities which had the effect of reducing their output during the month of February by about 40 per cent. The gross revenue had increased by £46,793, about 25 per cent. That was fairly satisfactory, but the expenses had also increased considerably. Generation costs increased by £22,897; distribution was about £900 up, and repairs and renewals cost them £18,174, as against £13,208, whilst general charges, which included taxes, insurance, &c., showed an increase of £5,800. In round figures while the revenue had increased by about £50,000, expenses had gone up by some £34,500, leaving them with only about £12,760 additional profit. During the year they connected 4,426 additional consumers, raising the number to 29,475, a very satisfactory increase. They had an increase of 4,222 in kW, as compared with an increase of 3,040 kW the previous year; while the sale of units had increased by rather over 3 millions to 14,434,000. He had no doubt that had it not been for the strikes they would have passed the 15 millions mark last year. The miles of streets supplied had increased from 500 to 525, which was about their normal rate of increase. Application was made to the South Australian Government Prices Regulating Commission for permission to increase their rates to meet the increased charges of coal, labour, &c., and they granted them an increase of 15 per cent. The special night tariff which they had adopted was making a little progress. The number of consumers had risen from 95 to 150, which showed that the concession was being appreciated. On the whole, he thought they would agree that the business had stood up against the difficulties it had had to contend with, better perhaps than might have been expected. That was due very largely to the loyalty, zeal, and energy of the local directors in Adelaide, and of the staff. Some progress had been made with the new power house at Osborne, Port Adelaide, although they had not spent much money. Altogether they had spent about £21,000 on that work, and everything went to show that they would soon be able to get to work on erecting the power house, and they had placed orders for a considerable amount of plant which would involve the raising of new capital in order to pay for it. During the year they had spent £133,400 on capital account, and the cost of the undertaking now stood at £1,025,000. As he had said, it would be necessary to raise further capital during the year, but it would be raised in Australia. An offer of ordinary shares was going to be made on February

1st at 25s. per share. They had got 150,000 of those shares available, and they considered that that would give them sufficient money for the current year. He was looking forward to the completion of the Adelaide power house to mark a great epoch in the development of the business, as it would enable them to supply in bulk.

Mr. R. S. Sellon seconded the motion.

Replying to a shareholder, the chairman said that the English shareholders would have the same rights as the Australian shareholders in regard to the new issue of shares if they cared to exercise them.

The report was carried.

Subsequently an extraordinary meeting was held, when the chairman proposed a series of resolutions providing for the transfer of the control of the company to the Adelaide board. He remarked that the course had been forced upon them owing to the action of the Government with regard to the question of income tax. The English Government had insisted upon income tax being paid here on profits earned entirely in Australia. It was quite reasonable that the Australian shareholders, who formed the majority of the shareholders, should object to paying their own tax in Australia and British income tax as well. The board had done their best to try and bring home to the Government the injustice of such a procedure, but beyond getting a small concession last year, they had not been able to get the injustice altered. Resolutions for removing the control of the company to Australia had already been passed by the Colonial shareholders. Fortunately they had a most excellent board in Adelaide on whom they could thoroughly rely to look after their interests. If the resolutions were carried they would effect an immediate economy of about £12,000 a year for the benefit of the shareholders.

Mr. A. F. Farish seconded the resolutions, which were opposed strongly by two holders of "A" preference shares on the ground that removing the control of the company from London would depreciate their holdings; but eventually the resolutions were carried.

Costa Rica Electric Light and Traction Co., Ltd.

For the year ended June, 1920, the net earnings in Costa Rica were £24,519, against £14,328 for the previous year. The net profit for the year was £12,691, against a loss of £2,549 for the previous year. The deficit of £13,022 is reduced to £330. The gold premium has averaged 160 per cent. during the year, as against 315 per cent. in the previous year, and 112 per cent. (the normal equivalent of the gold "colon") in the year (1913-14) before the war. At the last-mentioned rate the net profit in Costa Rica for the year under review, which amounts to C318,670.43, an increase of C21,365.08 on that of year ending June, 1919, would have been £30,063, as against £24,519, the difference between the current and normal exchange representing a loss of £5,544. The hope expressed by the directors in last year's report that they might resume payment in cash of the 5 per cent. debenture interest on June 30th, 1920, was realised, and the interest due on January 1st, 1921, was also paid in full. The directors had hoped to be able to pay off the first of the deferred warrants (that dated January, 1918), but they are informed by the trustees that the latter cannot consent to this payment at the present juncture.

British Columbia Electric Railway Co., Ltd.

The directors' report for the year ended June 30th, 1920, shows that after deducting £164,745 for depreciations, sinking fund, and renewals, and £13,000 for corporation profits tax, the net revenue from all sources was £412,327, plus £6,258 brought forward, making £418,585. Debenture interest absorbs £132,339, dividend on the 5 per cent. cumulative perpetual preference stock for the year £72,000, interim dividend at 3½ per cent. on the preferred ordinary stock for the year £65,032, and interim dividend at 3½ per cent. on the deferred ordinary stock £65,032, leaving available for further distribution £84,181. From this the directors recommend a final dividend on the preferred ordinary stock at the rate of 23s. per cent. per annum, free of tax, making £4 13s. per cent., free of tax, for the year, £21,368, and a final dividend on the deferred ordinary stock at the rate of 54s. per cent. per annum, free of tax, making £6 4s. per cent., free of tax, for the year, £50,167, leaving £12,646 to be carried forward. Taxation continued to increase rapidly. The following statement shows the amounts paid for the year 1920, as compared with the previous years of 1919 and 1918:—

	1918 $	1919 $	1920 $
Dominion Government Income Tax	21,100	97,477	101,000
Provincial Government Revenue and Property and Land Tax	54,716	60,550	67,831
Municipal Taxation	96,990	130,554	204,267
	$172,806	$288,581	$373,098

In last year's report it was stated that a Public Utilities Commission had been established in British Columbia entrusted with the duty of regulating the rates charged by the company for its various services to the public, but that owing to an amendment of the General Railway Act of the Dominion of Canada, passed on July 7th, 1919, the railways of the company had passed from the jurisdiction of the Province of British Columbia and of the Public Utilities Commission, referred to above, to that of the Dominion of Canada and of the Dominion Railway Board. It was also explained in last year's report that it was anticipated that legislation by the Dominion Parliament, reversing the amendment of 1919, would be passed early in 1920, the effect of which would be to return the company's railways to the jurisdiction of the Public Utilities Commission of British Columbia. As anticipated, legislation of this character was passed by the Dominion Parliament on July 1st, 1920, and the result, as indicated, would have been again to place questions relating to the company's railway in the hands of the Public Utilities Commission of British Columbia, but for the fact that somewhat earlier—in April, 1920—the Parliament of British Columbia had repealed the Public Utilities Act of British Columbia, thus abolishing the Public Utilities Commission, giving as their reason for so doing that, as the affairs of the railway had passed under the jurisdiction of the Dominion Railway Board, a Public Utilities Commission in British Columbia was no longer required. As the consequence of these events would have been to leave the company without any authority to whom appeal could be made for the regulation of rates and fares, a provision was incorporated in the Dominion Act of July 1st, 1920, providing for the retention of the company's railways under the Dominion Railway Commission for one year from the passing of the Act, viz., until July 1st, 1921. The question as to what authority will regulate rates and fares after July 1st, 1921, is undecided and is engaging the attention of the directors, who are hopeful that some satisfactory arrangement may be arrived at.

The net earnings of the company for the first five months of the current year, compared with those of the year under review, are as follows:—

	1919. $	1920. $	Increase. $
July	149,109	174,685	25,576
August .	166,808	187,984	21,176
September	181,811	183,327	1,516
October	183,415	184,339	924
November	214,119	214,789	670
	$895,262	$945,124	$49,862

Expenditure on capital account from July 1st, 1919, to June 30th, 1920:—

	$
Light and power extensions	212,088
Transmission lines and other electrical equipment ...	55,782
Railway extensions and developments	103,273
Lands and buildings	50,879
Trucks and sundry equipment	99,072
	$521,094

In presenting the above report at the general meeting, held on January 20th, Mr. G. P. Norton (chairman) said it was a report showing clearly a considerable improvement during the past year. This was due to an increase of revenue consequent upon the expanding trade and increased population of British Columbia. The speaker trusted that it was no longer necessary to tell the local authorities and public of British Columbia that, as the development of the Province depended to a great extent upon the development of its utilities, it was essential that the return secured should be sufficiently attractive to investors. A substantial capital expenditure had been necessitated by the expansion of the population, but the sound financial policy of the company in the past had enabled this to be made without calls for fresh capital. The company was financed on perpetual debentures; had these been redeemable much of the provision made for depreciation would have been absorbed by the redemption fund, and fresh capital would have been required.

Since 1912 the greater part of the output of the Western Power Co. of Canada had been taken by the company, and it had been thought desirable to obtain a controlling interest in the Power Co. Arrangements have now been made whereby the majority of the share capital of the Power Co. has been acquired on terms involving a comparatively small capital expenditure. It is intended to draw up plans for a fuller use of the Western Power Co.'s undertaking.

He (the speaker) was often asked the reason for the low prices of the company's securities and stocks; he invariably replied that it was due to Stock Exchange conditions and to a lack of complete confidence on the part of investors that a fair arrangement for the control of rates would be arrived at. There was no reason why the company, which had done so much to create prosperity in the province, should not share in that prosperity.

Mr. J. Davidson, who had recently paid a visit to Canada, gave his impressions and statistics of traffic. He stated that the number of passengers carried increased from 53,326,288 to 66,411,030, and freight carried from 331,794 tons to 430,931 tons. In addition to this, the electricity sold (in kW-hours) increased from 94,953,424 to 116,196,981.

The balance sheet and reports were adopted, and the directors and auditors re-elected.

French Companies.

The meeting of December 2nd of the *Société d'Electricité de Paris* has voted the distribution of 20 fr. per share and 33.33 fr. per part *bénéficiaire*. The credit balance of the profit and loss account has risen to 2,543,096 fr. The sales of energy totalled 135,589,189 kWh, against 134,357.660 kWh in the foregoing year.

The receipts for the financial year 1919-20 of the *Est-Lumière Co.* showed a loss on working of 4,860,156 fr., making with the deficit of last year a total of 9,578,026 fr. To secure the means of which the society stands in need, it is proposed to increase the capital and make an issue of bonds.

An amalgamation has been arranged between the *Société Westinghouse* and the *Compagnie Electro-Méchanique*, the shareholders of the former company giving eight of their shares for one of the latter.

The shareholders of the *Etablissements Paz et Silsa* passed the accounts on December 10th, showing a profit of 612.482 fr., and fixing a dividend of 11 fr. per share. The report is hopeful of the early abolition of trade restrictions imposed during the period of the war, and has worked to enlarge its branches, and to turn out from its works articles previously imported from England and America. The increase of its capital will enable it to purchase raw materials and enlarge its works.

Stock Exchange Notices.—The following have been ordered to be officially quoted:—

General Electric Co., Ltd.—78,641 ordinary shares of £1 each, fully paid (Nos. 2,033,335 to 2,111,975); and 22,891 7½ per cent. "B" cumulative preference shares of £1 each, fully paid (Nos. 1,600,001 to 1,622,891).

Hurst, Nelson & Co., Ltd.—200,000 ordinary shares of £1 each, fully paid (Nos. 1 to 200,000).

Lancashire Power Construction Co., Ltd.—400,000 6 per cent. (income tax free up to 6s. in the £) cumulative convertible first preference shares of £1 each, fully paid (Nos. 1 to 400,000).

London Electric Wire Co. & Smiths, Ltd.—400,000 7½ per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 400,000).

Mississippi River Power Co.—$648,300 first mortgage 5 per cent. 40-year gold bonds (Nos. C3,766 to 3,958 of $100, D13,002 to 13,067 of $500, and M16,321 to 16,916 of $1,000).

Petters, Ltd.—112,500 ordinary shares of £1 each, fully paid (Nos. 1 to 112,500) and 200,000 7½ per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 200,000).

A Swiss Investment Company.—The directors of the A.G. Columbus fur Elektrische Unternehmungen, of Glarus, reporting on the year 1919-20, state that the company's subsidiary—the Compania Italo-Argentino de Electricidad, of Buenos Aires—experienced a rapid increase in revenue in the past financial year, paid a dividend of 7 per cent., as against 6 per cent. in 1918-19, and raised its share capital to 1,000,000 dollars. The Swiss company, which participated in the augmentation by the conversion of a part of its loans to the Argentine company into new shares, proposes to pay a dividend of 7 per cent. out of net profits of 2,740,000 fr., being the same rate as in 1918-19, when the net profits amounted to 2,250,000 fr.

Shanghai Electric Construction Co., Ltd.—With a view to bringing the capitalisation of the company more nearly into accord with the value of its undertaking, the directors have decided to recommend an increase of capital from £320,000 to £400,000, and the capitalisation of £80,000 of undivided profit, by issuing as a bonus 8,000 fully-paid shares of £10 each (giving one new share for every four shares now held). The new shares will not rank for dividends payable out of the profits for the year 1920. The directors have declared a second interim dividend of 6 per cent. (12s. per share), less income tax (payable on February 1st), in respect of the year 1920.

Chatham & District Light Railways Co.—The report for 1920 shows that the revenue was £90,716, and the expenses were £69,174. After deducting from the balance, rent of Rochester Corporation lines, £3,744, interest £2,403, and £6,000 depreciation reserve, the balance is £9,395, plus £3,393 brought forward. Dividends of 5 per cent. on the preference and ordinary shares are paid, and £1,609 is carried forward. There was an increase of £11,876 in revenue and £16,559 in expenses, as compared with 1919. £842 was expended on deferred repairs. The investments have been written down to market value as at December 31st, 1920.

East London Railway Co.—The report for 1920 shows total gross receipts (estimated) £101,343; 56 per cent. of £101,343 would give the company £56,752 instead of the minimum rental of £30,000 per annum. Warrants have been posted for the six months' interest on £2½ per cent. (Whitechapel Extension), first (3½ per cent.), and second charge £4 per cent., Class "A" debenture stocks, also for 10s. per cent. for one year on the second charge £4 per cent. debenture stock Class "B."

Yorkshire (West Riding) Electric Tramways, Ltd.—The report for the year ended December 31st, 1920, shows, after providing for debenture interest, a net income of £28,676. Adding the amount brought forward, the available balance is £30,062. Dividend at 6 per cent. per annum, less tax, on 6 per cent. cumulative preference; to renewals, depreciation, and reserve fund, in lieu of accident insurance, £20,347.—*Financier.*

Companies Struck off the Register.—The undermentioned companies have been struck off the register and are dissolved:—

British Prometheus Co., Ltd.
Deaphone Co., Ltd.
Hemming Conduit Grip, Ltd.
Llanelly Motor & Electrical Engineering Co., Ltd.

British Mannesmann Tube Co., Ltd.—A large majority of the shareholders of the company having accepted the offer of Baldwins to effect an exchange of shares, the directors of both companies have decided to complete the provisional agreement establishing a fusion of interests.

Montreal Light, Heat and Power Companies.—The *Financial Times* states that the following dividends have been declared: 5 per cent. on Montreal Light, Heat & Power Consolidated shares, and 8 per cent. on Montreal Light, Heat and Power Co. common shares for the quarter ending January 31st.

Kaministiquia Power Co.—Dividend on the common stock for the quarter ending January 31st at the rate of 8 per cent. per annum.

Elliotts' Metal Co., Ltd.—Interim dividends, less tax, of 5 per cent. per annum on preference shares and 1s. per share on ordinary shares.

Metropolitan Railway Co.—The directors recommend, subject to final audit, a dividend on the ordinary stock for the past half-year at the rate of 2 per cent. per annum, making 1½ per cent. for the year, carrying forward about £15,500, after placing £50,000 to general renewals fund.

Gwynnes, Ltd.—Dividend for the eight months to September 30th, 1920, at the rate of 5 per cent. on the preference and 10 per cent. on the ordinary shares, £46,980 to carry forward.

Vera Cruz Electric Light, Power & Traction Co.—Dividend, 5 per cent., less tax.

STOCKS AND SHARES.

TUESDAY EVENING.

LAST week there was a good deal of buoyancy about the markets, more particularly those for gilt-edged stocks. This week, the wheel has turned in the other direction. In the House it is said that clients are beginning to get uneasy at the prospect of the Trades Unions and the Labour Party declining to fall in with the Government's scheme for dilution, whereby unemployment could be reduced, and work could be spread over a wider area. Possibly a simpler explanation is to be found in the fact that the remarkable jump in the price of the War Stock brought in a good many sellers. Moreover, the discounting of a fall in the Bank Rate was overdone, and at the beginning of the present week there was some little hint that, after all, money might not get cheaper for some time longer than the prophets had anticipated who put the end of this month as the latest date at which the 7 per cent. Bank Rate would be retained.

Nevertheless, investment stocks are holding their prices very well on the whole. The closing of the lists for the new W. T. Henley shares, before the advertised date for doing so, shows that there is plenty of money available for subscription to tempting offers even in the industrial world. We understand that the Melbourne Electric Supply Co. contemplates an issue of 8 per cent. preference shares of £5 each, and that the issue price will be arranged at about 95s. Quite a number of new issues which were made towards the end of last year, and which were left substantially in the hands of underwriters, are being absorbed, and prices naturally tend to improve.

Gas Light & Coke stock fell heavily, on the announcement that the price of gas was to be put up, but this has not affected any of the shares in the electric lighting list. It ought, of course, to have a strengthening effect, in that the electric undertakings are not bound by any sliding scale arrangements whereby dividends must be reduced if the price of the illuminant goes up, and vice versa. If the electric lighting companies increase their charges, this might have a favourable effect upon dividends. There are buyers about of City of London preference at 16s. 3d., and Newcastle-on-Tyne 5 per cent. preference are wanted at 12s. 6d., the company's 7 per cent. preference being also in demand at 18s. 3d. Bournemouth and Poole 4½ per cent. first preference can be sold at 5⅛, and the company's 6 per cent. second preference at a pound per share higher; the 4½ per cent. debenture stock can be placed at 56, and British Electric Traction 5 per cent. debenture stock is inquired for at 59. Debenture stocks of the various electricity companies are in short supply. It may be useful to holders if we set out a short list of those more particularly wanted, with the prices which can be obtained. The latter can probably be improved upon, especially in those cases where there is little stock in the market. The following list is confined to debentures and debenture stock only:—

Company.	Interest.	Price.
Anglo-Argentine Trams	4 p.c.	57
ditto	5 p.c.	56½
Auckland Tram	5 p.c.	87
Charing Cross, West End & City ...	4 p.c. & 4½ p.c.	67
Chelsea	4½ p.c.	75½
County of London	4½ p.c.	66
English Electric Sinking Fund 1st Mort.	5½ p.c.	82
London Electric Supply 1st Mort. ...	4 p.c.	70
Metropolitan Electric 1st Mort. ...	4½ p.c.	54
North Met. Elec. Power Supply ...	5 p.c.	55
South Met. Elec. Light 1st Mort. ...	4½ p.c.	69½
Toronto Power	4½ p.c.	63

The Metropolitan Railway's increased dividend of 2 per cent., making 1½ per cent. for the year, against 1¼ per cent. for the previous twelve months, had a strengthening effect upon the Underground list. Districts have risen to 16½. Metropolitans themselves are better at 22. London Electric ordinary rose to 2½. Underground Electric £10 shares at 2 are ⅛ higher, and the Income Bonds at 66½ show a gain of 3 points. Electric railway stocks, unlike those of the steam stocks, offer a fair amount of resistance to the general heaviness which, in the early part of the week, made itself felt in the Stock Exchange.

Metropolitan Electric shares are ⅛ better at 2⅞, and Westminsters at 5⅜ have added a similar fraction. Manufacturing shares are quiet, with Cromptons a weak market at 13s. 9d. The company's 6 per cent. preference shares are lower at 16s. 9d. British Electric Transformer preference hardened to 16s. 3d. Metropolitan Vickers preference at 1 13/16 have lost the greater part of the rise gained last week, and the ordinary shares are easier at 18s. 9d. Babcock & Wilcox eased off to 2¼, and Edisons are offered at 12s. 6d. possibly a little cheaper. Yorkshire (West Riding) Electric Tramways reports a net revenue for last year of £28,700, being a decrease of nearly £14,000 as compared with 1919. The preference dividend is to be paid, but nothing is carried forward.

In the telegraph market the debenture stocks are in demand. Eastern Telegraph 4 per cent. debenture stock at 63½ and Eastern Extension 4 per cent. debenture at a point lower are both better on the week. The ordinary stocks have also improved. Globes have risen to 15½, Westerns and Chinas to the same price, while Eastern ordinary remains at 154½. Anglo-American Telegraph preferred and deferred are both better, the latter adding ⅝ and the preferred gaining 3 points at 78½. Great Northerns at 21½ are a point up, but on the other hand, West India and Panama shares are flat at 11s. 3d. United River Plate Telephones at 6⅛ are 5s. to the good. Marconis have weakened to 2 1/16, the preference to £2 and Marines to 25s., while the Radio shares remain almost unchanged at 11s. 3d. and 8s. 3d. for preferred and common respectively.

Victoria Falls ordinary at 9s. are a little better. Mexico Trams at 40½ are 2½ higher, and the Sixes at 27½ gained a point. No change has occurred in the British Columbia Electric group. Rubber shares are dull and heavy, owing to the price of the raw stuff having gone back to nearly 1s. per lb., and in the armament market, movements are mostly downwards in consequence of the uncertainties provoked by the labour outlook.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Jan. 25, 1921.	Rise or fall.	Yield p.c.
Brompton Ordinary	8	12	6⅞	—	£10 4 4
Charing Cross Ordinary	4	7	8¼	—	10 0 0
do. do. do. 4½ Pref.	4½	4½	2¾	—	8 3 8
Chelsea	8	4	8⅛	—	6 8 0
City of London	8	10	1 5/16	—	8 12 9
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 2
County of London	7	8	7⅛		10 13 4
do. do. 6 per cent. Pref.	6	6	7⅞	—	7 15 0
Kensington Ordinary	6	7	8⅞	—	9 0 6
London Electric	Nil	2½	¾	—	10 0 0
do. do. 6 per cent. Pref.	6	6	2¾	—	10 18 2
Metropolitan	6	6	2⅞	+ ⅛	10 8 8
do. 4½ per cent. Pref.	4½	4½	2 9/16	—	8 15 8
St. James' and Pall Mall	10	12	6¼	—	9 12 0
South London	5	6	2½	—	8 12 0
South Metropolitan Pref.	7	7	13/9	—	10 8 8
Westminster Ordinary	8	10	6⅛	+ ⅛	9 17 6

TELEGRAPHS AND TELEPHONES.

	Dividend 1918.	Dividend 1919.	Price Jan. 25, 1921.	Rise or fall.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	78½	+3	12 10 0
do. Def.	83/6	1½	16⅝	+ ⅝	9 12 6
Chile Telephone	8	6	5⅝xd	—	*5 4 4
Cuba Sub. Ord.	7	7	6⅛	− ¼	*10 15 4
Eastern Extension	8	10	15½	+ ⅜	*6 9 0
Eastern Tel. Ord.	8	10	154½xd	—	*6 9 5
Globe Tel. and T. Ord.	8	10	15½	+ ⅜	*6 9 0
do. do. Pref.	6	6	8¾	+ ¼	6 17 2
Great Northern Tel.	22	22	21½	+1	10 4 8
Indo-European	13	10	80	—	8 6 8
Marconi	25	25	2 1/16	— 1/16	—
Oriental Telephone Ord.	10	12	2 5/16	—	*6 4 0
United R. Plate Tel.	8	8	6⅛	+ ¼	*6 10 8
West India and Panama	1/3	Nil	9/16	— ⅛	Nil
Western Telegraph	8	10	15½	+ ⅜	*6 9 0

HOME RAILS.

	Dividend 1918.	Dividend 1919.	Price Jan. 25, 1921.	Rise or fall.	Yield p.c.
Central London Ord. Assented	4	4	43½	—	8 4 0
Metropolitan	1	1¼	42	+1½	6 16 4
do. District	Nil	Nil	16½	+1	Nil
Underground Electric Ordinary	Nil	Nil	2	+ ⅛	Nil
do. do. "A"	Nil	Nil	6/6	+6d.	Nil
do. do. Income	5	4	66½	+3	—

FOREIGN TRAMS, &c.

	Dividend 1918.	Dividend 1919.	Price Jan. 25, 1921.	Rise or fall.	Yield p.c.
Anglo-Arg. Trams, First Pref.	Nil	5½	2¾ xd	—	10 0 0
do. do. 2nd Pref.	Nil	Nil	8¼	—	Nil
do. do. 5 % Deb.	6	5	67½	+1	8 18 10
Brazil Tractions	Nil	Nil	3⅜	—	Nil
British Columbia Elec. Rly. Pfce.	5	5	55xd	—	9 1 10
do. do. Preferred	2½	5	64½	—	*8 9 9
do. do. Deferred	Nil	3	54½	—	*11 8 4
do. do. Deb.	4½	4½	64½	—	7 16 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	40½	+2½	Nil
do. 6 per cent. Bonds	Nil	Nil	27½	+1	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	21½	−1	Nil
do. 1st Bonds	Nil	Nil	62½	−1	Nil

MANUFACTURING COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Jan. 25, 1921.	Rise or fall.	Yield p.c.
Babcock & Wilcox	15	15	2¼	— 1/16	*6 13 4
British Aluminium Ord.	10	10	⅞	—	11 8 6
British Insulated Ord.	12½	15	1⅝	—	9 6 10
Callenders	25	15	1⅜	—	*10 18 2
" 6½ Pref.	6½	6½	17/6	—	7 8 7
Castner-Kellner	20	17	2⅞	—	7 12 9
Crompton Ord.	10	10	13/9	− 2/-	14 11 0
Edison-Swan	10	10	12/6	—	—
do. do. 5 per cent. Deb.	5	5	70	—	7 2 10
Electric Construction	10	10	⅞	—	11 8 8
Gen. Elec. Pref.	6½	6½	18/-	—	7 4 5
do. Ord.	10	10	1⅞	—	*8 4 8
Henley	25	15	1½	—	10 0 0
do. 4½ Pref.	4½	4½	3¼	+ ⅛	6 18 6
India-Rubber	10	10	⅝	—	—
Met.-Vickers Pref.	—	8	1 13/16	+ 3/16	8 16 4
Siemens Ord.	10	10	1 1/16	—	*9 8 2
Telegraph Con.	20	20	21½	—	*5 11 6

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, January 28th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/4	1d. dec.
a Ammoniac Sal	per ton	£110	...
a Ammonia, Muriate (large crystal)	"	£92	...
a Bisulphide of Carbon	"	...	...
a Borax	"	£38	...
a Copper Sulphate	"	£38	£2 dec.
a Potash, Chlorate	per lb.	8d.	...
a " Perchlorate	"	1/0	2d. dec.
a Shellac	per cwt.	£20	...
a Sulphate of Magnesia	per ton	£18	...
a Sulphur, Sublimed Flowers	"	£23	...
a " Lump	"	£18	...
a Soda, Chlorate	per lb.	6d.	...
a " Crystals	per ton	£7	£1 dec.
a Sodium Bichromate, casks	per lb.	1/-	...
METALS, &c.			
p Babbitt's Metal Ingots	per ton	£95 to £300	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/1½	½d. inc.
c " Tubes (solid drawn)	"	1/2¾ to 1/3	½d. dec.
c " Wire, basis	"	1/0⅞	½d. dec.
c Copper Tubes (solid drawn)	"	1/5	½d. dec.
c " Bars (best selected)	per ton	£124	£6 dec.
c " Sheet	"	£121	£6 dec.
c " Rod	"	£124	£6 dec.
d " (Electrolytic) Bars	"	£80	70/- dec.
d " " Sheets	"	£143	...
d " " Wire Rods	"	£96	70/- dec.
d " " H.C. Wire	per lb.	1 1/16	1/16d. dec.
f Ebonite Rod	"	8/6	...
f " Sheet	"	8/-	...
n German Silver Wire	"	2/9	...
h Gutta-percha, fine	"	14/- to 16/-	...
h India-rubber, Para fine	"	1/0½	...
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l " Wire, galv. No. 8, P.O. qual.	"	£50	£4 dec.
g Lead, English Pig	"	£25	£1 dec.
g Mercury	per bot.	£12 10 to £12 15	...
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e " " " medium	"	6/- to 10/-	...
e " " " large	"	12/6 to 25/- & up	...
p Phosphor Bronze, plain castings	"	1/6 to 1/11	...
p " " rolled bars and rods	"	2/5 to 2/8	...
p " " rolled strip & sheet	"	2/5 to 2/9	...
d Silicium Bronze Wire	per lb.	1/8	...
r Steel, Magnet, in bars	"	1/8	2d. dec.
n Tin, Block (English)	per ton	£164 to £165	£37 to £38 dec.
n " Wire, Nos. 1 to 16	per lb.	4/6	3d. inc.
p White Anti-friction Metals	per ton	£78 to £300	...

Quotations supplied by—

a G. Boor & Co.	*g* James & Shakespeare.
c Thos. Bolton & Sons, Ltd.	*h* Edward Till & Co.
d Frederick Smith & Co.	*i* Bolling & Lowe.
e F. Wiggins & Sons.	*l* Richard Johnson & Nephew, Ltd
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.	*n* P. Ormiston & Sons.
	p ————

r W. F. Dennis & Co.

A Novel Electrical Precipitator.—*Chemical and Metallurgical Engineering* recently described, under the above heading, an installation to deal with the smoke of a battery of 32 McDougall roasters at a smelting works. With a remarkably low power input, this plant gives recovery of values exceeding 90 per cent. The smoke is discharged into a "dust chamber," which is connected by a short length of flue to the main smelter chimney. In the flue are corrugated iron sheets, suspended from the roof and set parallel to the flue walls to act as collecting electrodes. Discharge electrodes between the plates are formed of gridirons, of small iron pipe placed horizontally and hung from supporting beams at the ends and middle point. Dusty gas thus passes through an electrified atmosphere from the dust chamber to the stack. In this precipitator there is a very definite selective action on the mixed smoke. The first hoppers collect material high in copper, while toward the far end the dust is sufficiently high in lead content for its yieldings to be sent to the lead blast-furnace plant. The electrical capacity of the apparatus is 50 kVA, and it is able to deal with eight or nine tons of dust daily.

Engineers' Clubs.—We are informed by the hon. secretary of the Provisional Committee of the Engineers' Club (Birmingham), Mr. J. Fearn, A.M.I.M.E. (c/o B.S.A. Co., Ltd.), that Sir Alfred Herbert, K.B.E., Mr. Lincoln Chandler (of the Metropolitan Carriage Works), and Mr. Donald Hope (chairman of Messrs. Henry Hope & Sons, Ltd.) have accepted vice-presidencies of the club. Applications for membership are coming in rapidly, and those who wish to have the use of the club directly it is opened should apply soon, or they will find themselves on the waiting list. We have received from Mr. Fearn a list of members, in which we notice many well-known names. The president is Sir Hallewell Rogers, J.P., M.P.

The proposed Engineers' Club for London was mentioned at the informal meeting of the I.E.E., on Monday last, by Mr. G. Layton, who urged that the Council should afford encouragement and support to the scheme. About 50 gentlemen have already agreed to act on the Provisional Committee, including many of the most eminent members of the various branches of engineering.

THE PHYSICAL SOCIETY'S EXHIBITION.

(Concluded from page 73).

Mr. H. W. Sullivan exhibited a selection of interesting apparatus and instruments, including Cox's selenium amplifier for use in connection with submarine telegraphy, which was shown in operation; its novelty should make the apparatus of general interest, although two modified sets have been in operation at one of the Pacific Cable Board's stations for some years. The instrument is used to increase the working speeds of submarine cables by amplifying the very attenuated signals received at high speed sufficiently to operate ordinary recording or relaying apparatus. It is illustrated in fig. 6. A beam of light from the source L is projected on the mirror of the receiving galvanometer G, and thence to a pair of selenium cells Se₁, Se₂, which are arranged as a pair of bridge arms. With the galvanometer at zero, the surface of each cell is half light and half dark and the bridge system is balanced. Deflections of the galvanometer by received signals cause corresponding variations in the position of the light area on the cells and large corresponding changes in the relative resistance of the cells, thus actuating the instrument A, which may be a recorder of any desired type. In practice a large number of very narrow cells or sections of a cell is used, these being arranged in pairs with one "bar" of light to each pair, so as to make full use of the very small galvanometer deflections obtained when working at high speed on long cables; the various pairs are connected as a series of bridges in parallel, two such pairs being illustrated in fig. 7. Fig. 8 shows a working cell of 24 pairs of sections, the total selenium surface being 4 by 4 in. The terminal bar T is common to all sections, and the bars T_1 and T_2 are connected respectively to the right and left-hand sections of each pair. In the latest pattern all three terminal bars are cut in half so that a group of selenium sections may be placed in all four bridge arms, a small adjusting slide resistance at one apex of the bridge is then the only idle resistance in the circuit. The success of the system is due to the improved "plate" or built-up type of cell used. It has proved, during more than six years' continuous working, to be reliable, and it does not appear to deteriorate if correctly made. Its working resistance in the amplifier is about 1,000 ohms for each of the four groups of sections, or 4,000 ohms per sq. in. of surface. The inertia is comparatively small, and its effect is eliminated from the instrument A by shunting A with an inductance. Cells of this type can be made in smaller sizes for other purposes and sub-divided or not as required; they will respond satisfactorily to telephonic frequencies. Amplification is generally adjusted by varying the voltage of the battery B; with B=100 volts, L=100 c.p., and the cell placed about 15 in. from the galvanometer mirror, the energy applied to the galvanometer may be amplified ten thousand times in the instrument A. An amplification of forty thousand may be obtained by making L=500 c.p., B=150 volts, and in some cases sub-dividing the cell further. In ordinary practice in submarine telegraphy an amplification of 1,000 to 5,000 is usually sufficient to work a good Morse relay. The high amplification has enabled a simple and accurate method of correcting for earth currents and other causes of zero variation to be applied. An auxiliary relay in the selenium-bridge circuit controls a motor-driven rheostat which adjusts the balance of this bridge circuit so as to compensate for any zero variation in the system whether due to earth currents or other causes.

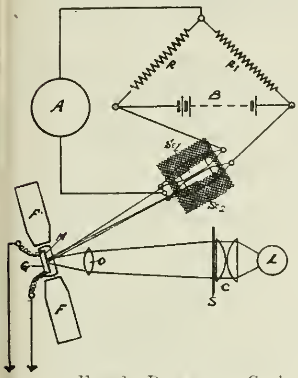

Fig. 6.—Diagram of Cox's Selenium Amplifier.

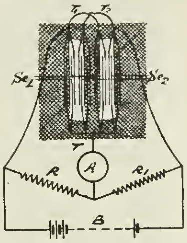

Fig. 7.—Diagram of Selenium Cell.

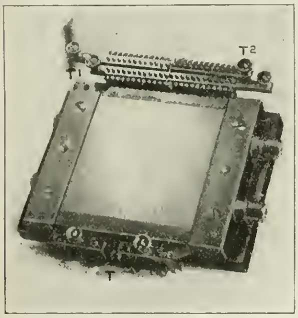

Fig. 8.—Selenium Cell.

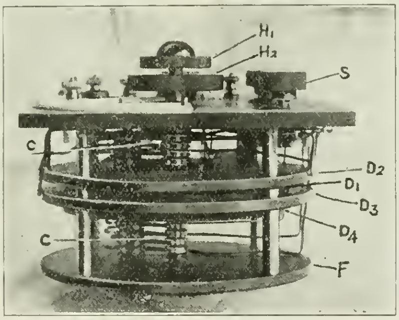

Fig. 9.—Variable Multi-coil Variometer.

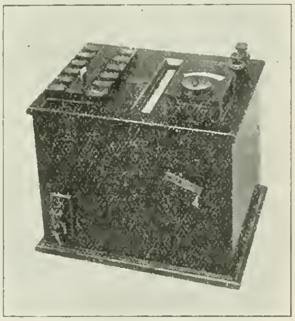

Fig. 10.—Yardometer.

The novel single-valve amplifying receiver for extra wide wave-length range (600 to 20,000 metres) was shown for the first time at the exhibition. The set is self-contained, the aerial and earth leads being brought direct to it; the only apparatus required external to the set are the 4-volt accumulators, 50-volt anode dry battery, and a pair of high resistance telephones. Single-circuit tuning is employed, the inductance being a continuously variable multi-coil variometer, fig. 9, in which an exceedingly high range of mutual inductance variation is obtained. The coils of the variometer are very flat and are embedded in insulating disks, one of which D_1, may be rotated between the other two D_2 and D_3. This arrangement gives an evenness of scale throughout the whole 180 deg. of movement. An inductance range of from 3,500 to 50,000 microhenries is obtained on the long wave-length scale, whilst a two-position multi-functioning switch S alters the internal variometer connections to obtain a short wave-length inductance range of from 200 to 3,500 microhenries. An inductance ratio of 250 to 1 is thus obtained throughout the range of the

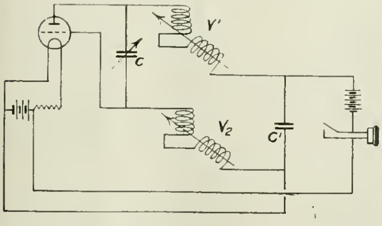

Fig. 11.—Heterodyne Wavemeter Diagram.

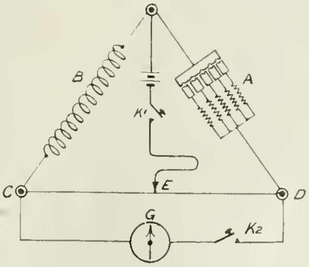

Fig. 12.—Yardometer Connections.

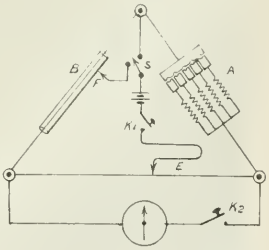

Fig. 13.—Yardometer Fault Locator.

instrument. The variometer is used in conjunction with an adjustable bank of fixed condensers which may be placed either in series or in parallel with the variometer by means of a series-parallel switch giving the wave-length range stated above. The variometer is also fitted with a set of reaction windings which are embedded in the disk D_4, and rotated relatively to the main inductance on a spindle concentric with the spindle of the latter, the two operating handles H_1 and H_2 being conveniently placed one above the other. The mutual inductance between the variometer coils and the reaction coils (the latter being also changed by the long-short wave switch S) may be adjusted to such values as will produce self-oscillation of any frequency corresponding to wave-lengths between 600 and 20,000 metres. The whole of the moving system is supported in upper and lower bearings carried by a framework F of rigid construction, which also supports the fixed system. Connection is made to all moving units through contact rings and fingers C.

A continuous-wave wavemeter with a range of from 600 to 6,000 metres, which can be used also as a plain oscillation generator for use in the separate heterodyne method of c.w. reception, was also exhibited for the first time. The circuit used is shown in fig. 10, the oscillatory circuit consisting of the variable air condenser C and the two variometers V_1, V_2, the circuit being closed to high-frequency oscillations by the fixed capacity C_1 of a sufficiently large value not to appreciably affect its natural frequency.

A new instrument called the "Yardometer," embodying a number of novel features, has just been designed by Messrs. Callender's Cable & Construction Co., Ltd., and Mr. W. E. Benson, for directly indicating the length of cable on a drum or coil without unwinding and passing it through a lineal measuring machine; the instrument has been specially designed to enable a person without any skill or technical knowledge to measure unknown lengths of cable by a simple mechanical operation. The instrument can also be used as a fault locator, and the approximate position of a fault in a drum of cable, or in a coil, can be located by a simple calculation. The instrument (fig. 11) comprises a handle for rotating a cylinder, on which the scale is marked in yards, a number of balancing resistances corresponding to 110 yards at 60 deg. F. of all the C.M.A. sizes from 1/.036 to 19/.064, and an indicating galvanometer and a key. In order to test a length of cable, say, 7/.044, the balancing coil marked with this gauge is plugged in, the handle rotated, and the key momentarily depressed until the galvanometer pointer is stationary, when the correct length in yards is read off on the scale through the window in the front. The whole operation can be carried out in a few seconds, as the galvanometer, being a central-zero instrument, enables the operator to determine in which direction the handle should be turned. The principle on which the instrument is designed is that of the well-known Wheatstone bridge, and is explained in fig. 12, where A is any one of a number of resistances corresponding to various standard sizes of cable which can be plugged in to balance the cable under test; B is the cable under test, C, D a slide wire of 1,000 actual inches in length wound on a drum with a contact maker E working on a threaded rod operated through gearing from the handle by which the drum is rotated; G is a sensitive indicating galvanometer, and K_1, K_2 are battery and galvanometer keys operated by the same knob. The correct length of cable is indicated on the dial when the ratio of $B/A=$ the ratio CE/DE, this condition being shown by the needle of the galvanometer remaining stationary when the key is depressed. Fig. 13 shows the operation of the instrument when used as a fault locator. Suppose a fault exists at F. The length of cable is first measured on the machine as previously explained, then by means of a 2-way switch S, the contact with the switch is changed from L to F; the handle is then rotated until the needle is at rest, when the actual distance from D in yards $=x(L+110)/(x+110)$, where $x=$ observed distance and $L=$ length of the cable in yards. For example, suppose the faulty cable is 220 yards long and that with the switch on F the balance is obtained at 80 yards, then the actual distance of the fault $=80(220+110)/(80+110)=139$ yards. The instrument will be found particularly useful for locating faults in cables lying in water in the test tanks, and which have no metallic sheath. The incorporation of the simple 2-way switch in the instrument, where the terminal is connected to the water tank, is original, and effects a great saving of labour.

Messrs. Elliott Bros. (London), Ltd., exhibited a large selection of apparatus and instruments, including small d.c. motors for driving Wheatstone and Baudot telegraph apparatus; portable multiple-range current transformers for use with dynamometer ammeters and wattmeters, which had practically straight-line ratios and negligible phase angle. They were fitted with self-contained non-detachable short-circuiting switches for the secondary windings whereby the instrument under test can be detached and the transformer still left in circuit without danger of overheating or damage to its insulation; transformers of this type are made for all working pressures up to 20,000 V. A special feature of the direct-reading potentiometer was the high insulation obtained by the enclosure of all current-carrying parts. The electrical revolution indicator consisted of a shielded magneto generator and liquid damped indicating instrument, and was specially designed for use on aircraft; the magneto is arranged for working one or more instruments. The portable speed recorder comprised a recording voltmeter and magneto generator, specially adapted for recording either more or less uniform speeds, or for obtaining acceleration curves where the speed varies at a very rapid rate. Other instruments shown included G.P.O. detectors, galvanometers, and the latest patterns of E.B.L. and "Century" testing sets, &c.

The Dubilier Condenser Co., Ltd., exhibited a number of condensers, including suitable types for use in connection with wireless telegraphy, power factor correction, and the protection of h.p. lines from the effect of lightning and surges.

The Lea Recorder Co., Ltd., had on view the instrument portion only of its well-known indicating, recording, and integrating machine for measuring the flow of water over V notches, or rectangular weirs, and various sketches illustrating the application of the device.

The Igranic Electrical Co., Ltd.—This exhibit consisted of an example of the now well-known "Leesona" coil-winding machine which it is claimed will produce coils of "virtually indestructible solidity and invulnerable insulation," and capable of withstanding severe working conditions. The machines are made by the Universal Winding Co., the Igranic Co. being the sole supplier in the United Kingdom and British Colonies and Dominions.

Messrs. Gambrell Bros., Ltd., showed an "emotometer" in use, together with a number of photographic records. This exceedingly interesting instrument was devised by Prof. Waller for the purpose of measuring a person's nervous response. In addition the firm showed a wide range of resistance boxes and bridges, potentiometers, galvanometers, measuring instruments, and accessories; also portable and wall type temperature indicators incorporating platinum couples fitted with Onwood's cold junction compensators. The cheapness of the firm's products, which is rendered possible by quantity production, makes them especially suitable for educational purposes; and it should be borne in mind that reduction in cost is not achieved at the expense of good accuracy.

THE IMPORT TRADE OF INDIA.

The following statistics of the imports of electrical and similar goods into British India in the year ended March 31st, 1919, are taken from the recently-issued official trade returns, details for the year ended March 31st, 1918, being added for purposes of comparison, with notes of any increases and decreases.

		1917-18 £	1918-19 £	Inc. or dec. £
Copper wire, excluding telegraph and telephone wire:—				
Total ...	cwt.	8,267	11,238	+ 2,971
	£	77,000	88,000	+11,000
From United Kingdom	cwt.	444	502	+ 58
	£	4,000	4,000	—
,, Japan	cwt.	7,700	8,200	+ 500
	£	72,000	68,000	− 4,000
Iron wire—				
Total ...	tons	7,600	7,400	− 200
	£	343,000	341,000	− 2,000
From United Kingdom	tons	660	270	− 390
	£	28,600	12,000	−16,600
,, Japan	tons	1,100	1,400	+ 300
	£	69,000	77,000	+ 8,000
,, United States .	tons	5,500	5,300	− 200
	£	221,000	228,700	+ 7,700
Electrical generators.—				
Total	£	5,000	15,000	+10,000
From United Kingdom ..		4,000	600	− 3,400
,, United States		500	14,000	+13,500
Electric motors—				
Total		47,000	77,000	+30,000
From United Kingdom ..		28,000	25,000	− 3,000
,, United States		18,000	50,000	+32,000
Other electric machinery—				
Total		141,000	168,000	+27,000
From United Kingdom		92,000	108,000	+16,000
,, United States		36,000	43,000	+ 7,000
,, Italy		8,000	12,000	+ 4,000
Mining machinery—				
Total	£	36,000	73,000	+37,000
From United Kingdom ...		17,000	9,000	− 8,000
,, United States		14,000	61,000	+47,000
Electric fans and parts thereof—				
Total		141,000	179,000	+38,000
From United Kingdom ...		13,000	15,000	+ 2,000
,, Italy		49,000	68,000	+19,000
,, United States		74,000	89,000	+15,000
Electric lamps and parts thereof—				
Total		127,000	173,000	+46,000
From United Kingdom ...		46,000	52,000	+ 6,000
,, Holland		40,000	71,000	+31,000
,, Japan		29,000	31,000	+ 2,000
,, United States		10,000	11,000	+ 1,000

	1917-18 £	1918-19 £	Inc. or dec. £
Electrical wires and cables—			
Total	217,000	242,000	+25,000
From United Kingdom ...	42,000	33,000	− 9,000
,, Japan	167,000	183,000	+16,000
,, United States	4,000	20,000	+16,000
Other electrical instruments, &c.—			
Total	301,000	361,000	+60,000
From United Kingdom ...	153,000	158,000	+ 5,000
,, Japan	81,000	62,000	−19,000
,, United States	43,000	105,000	+62,000
,, Holland	14,000	17,000	+ 3,000
Telegraphs, materials for construction and accessories—			
Total	6,000	4,000	− 2,000
From United Kingdom ...	6,000	3,000	− 3,000
Telephones, materials for construction and accessories—			
Total	13,000	17,000	+ 4,000
From United Kingdom ...	6,000	3,000	− 3,000
,, Sweden	5,000	6,000	+ 1,000
,, United States	1,000	6,000	+ 5,000

In addition to the foregoing, the following were imported as Government stores:—

Machinery and millwork—			
Total	177,000	255,000	+78,000
From United Kingdom ...	172,000	244,000	+72,000
Telegraph material—			
Total	150,000	142,000	− 8,000
From United Kingdom ...	149,000	141,000	− 8,000
Instruments and apparatus—			
Total	324,000	306,000	−18,000
From United Kingdom ...	321,000	305,000	−16,000

EXTRA-HIGH-TENSION DISTRIBUTION BY UNDERGROUND CABLE.

Discussion at Manchester.

At Manchester, on January 11th, Mr. R. O. Kapp's paper on the above subject, which was abstracted in our issue of December 17th, was discussed before the North-Western Centre of the Institution of Electrical Engineers.

Mr. **Watson**, referring to Mr. Kapp's suggestion that in the past the cost of distributing systems had been comparatively small, differed, because in the majority of undertakings, at any rate, the cost of l.t. distributing networks already in use was as a rule very nearly half the total capital employed. If in the past h.p. transmission had been used to a larger extent, speaking generally, the cost on the distributing and transmission side would have been appreciably lower than it stood in the books of most undertakings to-day. Mr. Kapp mixed up the two important matters of transmission and distribution; there was really a very clear line of demarcation between the two, as the terms were used, but his transmission meant a straight through transmission from point to point with a distribution centre at the end of it or situated at a certain point on its length; therefore, what Mr. Kapp in several instances called distribution was really a main transmission line. The speaker disagreed with Mr. Kapp's figure of £4 per kVA of peak load, which was much too small, especially in view of the fact that he included in that cost the switchgear and the transformers which might be used for distribution purposes at the different points. At any rate, at the present prices of cables and of labour for laying, the cost must come out at a somewhat higher figure than that. The author spoke of distributing 40,000 kW over only 5 square miles. That represented an exceedingly brisk demand in a very small area, which only extended apparently a maximum distance from the generating station of about a mile and a quarter. He could not agree with the statement that "On the other hand, overhead line work is not as cheap as cables when small quantities of power have to be distributed to isolated points of a complicated network," nor with the remark that "In the author's opinion it is very doubtful indeed if engineers will decide in future schemes that the advantages of cable protective gear are great enough to justify its cost." Much could be said for the herring-bone type of lay-out, particularly in the early development of an undertaking; in fact, the speaker did not think they could develop with any system other than a herring-bone type. The cost of point-to-point transmission with no tappings on the way or on the sides would be prohibitive. As time went on the herring-bone system would become a big system, and be connected up to the larger and more important main transmission lines, which by that time would have been constructed as developments occurred. The ring-main system was an ideal system to adopt when it was possible to do so on commercial grounds; but it was not every district which was so constructed geographically as to make a ring main system the ideal one, or even the less costly. In such a case it would be better to construct a duplicate main system, because, although as far as the cables themselves were concerned, they were duplicated, there was only one cost for excavation and one cost for reinstatement which, under the present-day scale of costs amounted to a considerable percentage of the total cost involved. On a ring main it was very desirable that the cross-section of the copper should be the same between the various inter-connected points, because under certain conditions they might be called upon to transmit practically the full power of one of the main feeders going out to that ring main from the generating station; and it was, therefore, essential that the cross-section of the copper should be of the same size as the individual cables coming up from the station.

Mr. **Williams**, in the absence of Mr. Romero, read his notes for him, in which the chief criticism was that the author only considered capital costs and disregarded losses altogether. He defended that attitude by stating that for the purpose of the rough generalisations dealt with, feeder losses were too small to need considering, which was a most misleading statement. The I^2R losses in a 0.2 sq. in., 3-core armoured cable laid direct and loaded at 250 amperes per core, which was well below the temperature limit of the cable, amounted to about 47 units per hour per mile at working temperature. With a load curve giving losses equal to 25 per cent. of the losses at 100 per cent. load factor, the annual value of these losses at 0.9d. per unit would be £386. The capital charges per mile per annum on a 6,600-volt cable of that size laid and jointed were about £270, or actually much less than the value of the losses. Those were fair average figures, but they could be modified widely without making the value of the losses in the least negligible as compared with the capital charges on the cable. Reduction of losses should never be lost sight of when stand-by feeders were under consideration. In a properly designed system stand-by feeders would generally go a considerable way towards paying their own capital charges by reducing I^2R losses, and in many cases (at pressures up to 6,600 volts at any rate) they would effect a net over-all economy as well as provide a stand-by. The points he emphasised were that at 6,600 volts the most economical loading was often well below the temperature limit; it was unwise and unsafe to run very near the temperature limit, and that the extra cost of running well below it was not very great. In comparing 33,000 and 6,600-volt transmission by capital cost alone, the author was doing an injustice to the 33,000-volt transmission, as for the same current density the losses at 33,000 volts were only one-fifth of the losses at 6,600 volts, whereas the capital cost was one-third. The author's temperature rise curves were ingenious, but the speaker thought most engineers would prefer to have sufficient copper to make it unnecessary for them to watch their cables so very closely. The capital cost of distribution, £4 per kVA of peak load, appeared to be extremely high for such a concentrated area as 5 square miles.

Mr. **Radcliffe** thought the paper contained much that was distinctly dubious, in so far as it related to purely hypothetical cases. The speaker was startled at the point made with regard to the centre of gravity of the load. It was rather a quibble. Perhaps in some of the hypothetical towns which had length without breadth it might apply; in an ordinary town, with a reasonably symmetrical lay-out, one need not worry about the academic distinction between the centre of gravity of the load and the centre which gave the minimum heating. The new equivalent to the centre of gravity which was based upon heating, apparently ignored losses entirely. He congratulated Mr. Kapp on his ingenious arrangement of transformer taps, which was a valuable scheme, giving an enormous range of voltage with a comparatively small number of taps. Generally he was in agreement with him on the question of changing voltages. The exceedingly short distance at which it paid to change over from one voltage to another was surprising. Another aspect of that matter would become important in the future. In large cities the load was becoming much more dense, and the cost of cables increased not so much owing to the increase in the cost of the cables themselves as to the increase in the cost of laying them. It might be desirable to consider increasing the pressure on existing feeders. Feeders that had been laid for 6,600 volts would undoubtedly be quite safe for a very much higher pressure. Probably another transformer step would not involve a cost in excess of that involved by the laying of additional l.t. feeders. It was pleasant to hear a good word for the cable sometimes, and Mr. Kapp's remarks on protective gear were distinctly refreshing. Some of the papers they had had recently on that subject were disconcerting. A herring-bone system with a number of taps on the cable was very bad, but a system which was practically the same thing, in which the cable was looped in and out of sub-stations, was quite legitimate, and comparatively easy to control. Ring mains had served a very useful purpose in scattered districts, but they were rather overrated for cities or dense areas. The distribution of the future would be, as the author suggested, some combination of the star and link system for the primary transmission, then a secondary star-and-link system, and, lastly, probably some sort of simple radiating system. It was not to be expected that every consumer on a h.t. system could have a duplicate supply any more than he could on an ordinary l.t. system, but all the important mains of the primary transmission would certainly have to admit of alternative routes in case of breakdown. Main feeders must not be tapped, but most engineers would question the desirability of reducing the cross section on ring mains. One result of the author's remarkable curve, No. 8, was that it led to the selection of

0.075 sq. in. as the maximum size of a 6,600-volt cable; in Manchester they had miles of 0.25 and 0.3 cable on 6,600 volts, and they also had cables of similar size in operation on 33,000 volts. Who was right? The heating theoretically seemed to be quite permissible, but nothing was stated about the data on which they were based as regarded permissible heat, current density, and so on, or whether they were equally applicable to 6,600 and 33,000 volts. The maximum temperature was not necessarily the same in the case of both cables, neither was it necessary to depend upon the same factors; that was to say, the limits were not governed by the same considerations. He could hardly agree that it was a suitable occupation for the switchman to dabble with those curves and tracings; he had far more important duties to perform. But something of that sort might ultimately become one of the duties of an operator upon a large system who, for want of a better term, he called "load controller."

Mr. J. B. Palmer agreed that "voltage drop on the e.h.t. system is always so small that it need not govern the lay-out as it does in the case of l.t. systems. In the case of e.h.t. cables, heating and not voltage drop is always the determining factor," but in the case of a power station supplying, not a town, but a group of towns, from a distance for which the voltage was just about the limit, that paragraph might be misleading, because undoubtedly the voltage drop might be very embarrassing indeed. He actually knew of one case where it was so. There were most remarkable differences of opinion upon what constituted average circumstances. It seemed that the expense one would be put to for stand-by plant would be enormously increased were it not for the fact that protective gear was necessary to cut out a faulty section and a faulty section only.

Mr. Kapp, in his reply to the discussion, said that his figure of £4 per kVA was probably too low; he took two limits, thinking that the truth would be somewhere between those limits. In most cases where one had to distribute electricity at, say, 6,600 volts to fairly small industrial consumers, the fixed charges on overhead lines were so high that there would be a limit to the size of the individual load. There were quite a lot of cases where there was a reason for protective or detective gear, but in the majority of cases he would rather expend the money upon better and extra insulation upon the cables. With regard to the 0.075 cable being too small, he did not know what current density was being worked to in Manchester, but they had to work to much larger densities in manufacturing than they did some years ago. According to the figures he got from manufacturers a 0.075 cable could safely take a load now for which ten, or even five years ago, they would have used a much heavier cross-section. If the Manchester cables were put down at the present date, the mains engineer would probably have a smaller section. With regard to the point that if they wanted to transmit 40,000 kW a 0.075 sq. in. cable would involve a very large number of cables, the 0.075 cable he had in mind was for a case of distribution, in which they would only have two or three, or perhaps four, parallel feeders, and in each case they would want a stand-by feeder. If they connected up to a very large works and had five, six, or more parallel feeders, one stand-by was a small proportion of the whole lot, then it was best to make each of them of a larger cross-section. The suggestion that the economic section of cable was often below the safe current density had been made in other places where the paper had been read, and it had been said that Kelvin's law gave a current density for a 6,000-volt cable which was lower than the safe current density, but he could not agree at all; there must be some misapprehension about how one should apply Kelvin's law to those cases of distribution. When Kelvin devised that law he had in mind the laying of one cable, and the problem was to determine the best cross-section of copper for that one cable. At the present day their cross-section of copper was fixed; generally it was a case of laying extension feeders. They were going to make them of the same cross-section as the existing feeders; therefore, the whole of the cost of the cable, plus the cost of laying and making good the ground, and everything else involved, varied as the cross-section; and the capital charges on all those must be equated to the losses to give the economical current density. In those cases it would be found that for the 6,600-volt cable the density given by Kelvin's law was always very much in excess of the safe current density for heating. The position of the economical site of the power house was given by Carrothers's method, even if they took account of the losses; in fact they could add the cost of the losses to the capital charges, and the economical position would still be given by Carrothers's method.

Discussion at Birmingham.

The paper was also discussed before the South Midland Centre at Birmingham on January 12th.

Major A. M. Taylor questioned the author's diagram which showed that at a distance of five miles from the generating station the cost of a 6,600-volt system would be the same as that of a 33,000-volt system, and gave particulars of a case which had been worked out in Birmingham. A sub-station with a present demand of 6,000 kVA was fed by three 0.15 sq. in. trunk feeders working at 1,500 amperes per sq. in. It was desired to double the voltsge on those trunks on account of voltage drop; the question to be considered was whether it was best to put in three additional cables or to introduce step-up and step-down transformers and transmit the whole 12,000 kW over the three existing mains. The result of the investigation was that on a two-mile transmission there would be an annual loss of £0.16 per kVA, on a three-mile transmission a gain of £0.16 per kVA, and on a five-mile transmission a gain of £0.80 per kVA. Some mains were as long as the latter, and in such a case the gain per annum would be about £30,000 on the total quantity of power which it was contemplated to transmit.

Mr. W. Brew said that some of the author's diagrams appeared to assume that the total cost of cable per unit of length was proportional to the sectional area of the copper. That assumption would only be approximately correct in the case of the largest cables, and took no account of the cost of trenching and reinstatement. When it was remembered that for medium and small e.h.t. cables laid singly the cost of trenching and reinstatement approached a figure nearly double that of the cable itself, it would be evident that the form of the diagrams referred to would require to be modified.

Mr. W. E. Groves observed that it was not possible to foresee the conditions that would arise during the development of a large supply scheme and, unfortunately, networks had to be planned a long time before the anticipated demand was realised. In the interval unexpected loads might turn up, and it was necessary, therefore, to adopt a step-by-step policy of planning. At the same time the design had to be based with some ultimate lay-out in view, and the present paper was, therefore, of great interest though limited in its application. The speaker agreed with the author's comments on the reliability of cables, and also that heavy outlays on pilot protection systems for distribution networks on a large scale were difficult to justify.

Mr. W. Wilson mentioned that his own experience in e.h.t. transmission had been solely with overhead systems. In those there was a well-defined relation between length of transmission and voltage, resulting in the rate of about 1,000 volts per mile.

THE ELECTRICAL CONTRACTORS' ASSOCIATION (INC.).

ANNUAL DINNER

On January 19th the annual dinner of the Electrical Contractors' Association (Inc.), the N.E.C.T.A., Ltd., and the National Federated Electrical Association was held at the Connaught Rooms; the president, Mr. P. Collinson, was in the chair, and amongst the guests were Messrs. Ll. B. Atkinson, R. Tweedy Smith, A. Albrecht, P. F. Rowell, J. Y. Fletcher, J. W. Beauchamp, Col. H. M. Leaf, Major H. Richardson, Messrs. H. G. Purchase, M.P., H. Hirst, C. H. Wordingham, E. C. Wansbrough, A. C. Cramb, L. Gaster, F. B. O. Hawes, and A. G. Beaver.

After the toast of "The King" had been duly honoured. Mr. H. Hirst proposed "The Allied Associations and Honorary Officials." He claimed that no one had done more than he to establish the contracting industry on a sound basis; in other countries installation work was carried out by the large manufacturing firms or companies owned and controlled by them, and in this country in the early days the same condition had obtained. When, in 1886, he proposed to start a business for the supply of electrical apparatus, he was laughed at. His first catalogue of 1886 was designed to help the big firms, which had found that contracting did not fit in with their business, and sublet the contracts to their foremen, who were the first contractors. The big firms boycotted him because he gave away too many "secrets" in the shape of hints for wiremen. All his life he had devoted attention to the contractors, whose wants he supplied, and when they formed an association he took the keenest interest in it, considering that by that step they had elevated their status. He urged that further progress should be made in that direction with a view to promoting efficiency, and cited a bad lay-out as an example of the harm done to the industry by an inefficient contractor. In Germany and the United States, he said, the producer imposed his will on the consumer; here the consumer's views prevailed, with unfortunate results. The contractor was the link between the manufacturer and the consumer, and should study the problems that were met with in the vast field of domestic applications of electricity that was opening before the industry.

Responding, the Chairman thanked Mr. Hirst for his "scathing remarks," and said that the most important matter before the Electrical Contractors' Association was the question of registration or licensing of contractors; the time had come when the type of contractor to which Mr. Hirst had alluded should be eliminated from the trade, and the unskilled man prevented from setting up in business. The Board of Trade would not accept the proposed scheme, but sooner or later they hoped to gain their end. The E.C.A. was also dealing with the training of apprentices; committees had been formed in all the large towns to supervise their training, and to make arrangements with the local education authorities for classes, with a view to turning out a man much in advance of the present operative. The question of municipal trading had received their attention, and they hoped soon to get into closer touch with the municipal engineers, and to arrive at an understanding with regard to their respective spheres.

The N.E.C.T.A., which was formed to enter into trading agreements with manufacturers, had not made the progress that was anticipated, but their agreement with the Cable Makers' Association had operated most satisfactorily; there was not a single case of unfair trading in the past year. Such an agreement was of mutual benefit, tending to keep the foreigner out of our market. To-day, assisted by the high rate of exchange and the low cost of living, the German manufacturer was in a good position to attack the British market; the samples were here already, and the goods would follow. The National Federated Electrical Association was formed to settle wages with employes; other sections of the industry thought they were paying excessive rates, but they were a small body, under great pressure. They contemplated linking up with the Engineering Employers' Association, with whose guidance they hoped their future settlements would not be so much open to criticism. They could readily come to an understanding with the Electrical Wholesalers' Federation, and the Electrical Development Association might play a great part in the future of the industry. More linking up of Associations was desirable, to remove friction and avoid loss of energy.

Mr. H. G. Purchase, M.P., also responded, laying stress on the importance of efficiency, and claiming that in the exercise of scientific imagination this country excelled the United States and Germany.

Mr. H. J. Cash, proposing "The Guests" (I.E.E. and kindred Associations), said that contractors often did not attach sufficient importance to membership of the Institution. The old views of the Institution were dispelled; it was a body which looked after the interests of the whole industry, every section of which was represented on the Council and committees, and at its meetings they met engineers and manufacturers on common ground. As a member of the Council, he knew that the contractors were welcomed and regarded as fellow engineers, and their advice was sought in all matters in which they could afford assistance. The contractors had not always seen eye to eye with the I.M.E.A., but really their interests were identical, and they ought to make common cause in the future. The Cable Makers' Association worked in harmony with them, not only for financial benefits, but for the general interests of the industry, and their joint committee provided for the exchange of views and promoted good feeling. The Electrical Development Association was one of the great powers of the near future, and ought to be supported by every branch of the industry. The Electrical Trades Benevolent Institution was doing an enormous amount of good, and the Illuminating Engineers' Society's work was of great benefit to contractors.

Mr. Ll. B. Atkinson, responding, emphasised the importance of combination in industry, and complimented those who had developed the Association out of so widely scattered a body as the contractors. The Association had already immensely raised the status of the industry, and he did not agree with Mr. Hirst as to the technical ability of the contractors, many of whom, to his knowledge, had nothing to learn about their business. The trading agreement with the Cable Makers' Association, which had been made in the face of great difficulties, was not only useful to the contractors by standardising their position, but had been valuable to the cable makers in classifying their customers. On the whole, its advantages had been enormous. Other associations which did not make the same experiment were lacking in progressiveness. The Institution of Electrical Engineers was a powerful instrument for the good of the industry; it was the largest institution in the country, and in enterprise and ability second to none. The Cable Makers' Association, which had existed for 24 years, had aroused the deepest hostility in the early days, but that feeling had passed, and in his person the I.E.E. had recognised its merits.

Major H. Richardson, president of the I.M.E.A., also responded, and on behalf of his Association, said that the desire for co-operation was never before so real and earnest. Experience had taught them the value of tolerance; to-day the electrical industry had the world at its feet, and they were all entitled to participate in the good times that were coming. The time had come for the amalgamation of many bodies with closely similar objects, to the advantage of all parties, including the customer. The I.M.E.A. was on the verge of holding important conferences with the E.C.A., and would come to them determined to seek a happy outcome from the negotiations. The domestic heating and cooking load was going to be a very big thing, and was starting already. The I.M.E.A. was considering the all-important question of tariffs; personally, he was wedded to the fixed charge plus the smallest possible running charge. A really cheap price was essential. The tariff should be reduced to the simplest terms, which could be understood by the man in the street; mathematical accuracy was out of place in quoting to the consumer.

Mr. W. R. Rawlings proposed "The Electrical Trades Benevolent Institution," which he thought had not been adequately supported by contractors; they should help to make the home they were going to a little more comfortable. They could not foresee the future, and they would be surprised if they knew the positions that had been occupied by the people who came to them for help.

Mr. J. Y. Fletcher, in reply, said the contractors had supported the Institution, but the fund could not do what it should do; the industry was big enough to carry its own casualties, and a very energetic and concerted effort would be made later in the year, to put the fund on the broad basis which it should possess. It could deal with current needs, but would have to face much heavier calls in the near future. He looked forward to a generous response to the campaign, and laid stress on many small subscriptions in preference to a few large ones. The Institution, perhaps, had not advertised itself sufficiently, had not yet made an adequate appeal to the industry. He concluded with special thanks to the electrical Press for its generous assistance to the Institution.

Mr. W. Cross proposed "The Chairman," one of the oldest members of the Association, and one of the founders of the Bradford branch, past chairman of the Northern Section, and a member of Council for many years. The toast was accorded musical honours, and in responding, Mr. Collinson referred to his retirement from business due to ill-health, and his approaching retirement from the office of president. Often it seemed that they were working hard and not making progress; but looking back over a period of years, he saw that they had made progress, and established the contracting industry on the footing of a trade in itself.

A musical entertainment was provided under the direction of Mr. E. L. Halford, F.R.C.O., and the function as a whole was regarded as an exceptionally successful and enjoyable one.

ELECTRONS.

By SIR WILLIAM BRAGG, K.B.E., F.R.S.

(*The twelfth Kelvin Lecture, delivered before* The Institution of Electrical Engineers.)

It is at the wish of your Council that I am speaking to you this evening on the subject of electrons.

Without this explanation you may well be amazed at my attempt to deal with so large a subject, on which Sir Oliver Lodge and others have spoken to you on many different occasions. But, of course, I set myself certain limits, and propose to speak mainly on two lines of recent research, referring to the part played by the electron in radiation processes and to the part it plays in atomic structure. And first, with your permission, I will put in a background of general facts.

In recent years the results of experimental research on the properties of electrons have accumulated with startling rapidity. As knowledge grows, the importance of the part played by the electron in the mechanics of the world becomes even clearer. There are all the right signs that progress is being made along a road that really leads somewhere; we are continually finding that, through some electron action, phenomena are linked together between which we had hitherto seen no connection. Precision is given to our views; we find ourselves able to express, quantitively and with confidence, laws and relations which have been matters of vague surmise. Every experiment that is finished suggests others that are promising. The whole world of experimental physics is full of new life, and of the consciousness that after a period of hesitation the tide of discovery is sweeping on again. I hope I may be allowed to claim that when an advance is made in the realm of physics all other natural sciences feel the impulse sooner or later.

While knowledge grows by experiment, theory is also busy. The attempts to co-ordinate the new discoveries are of singular interest because of their daring, their width, and their strength; because they are so often fruitful in prediction; and, not least, perhaps, because they seem so often to be irreconcilable with each other.

Altogether, then, a lengthy course of lectures might well be devoted to the subject of electrons, as indeed is the case in our universities. But your Council has asked me to confine myself—and I assure you I am very thankful for the restriction—to a brief description of the main features of a great inquiry, and of the direction in which that inquiry is moving.

It helps to a right appreciation of the position as regards the electron if we observe its strong resemblance to the older state of things when first the atomic theory of matter was clearly defined. Just as chemistry has grown and prospered on its recognition of the unit of matter, so electrical science has already begun a new life, and to all seeming, a most vigorous one, based on the understanding of nature's unit of electricity. There are many different atoms of matter, nearly a hundred are distinguishable by their different chemical reactions; but the number of different kinds of electrical atoms is very much more limited. We are clear as to the existence of one, the electron, nature's unit of negative electricity. We suppose that there is a definite positive counterpart, but our ideas about it are much less precise. We seem to get along very well at present without any intimate knowledge of the positive, or perhaps we should say positives; for present purposes the negative unit is that which gives definition to our work.

If the chemist has found so much profit in his recognition of the fact that nature has just so many ways, and no more, of doing up parcels of matter, the electrician will surely gain in the same way, when he grasps the fact that electricity is not merely measurable in quantity, but that there is already a unit of nature's choice, possibly no more than one unit.

We may say with justice that the most wonderful advances in modern physics are the reward for our appreciation of this truth, and we may hope with equal justice that we are yet far from reaping the full benefit.

The first suggestion of the atomic character of electric charge came, it is well known, from observation of the laws of electrolysis. Since the movement of atoms or atom clusters or ions across the electrolytic cell was accompanied by a simultaneous transfer of electricity, in which each ion, of whatever nature, bore always the same charge or at least a simple multiple of it, there was a clear indication that this division of electricity into parcels of constant magnitude implied the existence of some natural unit charge. No progress, however, was made or could be made so long as the charge could only be observed as an attachment to an ion; it was not even clear that it could ever have a separate existence. In the long series of researches which finally led to the isolation of the electron and the determination of its properties, there were certain that marked definite stages in the forward movement. Crookes examined the electric discharge in bulbs exhausted to a high degree by the new air pumps which he had succeeded in making; and he observed the so-called cathode rays, streaming away from the negative electrode. He showed that they possessed the properties to be expected from a stream of particles projected across the bulb, and carrying negative electricity with them; for, on the one hand, they could heat up bodies on which they fell, and on the other, they were deflected in crossing a magnetic field. Crookes spoke of a fourth state of matter, and defended his view against the opposing hypothesis, held largely on the Continent, that the stream consisted of electromagnetic waves in some form or other. Hertz showed that the rays could pass through thin sheets of matter such as aluminium leaf, and Lenard took advantage of this to coax them outside the bulb and display their effects in the air outside.

In the later years of the last century came the great experiments of Wiechert, Thomson, and many other well-known observers who weighed the electron and measured its charge, and showed that there was only the one electron though it was to be found everywhere and in every body. Since then, the measurements of these quantities have been repeated many times with increasing skill and understanding. They have reached their present high-water mark perhaps in the experiment of Millikan at Chicago, who gives us the value of the charge in electromagnetic units $e=1.591\times10^{-20}$, the mass being 0.903×10^{-27} gramme or 1/1 830 of the mass of the hydrogen atom.

So we arrive finally at an accurate comparison of these unique and fundamental units of nature with the units which we ourselves have chosen for our convenience, and without, of course, any relation to the other. We infer from experiments such as those of Kaufmann and Bucherer, that the energy of the moving electron may be considered to exist wholly in the form of electromagnetic energy such as is necessarily present when an electrical charge is in motion; and that its mass is in this way perfectly accounted for. But this conclusion sets a limit to the size of the electron and we must assume that its radius, if its form is spherical, is not more than 10^{-13} cm. or about a hundred-thousandth of the radius of any atom.

Why, we may well ask, have these measurements of charge and mass never been made before? The electron is everywhere; the transfer of electricity from place to place consists always in the transfer of electrons. The electric current is a hurrying stream of electrons; all our electrical machinery concerns itself with setting these in motion, giving them energy, and again withdrawing it. In the processes of electrolysis, the electrons are handed to and fro. Everywhere they fill the stage, why have we not noticed hitherto their qualities, which so far can be expressed so simply?

The answer is that we have never, until recently, been able to make them move fast enough in spaces sufficiently empty of air or other gases. It is only when an electron has a sufficient speed that it can escape absorption in the atoms which it must be continually meeting. Unless an electron has a speed exceeding about a three-hundredth of the velocity of light, that is to say, such a speed as it acquires in falling through a potential of a few volts, it sticks to the next atom it runs up against; even with ten times that speed it can only move a fraction of a millimetre through air at ordinary pressure before it loses its velocity and, therefore, its power of going through the atoms. When Crookes first saw the cathode-ray stream in full course, it was because he had reduced the number of gas molecules in his bulb to such an extent that an electron could fly in a straight line from end to end of the bulb without going through more than a hundred atoms or so, and the induction coil had given it quite enough speed to do that without turning out of its course; no matter what sort of atoms they were. Incidentally, since atoms can be traversed in this way, we naturally think of an atom as a very empty affair.

Electrons flying still faster than in the discharge tube are found to constitute a part of the radiation from radioactive substances. Some of the β-rays have velocities nearly equal to that of light, and can pass through millions of atoms before their energy is spent. In open air a β-ray may have a course of metres in length, though it is generally broken, by encounters with traversed atoms, into a path of corners and irregularities.

It is speed which gives separate existence to the moving electron; and speed which also betrays its presence to us. For, on its way, the electron here and there chips away another electron from an atom which it is crossing and leaves behind it a separation of electricities which may subsequently influence chemical action as in the case of the phosphorescent screen or photographic plate, or provide a current for the ionisation chamber. We do not know exactly how this removal of electrons is effected, nor why some atoms part with electrons more easily than others so that the flying electron loses less energy as it goes through; there is much that is obscure in the whole process. But it gives us a ready means of observation, without which indeed our knowledge of the electron would be far less than it is.

These electrons which are so made manifest by speed form but a minute fraction of their whole number. They are to be found in every body, and in every atom of every body. They form one of the elements of construction of every atom; and it is one of the most immediate aims of present research to find in what way they are built into atomic structure. In every atom there are electrons of which one can be removed at the cost of a certain amount of energy, of the order of 10^{-11} erg; part or perhaps all of which may be recoverable, so that the store of energy in the atom remains what it was. The potential through which an electron must fall so that it acquires this energy, and is able to effect this removal when it strikes the atom, is known as the ionisation potential. Whether a second electron can be removed at anything like the same cost is difficult to say. There are other electrons with the atom which are intrinsically far more difficult to remove. On the other hand, some atoms, for example, those of the metals, have each one or more electrons which are little more than hangers on, and are indeed removed with very little trouble. A block of pure metal is full of such loosely bound electrons, so that if an electric potential difference is maintained across the block an electron flow or electric current is produced. The metal "conducts."

At sufficiently high temperature all bodies become conductors; we must imagine that the violent thermal agitation shakes electrons free from their ties to the atoms even when at low temperature the bonds ordinarily remain unbroken. At high temperature, too, the electrons acquire high velocities as they move too and fro with their proper share of heat energy. At the surface of the hot body the electrons may break away; and hence the "thermionic emission" investigated by O. W. Richardson. So copious is this supply of electrons at the surface of a hot body that if the latter is made negative in potential relative to its surroundings there is a current discharge which may sometimes be measurable in amperes. Of course, such a current can only pass one way, negatively from the hot body, or positively towards it. So we get the basic principle of the "valve," and so Coolidge provides the electrons for projection against the target in the X-ray bulb which he has designed. At this point we find already the adaptation of our new knowledge of electrons to apparatus of extraordinarily great use to mankind.

If we now plunge a little deeper into our subject we come to certain most fascinating regions of it, where exploration is still in full progress. In one of these we find the most remarkable connection between moving electrons and electromagnetic waves. The one, it seems, can always call up the other; and the action obeys certain precise numerical laws.

Let us take as an example the production of X-rays in a Coolidge bulb. A plentiful supply of electrons is provided at the cathode by heating a fine spiral of tungsten wire to a high temperature. A high potential difference between cathodes and target is provided by some approximate means, and the electrons are hurled at the target, each possessing an amount of energy equal to the product of the electron charge and the applied potential. Where the electrons strike, some of their energy is converted into electromagnetic waves of very high frequency, the so-called X-rays. Suppose that we measure the energy supplied to each electron—not an easy matter with the usual arrangements, but very easily done if, as in certain experiments of Duane and Hunt, at Harvard University, the potential is derived from a great storage battery of 20,000 volts. Suppose, further, that we analyse by the X-ray spectrometer the X-ray radiation that issues from the target. We find that the frequencies of the emitted rays may have a wide range of values, but that the upper limit of the frequencies is always proportional to the energy of the electron, and, therefore, to the potential imposed on the tube. This ratio remains the same no matter what is the intensity of the electron discharge, and no matter what the nature of the target. This ratio of electron energy to maximum frequency is a number which has turned up in previous cases where the emission of radiation energy has been measured; it is known as Planck's constant, and is denoted by "*h*." Its value is 6.55×10^{-27}. Although the constant has been met with before, there is probably no instance where the transformation of energy which it governs is so simply displayed or so easily measured as in the case just described.

In certain measurements made by Duane, the X-ray spectrometer was set to observe the presence of a certain frequency as soon as it appeared. The potential on the tube was then increased by degrees. The rays of the given frequency appeared as soon as the energy supplied to the electron was equal to the frequency multiplied by *h*. As the potential was increased still further these rays increased in intensity.

It is to be observed that the production of X-rays is an aggregate of individual efforts by separate electrons; each electron produces its own train of X-rays when it strikes the target. There is no sign of any combined action, as indeed is evident from the fact that the intensity of the cathode-ray stream is without influence on the frequencies of the X-rays produced.

The crucial point is that where the energy of an electron is handed over in whole or in part, the frequency of the X-ray waves that take over the energy is determined by the quantity of energy handed over. This explains why there is a limit to the frequency of the X-rays; it is because there are some electrons, though only a fraction of the whole number, which give up all their energy to the formation of X-rays at the moment of striking, before they have lost energy in collisions. The rest of the rays, all those which have lesser frequencies, will come from electrons that have lost speed in this way, or possibly have transferred only part of their energy. The atom of the target is playing the part of a transformer, and does not determine the frequency, so far as these effects are concerned.

All this is wonderful enough; but the marvel is greatly increased by the discovery that the effect is reciprocal. Just as the swiftly moving electrons excite X-rays, so X-rays when they strike any substance lose their energy, which now appears as the energy of moving electrons. And, again, we find the same variation in the result and the same limit to that variation. Among the electrons so set in motion we find, examining them as soon as possible after their motion has begun, every variety of energy-content up to a certain critical value which is equal to the frequency of the X-rays multiplied by the same constant *h*. It is to be observed that we cannot measure all the electron velocities as soon as they exist because some of the motions begin in the body of the substance, into which the X-rays have penetrated, and have lost speed on the way out. Again, therefore, there is nothing against the hypothesis that the energy of every electron set going by waves of given frequency is originally the same, and is determined by the standard condition already given.

Not only in the case of X-rays are these effects observed, but also in the case of light. The only difference is that the frequencies of light vibrations are some 10,000 times less than those of X-rays, and the electron energies are correspondingly smaller. When the light waves produce the electrons we have what is known as the photo-electric effect. The production of light by electrons has been much studied recently in experiments to find "resonance-potentials," that is to say, the magnitudes of potentials which must act on electrons so as to give them enough energy to excite certain particular radiation from atoms on which they fall.

Exactly how this strange transfer of energy from one form to another takes place, we do not know; the question is full of puzzles. The magnitudes involved are hard to realise; it helps if we alter their scale of presentment. Suppose that the target of the X-ray bulb were magnified in size until it was as great as the moon's disk, that is to say, about 100 million times. The atoms would then be spheres a centimetre or so in diameter. But the electrons would still be invisible to the naked eye. The distance from earth to moon would correspond roughly to the distance that ordinarily separates the bulb from an observer or his apparatus. We now shoot electrons at the moon with a certain velocity; let us say that in every second each square yard or square foot or square inch, it does not matter which, receives an electron. A radiation now starts away from the moon which immediately manifests itself (there is no other mean manifestation whatever) by causing electrons to spring out of bodies on which it falls. They leap out from the earth, here one and there one; from each square mile of sea or land, one a second or thereabouts. They may have various speeds; but none exceed, though some will just reach, the velocity of the original electrons that were fired at the moon. That, reduced again to normal size, is the process that goes on in and about the X-ray bulb; which is part of a universal natural process going on wherever radiation, electron, or wave, falls on matter, and which is clearly one of the most important and most fundamental operations in the material world.

(*To be concluded.*)

ELECTRIC ARC WELDING APPLIED TO ALUMINIUM.

By F. J. HEYES, B.Eng.

The following is an abstract of a paper which was read at the Liverpool Sub-centre of the North-Western Centre of the Institution of Electrical Engineers, on January 17th:—

Ever since the discovery of aluminium the greatest difficulty has been experienced in joining pieces of it together, either by soldering with some other metal, or alloy, or by autogenous welding.

The first and greatest difficulty to be overcome is the affinity of aluminium for oxygen. In order to get any two pieces of metal to unite, it is essential that the surfaces should be free from any coating of solid dirt or oxide which will prevent them coming into intimate contact. The affinity is so great that even at ordinary temperatures a clean surface quickly becomes thinly coated with oxide, and at temperatures approaching its melting point it immediately becomes thickly coated, and small pieces of the metal will burn away completely. The melting point of the oxide is far above that of the metal, so that it is impossible to weld two pieces together without some flux which will dissolve or get rid of the oxide.

With a plain aluminium rod without any coating of flux, on striking the arc the metal instead of dropping off as soon as it is melted hangs in globules on to the end of the electrode till they become as much as half an inch in diameter, when using a number of electrodes, they then fall on to the plate which is to be welded. These globules become thickly coated with oxide, and so does the plate, so that when they drop off they adhere to the plate only at the point where they are playing, and when cool they can be easily pulled off with the fingers. All the time that this is taking place thick clouds of fumes are given off, and eventually the pieces of aluminium which were to be welded melt, but show no signs of adhering to one another. The thick clouds of fume are probably due to the fact that some of the aluminium is vaporised by the intense heat of the arc, and burns away much more freely.

There are three ways of dealing with the oxidation: First by protection of the surfaces from contact with the air and consequent oxidation, by some flux which fuses easily and will not prevent the surfaces coming together. Secondly, by solution of the infusible oxide in some fluxible substance which does not affect the quality of the weld; and thirdly, by chemical combination of the oxide to form some substance which is fusible at the temperature of melting aluminium, or a combination of the oxide to form some substance which is fusible at the temperature of melting aluminium, or a combination of these may be used.

Perfect protection of the surface cannot be obtained in practice, so that it is necessary to combine protection with solution in one form or another. Chemical combination has the disadvantage that any substance that combines with the oxide will also combine with the aluminium, and so may be used up before dissolving all the oxide, or portions of it may become embedded in the deposited metal and cause subsequent corrosion. Hence solution of tin oxide in some solution which is chemically suitable when in contact with aluminium is the best method if obtainable.

Chlorides of the alkaline metals are very suitable for protection of the molten surface from contact with the air, as they melt below the melting point of aluminium, and do not interfere with the making of the weld. Fluorides of the alkaline metals and of aluminium have the property of dissolving aluminium oxide without chemical combination, so that they would appear to be the most satisfactory if there were no other obstacle to their use. Bisulphates of the alkaline metals being unsaturated compounds can combine with the oxide, and are very useful for this purpose.

Arc welding of aluminium has been attempted by the author, using the ordinary acetylene welding fluxes, without any success whatsoever, and he reached the conclusion that it is essential to use a flux which is not easily vaporised. For this purpose he found cryolite suitable. In arc welding a small pool of molten aluminium is formed at the point being welded, the temperature of which is far above the melting point of the metal, some of the aluminium being deposited in the form of vapour. At this temperature the cryolite becomes quite fluid, and runs freely on the surface, enabling a very good weld to be made. In trying to weld with a plain electrode the aluminium hangs in globules at the end of the electrode, as already explained, and there is still a tendency for this to occur when using cryolite alone. A small percentage of chloride, however, overcomes this difficulty and renders welding much easier.

In arc welding it is essential to have a coating of flux on the outside of the electrode, as otherwise the aluminium in passing from the end of the electrode to the work becomes so thickly coated with oxide that a very large quantity of flux would be required to deal with it. Where the electrodes may be subjected to rough handling it would be very desirable to have the flux enclosed in the electrode, but as this is impossible, it becomes necessary to fix the flux on the outside of the electrode, which may be done satisfactorily with a binding of fine cotton.

In welding iron or steel a current of about 80 amps. is required for a plate about ¼ in. thick, using a No. 8 electrode, but to weld a similar sheet of aluminium satisfactorily it is necessary to use about 150 amperes. The only explanation offered for this is that aluminium is a much better conductor of heat than iron, and as it is necessary to keep the pool of metal at the point being welded well above the melting point it is necessary to use a much higher current. When the plates being welded are cold it is impossible to weld with a smaller current, but if the work be preheated to about 400 deg. C., a good weld may be made with about 60-80 amps. This bears out the above explanation, as the melting point of aluminium is only 500 deg. C. it does not require so intense a heat to keep the point being welded above this temperature if there is only about 180 deg. C. difference between it and the surrounding portions of the material.

The welding current should increase with the thickness of the plate; for ⅛ in. thickness 120-130 amps. is required, for ¼ in., 140-150 amps. The reason for this is that with a thick plate there is a greater area to conduct away the heat from the molten pool under the electrode than there is with a thin one. In welding a very thick plate a condition is reached where heat is conducted away from the greater part of the surface of a sphere of which the point being welded is the centre. For plates thicker than that corresponding to this condition no increase in welding current is required.

The possibility of producing a pool of metal well above the melting point at the spot being welded without heating up the whole plate to the melting point, is one of the great advantages of arc welding over oxy-acetylene welding. In work which has been welded with the oxy-acetylene flame it is frequently found that the pieces have run together only on the surface, as if the operator attempts to melt the aluminium to a greater depth a large portion of the work may be melted out. This is not so likely to happen when using the electric arc, as the heating effect is much more local.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

176. "Rail-less tramway, &c., vehicles." R. H. Wilkinson. January 4th.

231. "Submarine signal receiver." A. W. Sarnmark. January 4th. (Sweden, December 1st, 1919.)

236. "Elastic-fluid turbines." British Thomson-Houston Co. (General Electric Co.). January 4th.

256. "Rectifier." W. B. Lucas and E. L. Markey. January 4th (United States, July 31st, 1916.)

352. "Process for fixing atmospheric nitrogen." Nitrogen Products Co. January 5th. (United States, July 5th, 1919.)

367. "Cartridge fuse." A. L. Eustice. January 5th. (United States, July 23rd, 1914.)

368. "Safety fuse." A. L. Eustice. January 5th. (United States, March 14th, 1917.)

369. "Cartridge fuse." A. L. Eustice. January 5th. (United States, June 22nd, 1914.)

373. "Knife-blade fuse." A. L. Eustice. January 5th. (United States, March 7th, 1918.)

448. "Safety protective devices for radiological installations." Soc. Anon. Etablissements Gaiffe Gallot et Pilon. January 5th. (France, January 6th, 1920.)

489. "Rontgen-ray apparatus." Reiniger Gebbert & Schall Akt.-Ges. January 5th (Germany, June 23rd, 1915.)

616. "Thermo couples." C. E. Foster. January 6th.

676. "Rontgen-ray apparatus." Reiniger Gebbert & Schall Akt.-Ges. January 6th. (Germany, January 12th, 1916.)

795. "Vacuum cleaning devices." Apex Electrical Manufacturing Co. January 7th. (United States, July 9th, 1915.)

796. "Suction cleaning devices." Apex Electrical Manufacturing Co. January 7th. (United States, September 29th, 1915.)

797. "Suction cleaners." Apex Electrical Manufacturing Co. January 7th. (United States, January 17th, 1917.)

798. "Vacuum cleaning devices." Apex Electrical Manufacturing Co. January 7th. (United States, November 25th, 1916.)

974. "Thermo static control apparatus." A. D. Horne. January 8th.

984. "Mercury-vapour jet pump with arc." Siemens & Halske Akt.-Ges. January 8th. (Germany, October 3rd, 1919.)

1,089. "Transmitters for signalling." A. W. Särnmark. (Sweden, December 1st, 1919.)

1,104. "Device for increasing sound energy with submarine sound transmitters." Signal Ges. January 8th. (Germany, October 2nd, 1915.)

1,105. "Electrical tuning circuits for submarine sound-receiving apparatus." Signal Ges. January 8th. (Germany, December 31st, 1917.)

1,106. "Arrangements for transmitting signals and articulate speech under water." Signal Ges. January 8th. (Germany, December 20th, 1919.)

1,107. "Switching arrangement for telephone systems with electro-mechanical switches." Ges. fur Elektromechanische Telephonapparate. January 8th. (Germany, June 4th, 1914.)

1,112. "Electric arrester." P. Bendmann. January 8th, (Germany, August 9th, 1919.)

1,127. "Insulators." Metallurgique Electrique (Ancienne Soc. Anon des Etablissements Vedovelli et Priestley. January 8th. (France, December 13th, 1919.)

1,136. "Dynamo or motor." D. Suchostawer. January 10th.

1,139. "Incandescent electric, &c., lamps." A. G. France. January 10th.

1,145. "Electric heaters." J. W. Pritchard. January 10th.

1,152. "Spark gaps for electro-magnetic wave signalling systems." F. Lowenstein. January 10th. (United States, August 25th, 1914.)

1,156. "Electrical machines operating with high-frequency electro-magnetic wave energy." H. Plauson. January 10th. (Germany, July 5th, 1919.)

1,157. "Converting static atmospheric electrical energy into dynamic electrical energy." H. Plauson. January 10th. (Germany, November 13th, 1919.)

1,158. "Conversion of atmospheric electrical energy." H. Plauson. January 10th. (Germany, March, 1915.)

1,214. "Cathode tube transmitters for telephoning with high frequency oscillations." Deutsche Telephonwerke Ges. January 10th. (Germany, August 29th, 1918.)

1,215. "Circuit arrangements for high-frequency telephony." Deutsche Telephonwerke Ges. January 10th. (Germany, September 17th, 1918.)

1,216. "Circuit arrangements for stations provided with transmitters and superposed receivers for high-frequency cable telegraphy." Deutsche Telephonwerke Ges. January 10th. (Germany, September 25th, 1918.)

1,217. "High-frequency telephony and telegraphy." Deutsche Telephonwerke Ges. January 10th. (Germany, November 15th, 1919.)

1,228. "Self-induction coil couple for charging duplicable four-fold cores of telephone cables according to the Pupin system." Felten & Guilleaume, Carlswerk Akt.-Ges. January 10th. (Germany, January 3rd, 1920.)

1,233. "Apparatus for recording and reproducing telephonic messages." M. de Medico. January 10th. (France, October 31st, 1919.)

1,236. "Arrangement for telephone installations with intercommunication working." Siemens & Halske Akt.-Ges. January 10th. (Germany, December 8th, 1916.)

1,237. "Arrangement for suppression of earth leakage current of high-voltage networks." Siemens-Schuckertwerke. January 10th. (Germany, May 31st, 1918.)

1,238. "Arrangement for compensation of charging currents of high voltage networks." Siemens-Schuckertwerke. January 10th. (Germany, June 2nd, 1919.)

1,242. "Sparking plugs." L. Siegl. January 10th. (Austria, July 26th, 1919.)

1,243. "Electric connecting plugs." O. O. Kring and O. Stalhane. January 10th. (Sweden, November 27th, 1918.)

1,291. "Accumulator plates." L. de M. Cattley. January 10th.

1,297. "Protective device for electric circuits." R. Dreyer. January 10th. (Germany, January 12th, 1918.)

1,303. "Electric gasfilled glow discharge lamps." A. Lederer. January 10th. (Austria, September 15th, 1913.)

1,304. "Electric gasfilled glow discharge lamps." A. Lederer. January 10th. (Austria, September 16th, 1913.)

1,305. "Transmission of electrical energy." L. Duverger. January 10th. (France, February 16th, 1918.)

1,306. "Transmission of electrical energy." L. Duverger. January 10th. (France, January 15th, 1919.)

1,307. "Transmission of electrical energy." L. Duverger. January 10th (France, January 21st, 1919.)

1,308. "Transmission of electrical energy." L. Duverger. January 10th. (France, May 8th, 1919.)

1,317. "Automatic electric switches." H. Bollinger. January 10th. (Germany, August 19th, 1913.)

1,324. "Wireless telegraph receivers." Ges. fur Drahtlose Telegraphie. January 10th. (Germany, August 29th, 1919.)

1,325. "Wireless receiving systems." Ges. fur Drahtlose Telegraphie. January 10th. (Germany, December 2nd, 1919.)

1,326. "Wireless telephone transmitters." Ges fur Drahtlose Telegraphie. January 10th. (Germany, December 11th, 1919.)

1,327. "Means for automatically adjusting constants of oscillation circuits." Ges. fur Drahtlose Telegraphie. January 10th. (Germany, December 13th, 1919.)

1,328. "Wireless telephone transmitters." Ges. fur drahtlose Telegraphie. January 10th. (Germany, December 23rd, 1919.)

1,329. "Means for changing periodicity and tension of alternating current supply." Ges. fur Drahtlose Telegraphie. January 10th. (Germany, December 27th, 1919.)

1,340. "Production of electric insulating material." E. Juchli. January 10th. (Switzerland, August 8th, 1919.)

1,364. "Correction of amplitude of high-frequency oscillations." J. Engl, J. Massolle, and H. Vogt. January 10th. (Germany, April 7th, 1919.)

1,371. "Control of electric currents by sound." J. Engl, J. Massolle, and H. Vogt. January 10th. (Germany, August 2nd, 1917.)

1,387. "Electric switch." Herold & Co. January 10th. (Germany, January 23rd, 1920.)

1,406. "Electron tubes." J. Engl, J. Massolle, and H. Vogt. January 10th. (Germany, December 2nd, 1919.)

1,419. "Electrical welding machine." Moll-Werke Akt.-Ges. January 10th. (Germany, April 28th, 1919.)

1,420. "Electrodes for resistance welding machines." Moll-Werke Akt.-Ges. January 10th. (Germany, June 5th, 1919.)

1,421. "Alternating current electric motors." British Thomson-Houston Co., Ltd. January 10th. (United States, September 11th, 1914.)

1,422. "Electric braking system." British Thomson-Houston Co., Ltd. January 10th. (United States, March 25th, 1918.)

1,423. "Alternating current electric motors." British Thomson-Houston Co., Ltd. (General Electric Co.). January 10th. (United States, December 28th, 1915.)

1,424. "Alternating current electric motors." British Thomson-Houston Co., Ltd. (General Electric Co.). January 10th. (United States, December 22nd, 1917.)

1,425. "Electric motors." British Thomson-Houston Co., Ltd. (General Electric Co.). January 10th. (United States, January 4th, 1918.)

1,427. "Electrical apparatus." J. Bijur. January 10th. (United States, November 8th, 1919.)

1,433. "Electrically welding sheet metal." Moll Werke Akt.-Ges. January 10th. (Germany, October 29th, 1919.)

1,434. "Connections for reinforcement of electric currents and voltages." J. Engl, J. Massolle, and H. Vogt. January 10th. (Germany, April 16th, 1919.)

1,446. "Arrangement for strengthening electrical currents and tensions." J. Engl, J. Massolle, and H. Vogt. January 10th. (Germany, October 9th, 1919.)

1,450. "Differential wire system for controlling amplitude of high-frequency waves by low frequency." J. Engl, J. Massolle, and H. Vogt. January 10th. (Germany, March 3rd, 1919.)

1,451. "Differential connection for control of amplitude of high-frequency vibrations by low frequency." J. Engl, J. Massolle, and H. Vogt. January 10th. (Germany, September 8th, 1920.)

1,463. "Electrically-driven glow lamp for reproduction of acoustic electric frequencies." J. Engl, J. Massolle, and H. Vogt. January 10th. (Germany, March 3rd, 1919.)

1,494. "Wireless radio-signalling by the arc system." L. Cohen. January 10th. (United States, November 13th, 1915.)

1,495. "Cleaning and washing electric bulbs." C. O'Donnell. January 10th.

1,500. "Electrolytic separation of platinum from other metals." E. Slatineanu. January 10th. (Switzerland, December 19th, 1919.)

1,514. "Electrical trip switches for railway, &c., indicating mechanism." P. H. Waller. January 10th.

1,522. "Rheostat resistance grids." W. H. Keller. January 10th. (United States, January 6th, 1914.)

1,540. "Automatic, &c., telephone systems." Relay Automatic Telephone Co., Ltd. January 10th. (Sweden, December 31st, 1919.)

1,564. "Electrical connections and switches for enabling an electric current-consuming device to be used on circuits of different voltages." R. Heilbrun. January 10th. (Germany, February 18th, 1914.)

1,592. "Electric batteries. M. A. Adam and G. Antonoff. January 10th.

1,596. "Regulating electric central station and sub-station." R. Bosselmann. January 15th. (Germany, September 15th, 1919.)

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1918.

14,778. "Wireless signalling systems." British Thomson-Houston Co. (General Electric Co.). September 11th. 1918. (155,602.)

1919.

17,294. "Switchgear for controlling electric motors." J. A. Hirst and P. S. Brooks. July 10th, 1919. (155,614.)

20,601. "Electrical resistance units." C. C. Turner and Abbott, Turner and Co. August 21st, 1919. (155,622.)

23,098. "Boxes for electrical apparatus." Crompton & Co. and W. F. Jones. September 19th, 1919. (155,634.)

23,150. "Electric heating of water." S. H. Calvert. September 20th, 1919. (155,637.)

23,313. "Wireless telegraph receivers." E. W. B. Gill. September 22nd, 1919. (155,642.)

23,425. "Electrical indicators and like apparatus." J. G. Hooper and F. R. Hobley. September 23rd, 1919. (155,648.)

23,876. "Electric motor control systems." British Thomson-Houston Co. (General Electric Co.). September 29th, 1919. (155,662.)

25,820. "Manufacture of grid resistances." L. Satchwell. October 21st, 1919. (155,689.)

29,617. "Telephone and like circuits." Western Electric Co. (Western Electric Co.). November 27th, 1919. (155,698.)

1920.

1,086. "Electrical connections." A. F. Caine and Edison Swan Electric Co. January 13th, 1920. (155,717.)

2,327. "Apparatus for electric heating of engines of the hot-bulb type before starting." Petters, Ltd., and G. B. Petter. January 24th, 1920. (155,719.)

8,435. "Current collecting devices for electric traction." L. Vallino. March 20th, 1919. (140,171.)

10,168. "Automatic and semi-automatic telephone systems." Western Electric Co. April 11th, 1919. (141,703.)

11,638. "Use of thermionic devices for producing frequency harmonics of electric oscillations." Western Electric Co. April 28th, 1919. (142,474.)

17,003. "Electric switch." J. Beissbarth. January 31st, 1919. (146,268.)

19,005. "Electric transformers for use with measuring instruments." Compagnie pour la Fabrication des Compteurs et Materiel d'Usines a Gaz. June 26th, 1914. (147,047.)

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GERMAN INDUSTRIES IN 1920.

A MORE favourable impression will be left on the minds of those who peruse the latest official report on the industrial and economic situation in Germany than that which was created by the report for 1919. At the same time, it would have been better if the Department of Overseas Trade had characterised the present document as a report for 1920 rather than to have set it forth as dealing with the situation in December, 1920, because the report contains very little—if, indeed, anything—appertaining to the final month of last year.

The report, which has been prepared by Mr. J. W. F. Thelwall, commercial secretary to the British Embassy, Berlin, assisted by Mr. C. J. Kavanagh, British commercial secretary in the occupied territories, Cologne, states that on looking back over the past two years it is impossible not to be struck by the evidence of improvements in all departments of public life in 1920, excepting State finance, as contrasted with the previous year. In itself this assertion merely confirms everything which it has been possible to gather from the German newspapers during the past two years. The two chief impressions formed by Mr. Thelwall in surveying the country's activity in 1920 are represented by the constitution of combines within the country and co-operation with foreign groups. These combines, which aim at uniting whole branches of industry, are said to be intended to be an alternative to State ownership. The problem, however, might have been set in stronger terms, as the combinations are also partly being promoted to defeat State ownership or socialisation. Unfortunately both of the commercial secretaries fall into the error of also applying the word "syndicates" to these financial amalgamations and communities of interests by means of an interchange of shares between the companies concerned. Syndicates are industrial associations of manufacturers for the regulation of production and prices, and the members are financially entirely independent of each other.

As the report reminds us, the inclination to form combinations has so much increased that the bulk of the coal, iron and steel industries will be held by a few groups led by dominant personalities, and while these are perhaps the most striking on account of size and power, similar organisations are in existence or in process of formation throughout the country. The old chemical trust, for instance, has been strengthened and prolonged, shipping is said to be controlled by two companies only, and the electric lamp industry, the motor-car industry, and the oil and fat trades have formed trusts of their own. Moreover, manufacturing firms have established connections with companies in other countries, either by granting the latter a direct interest in the German concerns or by the formation of a company abroad in which several German companies participate, with the object of ensuring the delivery of raw materials. Such arrangements have been made in the oil and margarine industries with the Dutch, in the electrical and textile industries, and in shipping, with the Americans, in the rubber industry with the British, and in ores with the French.

Turning to the consideration of the export trade, we find emphasis laid on the fact that the country must concentrate a large part of her energies on developing this trade as being one of the most effective means for bringing about economic restoration. It is impossible to say how far she has been successful, owing to the absence of official figures, but the report remarks that all indications go to show that the country has lost none of her old skill in adapting hérself to the requirements of various markets, and in organising and directing her export trade into the most profitable channels. No doubt the foreign trade would expand even more rapidly if it were not hampered by a complicated system of licensing, but despite this, it is said that German competition will be found and must be reckoned with from South America to Japan, there being quite enough neutral and Allied shipping to carry it there. As the goods start with the initial advantage of lower costs of production, freight rates do not deprive them of their competitive power as compared with goods made in other European countries. The subject of coal is discussed at some length, and it is concluded that while German industry is not abundantly supplied with coal, it is far from being annihilated through the lack of it, and the situation is improving in so far as the production of coal is concerned.

The position of the iron and steel industries is dealt with at some length by Mr. Kavanagh, who points out that the most prominent feature is the rapid progress which has been made in extricating the industry from the state of disorganisation which followed the losses of territory and productive works under the Treaty of Peace. After referring to the soaring of prices of iron and steel down to April, 1920, he states that it was not until the Eisenwirtschafts Bund (Federation of the Steel Industry) came into operation in that month that any sort of stability was visible in the market. Quite so, stability in prices under the dictation of the Government. The Commercial Secretary, however, does not tell us that this so-called self-governing federation was forced on the iron and steel makers against their will; that it is composed of 70 members, of whom only 17 are steel makers, 35 are workmen members, and the remainder are merchants and consumers; that the federation is in reality controlled by the workmen members and the consumers with the support of the Minister for Economic Affairs; that it is a re-introduction of the war-time system of compulsory administration for ulterior political purposes, and is hampering the development of the industry, despite the urgent demands of the steel makers for the immediate abolition of this "self-governing body."

Dealing also with the subject of amalgamations, the report remarks that smelters and steel makers are acquiring coal interests, and assimilating rolling mills, sheet metal works, and shipyards, and mechanical and electrical concerns are entering into agreements with iron and steel producers with a view to ensuring a sufficient supply of raw materials. The resulting combinations in some cases are of considerable magnitude, and one case—that of the Siemens-Rhine-Elbe-Schuckert Union—has given rise to a concentration which controls a capital of 500,000,000 marks, and employs 200,000 hands. It is also recalled that the A.E.G. has concluded a working agreement with the Burbach-Eich-Dudelingen Steel Co., Luxemburg, through the former's association with the Felten and Guilleaume Co., although this chiefly concerns the supply to the latter of semi-finished steel to compensate for the loss of the Steinfort (Luxemburg) Steel Works. In addition, particulars are given of other amalgamations, and it is added that further fusions are in prospect. The report also deals with the mechanical engineering industry, which is referred to in another part of the present issue.

The further parts of the report treat of the chemical industry, oils and fats, the textile industry, labour, and the cost of living. But apart from the passing references to electrical firms already given, and a brief note on electrical power stations, we look in vain for any particulars concerning the electrical *manufacturing* industry, while even the shipbuilding industry is dismissed in eight lines. If information respecting these two important industries becomes available to persons outside Germany, it should also be at the disposal of those residing there; and it is very unfortunate, to say the least, that prominence should be given to certain industries to the practical exclusion of others which are of importance, at least equal to, if not greater than, that of those which combine to swell the volume of the report.

Non-Statutory Suppliers.

An idea seems to be germinating that an opening may show itself, sooner or later, for some unconsidered trifles to be picked up in the way of unauthorised distribution of electricity supply. The idea is that when the various Joint Electricity Authorities get under way there will be transmission lines here and there and everywhere in a district, and that a discreet Autolycus, dispensing with any statutory permission or powers, can quietly start distribution, purchasing his supply in bulk. Being under no restrictions and unhampered by any duties or obligations, he foresees a good harvest in this form of enterprise. Up to the present, although there are a number of non-statutory electric supply companies, a natural limit has been placed on them by the fact that they have been obliged to provide generating stations and so on, with the corresponding increased risk. It was felt by the Board of Trade Electric Power Supply Committee that it was advisable to give these companies an opportunity of regularising themselves at a small cost and by an easy statutory procedure, and under the 1919 Act the Special Order which was substituted for the more ponderous Provisional Order covers such eventuality. It is up to the Electricity Commissioners therefore to check promptly an extension of irregular supply of the kind anticipated; otherwise there might crop up a swarm of these pygmy systems of distribution which would seriously stand in the way of the systematic methods ensured by the terms of a statutory Order. A statutory undertaker must distribute practically to everyone who wishes it, in the given area. A non-statutory supplier is not loaded with such public duties. Our remarks do not apply to most of the present non-statutory companies, which are indeed giving supply to the public in unimpeachable style. But the netting of the country with bulk-supply transmission lines may entice forth quite a special kind of adventurer, who should both in the interests of the public and of the industry be peremptorily discouraged.

I.E.E. Informal Meetings.

The informal meetings of the Institution are maintaining their high standard, and establishing their claim to become a permanent feature of its proceedings. On Monday last an excellent discussion took place on Mr. Milne's pet subject—the cheapening of electric wiring. This is a matter to which we have previously drawn attention as one of urgent importance, and it is somewhat to be regretted that the discussions, according to the rigid rule of these meetings, are not available for publication. This defect, however, is to be remedied, as it is proposed to furnish a précis of the discussion to the Press on future occasions.

The Liverpool Inquiry.

Great interest has attached to the proceedings at the inquiry—the first effective inquiry under the 1919 Act, for the Bristol one no sooner began than it ended for the time—which was held at Liverpool last week. The proceedings occupied five days, and were adjourned for a month or more. It is clear, therefore, that an inquiry of this nature, affecting the complete reorganisation of electricity supply in an industrial area of the first importance, and the outlay of 4 or 5 millions sterling, is a very onerous and protracted undertaking, and if later inquiries are equally exhaustive, the Commissioners will have a busy life during the next year or two.

The inquiry revealed the fact that certain authorities within the area, both municipal and company, were by no means favourably disposed towards co-operation, still less towards absorption in the scheme; the Commissioners have no compulsory powers, except the power of withholding sanction to extensions of plant, and therefore any undertaking which chooses to stand out and carry on as at present can do so. We hope, however, that no such action will be taken as will impair the efficiency and success of the Joint Electricity Authority which will doubtless be set up.

MESSRS. HIGGS BROS.' MOTOR WORKS.

We recently had the pleasure of visiting the works where the Higgs motors are made, at the Sand Pits, Birmingham, and procuring photographs of their equipment and products.

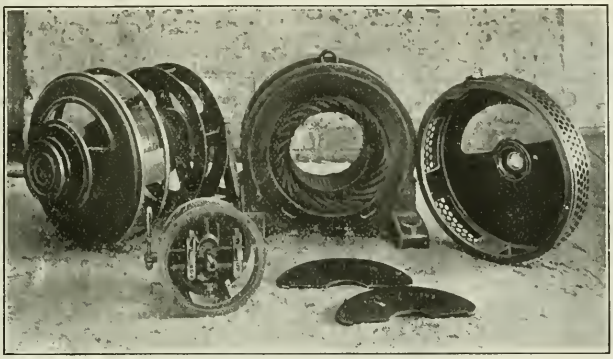


Fig. 1.—Assembled Components of an A.C. Motor.

Fig. 2.—Exterior of Works

This young firm has "made good" in a comparatively short but strenuous time, and its methods are characterised by certain features, particulars of which, we trust, will be found interesting.

In the first place, it is worthy of note that Mr. W. F. Higgs, the founder of the firm, whilst acquiring knowledge and experience as an apprentice, always kept before his mental vision a determination to establish a business of his own—a purpose which, in these days of big concerns, requires a good deal of pluck and resolution. In 1912 he commenced operations at Balsall Heath, in premises occupying 1,500 sq. ft., with a staff whose combined wages for the first few weeks amounted to £4 12s. a week; the rent was £7 10s. a quarter, electric power cost £8 a quarter, gas £3, and insurance £1 10s. a year. With this small beginning, he carried on for 12 months—and made a net profit of 100 per cent. on his modest capital! From these figures the young manufacturer may draw encouragement; clearly there is still scope for a small manufacturer, provided that he has the ability and application necessary to deserve success. In those days the largest size of motor made by the firm was rated at 5 h.p.: not only home but also German competition had to be faced, and the greatest care was necessary to secure the utmost economy of labour and material.

Since then, of course, the firm of Higgs Bros. has made great strides, and has firmly established its position in the national goodwill; but true to the original idea, it has grown up entirely on its own foundation, admitting no outside capital, and incurring no debt. Motors are now built up to 50 h.p., a limit beyond which Mr. Higgs, who controls the designs, will not go, as the factory equipment is designed for dealing with a maximum weight of one ton. While the brisk demand arising out of the war conditions naturally helped the development of the business, the impossibility of carrying out extensions had a contrary effect, and when the business was transferred to the Sand Pits in 1917, it was necessary to make the best of such accommodation as was available; this took the shape of two five-storey buildings, cut up into some 40 shops, so that the lay-out is far from ideal. In spite of this drawback, the firm has prospered in its new home, but when, as planned, it is able to move to a more convenient building, it will be in a position to make further economies in the processes of manufacture.

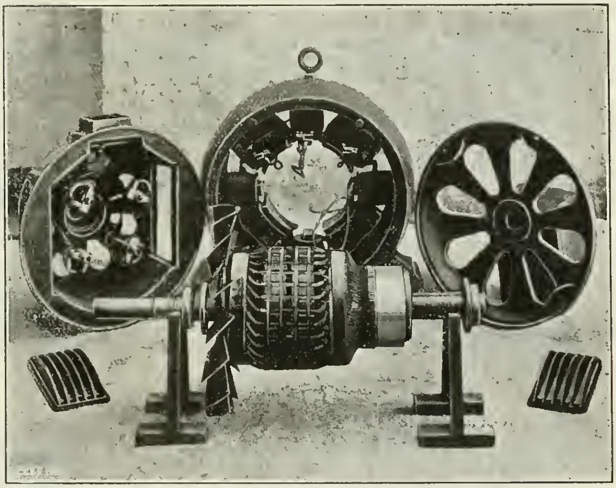


Fig. 3.—Assembled Components of a D.C. Motor.

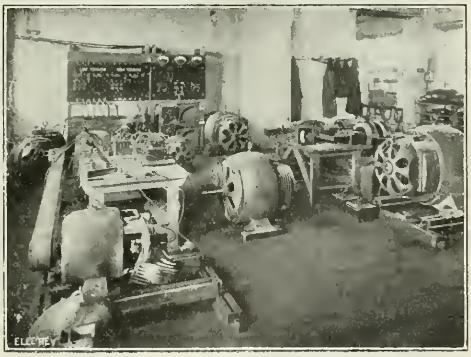


Fig. 4.—Experimental Shop.

As illustrating the progressive policy of the firm, we record with much pleasure the fact that in 1917 the metric system was substituted for English weights and measures throughout. In the ordinary course, new designs were in preparation, and these were drawn out entirely in metric measures, with the exception of the steel for shafts, which could not be obtained in millimetre sizes. Mr. Higgs derides the statement which is constantly made by opponents of the system, that the cost of the change is ruinous; as we showed in a series of articles in 1915, this objection is imaginary. The decimal metric system is now in use throughout the factory, except for screws larger than the B.A. sizes (which are already metric), and Messrs. Higgs Bros. would prefer to use the metric screws if they were obtainable, regarding the design of the thread as superior to the Whitworth type.

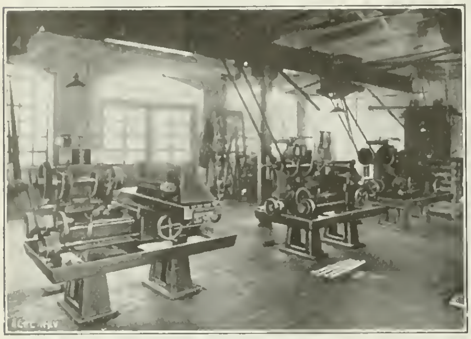


Fig. 5.—Special Machine Shop.

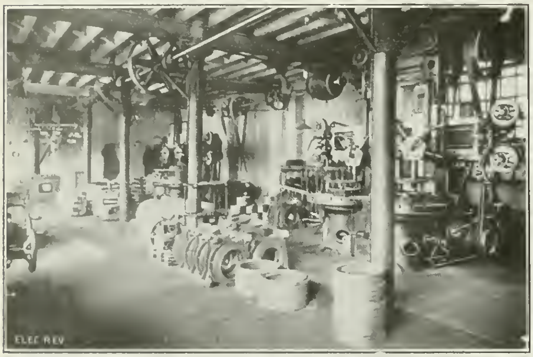


Fig. 6.—Heavy Machine Shop.

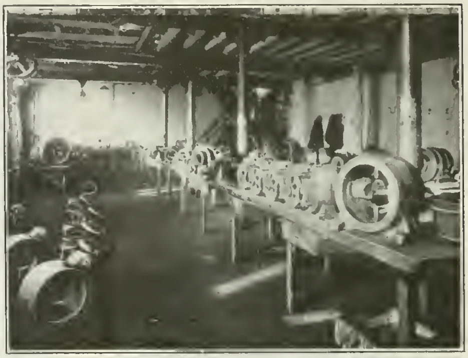


Fig. 7.—Assembly Shop.

The motors built by the firm are rigidly guaranteed to comply in every respect with the British Engineering Standards, and with the makers' specification: if a customer is not satisfied with a machine, it is either made satisfactory or replaced by another. On January 1st, 1921, we were informed, prices were reduced not only on new orders, but also to an equal amount on those in course of execution.

The firm objects to a maximum temperature exceeding 200° F. in any part of a machine, and while it recognises the necessity of rating a machine up to the maximum safe load, it regards reliability as the supreme consideration, to which all others must give way. For this reason, the first machine of a new design is built with thermo-electric temperature indicators incorporated in its structure; by this means precise information as to its proper rating is obtained, and it is certain that repetitions of the same design will give the same results.

The motors are built for d.c. and two or three-phase a.c., in two types—"protected," and "enclosed ventilated"—and are suitable for most applications in mills, factories, &c. No variation from the standard designs is permitted; if a special machine is asked for, a standard machine is offered that will do the work with reliability. All the motors are fitted with ball bearings, which enable small clearances to be safely employed, resulting in high efficiency and high power factor.

Messrs. Higgs Bros. have never had any trouble with their workmen, even when strikes have been in progress elsewhere: their policy is to pay good wages, treat the men well, and to take a real interest in their welfare. Amongst the amenities which they have provided are a works canteen, football field, and rifle range, and the sports club is a popular institution. The authority of the foremen is safeguarded by passing all communications with the men through their hands, but, at the same time, direct contact with the men is maintained, the foreman being a party to all interviews.

Piecework is in force throughout the works, but is not favoured by the firm; when conditions permit of it, the "conveyer" system will be adopted, with high, but fixed, wages. An efficient organisation to keep every man supplied with work is considered essential to economical production, and punctuality in the highest offices is obligatory, for the sake of example.

The great majority of the machines sold are supplied direct from stock, there being usually from 400 to 500 finished motors in stock, and 1,000 in course of manufacture. An elaborate system of stock-cards is in use, which ensures that, say, six machines of a certain size are always in stock; when that limit is reached, a batch of six more is put on order. A system of keeping monthly records in the form of curve diagrams is also employed, giving minutely detailed information on a wide range of subjects, such as manufacturing costs, wages, insulation failures, &c.—the set of curves numbering upwards of 30, and being always kept up to date.

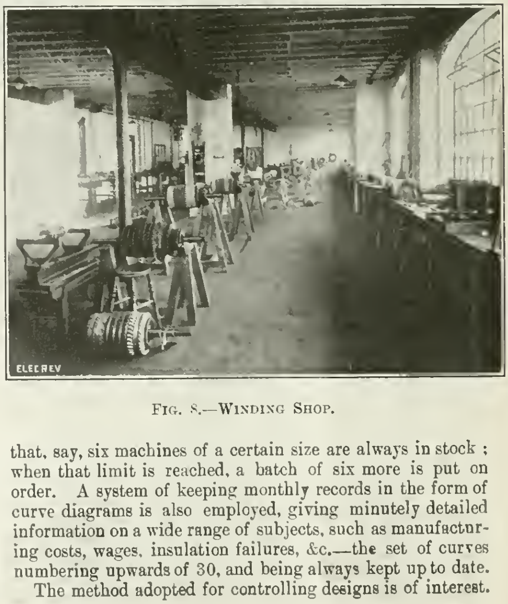


Fig. 8.—Winding Shop.

The method adopted for controlling designs is of interest.

The structural details of a particular design are fixed, after due investigation and experiment, by Mr. W. F. Higgs, but the windings have to be varied to suit "the infinite variety" of voltages and frequencies enjoyed by the long-suffering consumers in this country. A folder is set apart for one standard mechanical design, the whole of the details of which are invariable; this folder contains a series of design sheets recording the data corresponding with the different windings used with that particular carcase.

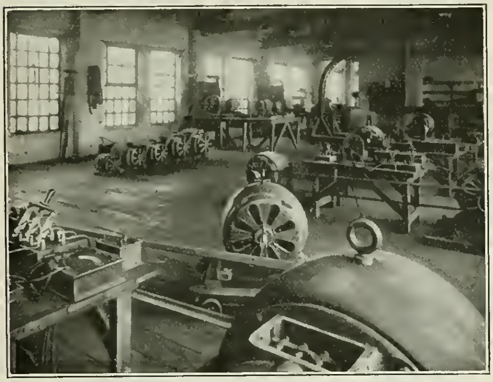


Fig. 9.—Test Room.

The drawings are prepared in accordance with a uniform system which has been developed to a high degree of perfection, each detail having a standard sheet to itself, showing only those dimensions with which the shop is concerned; moreover, on corresponding drawings of the same detail, but of different sizes, the lettering, and even the positions of the lettering and dimension lines, &c., are identical, except in respect of the dimension figures themselves. Every item without exception that is required for a machine is entered on the list of material for that machine, and no machine is allowed to go into stock until it is complete to the last screw.

The stock is divided into three classes:—(1) single component parts; (2) assemblies of components; and (3) complete machines. In every case orders are put through in batches, the number of items included depending upon the size and nature of the particular part, but never being less than six. Taking, for example, a batch of six steel shafts; the batch is started on its course, accompanied by a card containing particulars regarding the order, the number of operations and the time allowed for each operation, and other necessary data; provision is made for recording the inspection of the part at appropriate stages, and the batch is not accepted in the stores unless every item is present and completed. Even spoiled work has to remain with the order up to the final inspection and arrival at the stores, so that no scrap accumulates in the shops, and no part is ever lost. Cast-iron yokes, which are at present purchased in batches of 20 to 50, are received into the "rough castings store," which is a buffer between the delivery office and the workshop, and each batch is controlled by a stock card, so that the precise quantity available is always on record.

Figs. 1 and 3 show the chief assembled components of standard a.c. and d.c. motors. The d.c. machine has a cast-iron yoke with mild steel poles and interpoles cast in place; all machines above ½ h.p. are provided with interpoles, and every machine is capable of a speed variation of 100 per cent. by field control. The ball bearings are of the same size at both ends of the shaft, and the machines are reversible without moving the brushes, commutation being on the neutral point. There are no loose wire connections inside the machine, stiff wires being used, with soldered joints. The poles are provided with laminated shoes, and the coils are wound with enamelled wire, taped with black tape, and labelled with a stamped metal number disk which enables a user to be supplied with an exact duplicate in case of need. The motor is thoroughly ventilated by a fan attached to the armature. The terminals are housed in a compartment in the top of the yoke, which is covered with a c.i. box containing spare brushes and springs, running instructions, a lubricator, and enough grease to last for two years—the use of the right kind of grease being essential to the success of ball bearings. The d.c. machine is dispatched from the works bolted to a couple of battens, without a crate, a method which has proved both satisfactory and economical (for this reason the lubricator abovementioned is put into the box for safety in transit).

The brush gear is of particular interest: the arms are fixed to the rocker by an ingenious coned joint, which ensures permanent rigidity, and the brush-holder box is a die-stamping of metal having a tensile strength of 33 tons per sq. in. and an elongation of 15 per cent. Morganite Link 1 brushes are used.

In the a.c. motor the outside of the stator laminations is exposed to the air; the stator is wound with formed coils, of wire enamelled and single-cotton-covered in the small sizes, d.c.c. in the larger. The enamel coating stands a pressure of 2,800 V between adjacent layers. The interior of the stator, and the exterior of the rotor, are ground, so that a very fine clearance is practicable, the size of which is known with certainty to 10 per cent.

The rotors are always wound three-phase, and provided with two radial slip-rings, the shaft providing the third contact. A simple but effective short-circuiting gear is used. Squirrel-cage rotors are built on the system described in our issue of May 14th, 1920, with flat copper bars, twisted at the ends so as to form a cylinder, and welded together, making a sound but inexpensive job.

We give herewith a number of views taken in the workshops. The firm is self-contained as far as possible, and intends eventually to have its own foundry. Core laminations are stamped on the premises, and coated with insulating paint by spraying. Die stampings are used for couplings, brush boxes, &c. All shafts are ground to a finish, and the machined parts are made completely interchangeable with the aid of gauges. The bases of castings are faced in the lathe, not planed. All jigs, tools, and gauges are made on the premises. Several single-purpose machine tools, designed and built by the firm, are installed. Pulleys are made on novel lines, the face being finished in one cut. The variety of parts stocked is kept down to the minimum; for example, 17 different screws suffice for the whole range of 32 standard machines, from ¼ to 50 h.p.

Every machine is tested on load for three hours, flashed five times, and certified by the head of the testing department, which is equipped with means for carrying out tests at any frequency from 25 to 60 cycles, and any pressure up to 3,000 V.

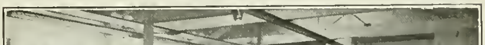


Fig. 10.—Finished Motor Store.

In concluding this brief sketch of the firm's activities, we desire to express our appreciation of the cordial reception accorded us by Mr. W. F. Higgs, A.M.I.E.E., and his partner, Capt. C. Higgs, M.C., R.E., on the occasion of our visit. Messrs. Higgs Brothers cast their name on every machine that they build, with pardonable pride—for it is the mark of a machine which can be depended upon to do all that is claimed for it.

EDISWAN JUNCTION BOXES.

Amongst the various difficulties with which electricity supply engineers have had to contend during the last few years has been the slow production of junction boxes. Bad as the position was for obtaining deliveries during the war, the supply undertaking could feel that it had other reasons as well, backed by the approval of the Government and public, for the exercise of deliberation and selection in extensions of networks and the connecting-up of new consumers. Since the Armistice, hundreds of new consumers have been clamouring for connection, but the supply of straight-through and terminal boxes for the new mains, and service boxes and house-service cut-outs for new consumers, lagged months behind the demand. Arrears accumulated during the moulders' strike, and now, although foundries are gradually making up for lost time, cable deliveries are also appreciably better, and the demand for junction boxes is likely to show little sign of abatement.

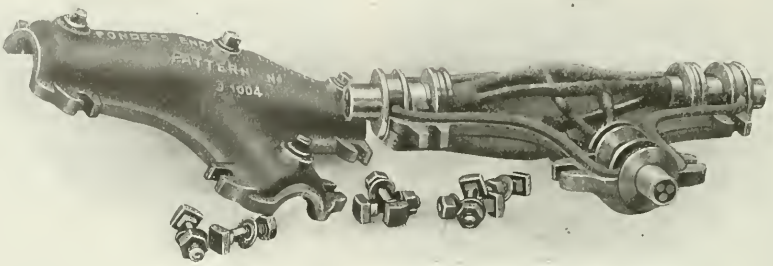


Fig. 1.—House-service Box for 3-core Cable.

In these circumstances, it is not surprising that the Edison Swan Electric Co., Ltd., whose cable department has developed as rapidly in the output of main cables as in the supply of cables for house wiring, should have decided to commence the manufacture of junction boxes at the Ponders End Works.

The Ediswan boxes, while following the lines which have been found most suitable for normal conditions in general practice, possess some interesting features in technical detail. Fig. 1 illustrates the three-core service box, a feature of which is that, while there is ample room for making connections, and good clearance between the conductors themselves and the wall of the box, the amount of compound required for filling is reduced to a minimum. This point will be particularly appreciated by engineers in charge of large networks, on which the expenditure on box componnd is a serious item. It will be seen by the illustrations that the compound gland type has been adopted, and that the uncertainty of proper bonding between the lead of the cable and the box, occurring in some designs, is eliminated by a tinned copper earthing strip at each way, which is sweated to the cable and screwed down against a machined surface on the box itself. Another point, which will meet with the approval of the practical mains engineer, is the thickness of the lugs. Many engineers know to their cost the trouble from breakages of lugs in the earlier designs of junction boxes.

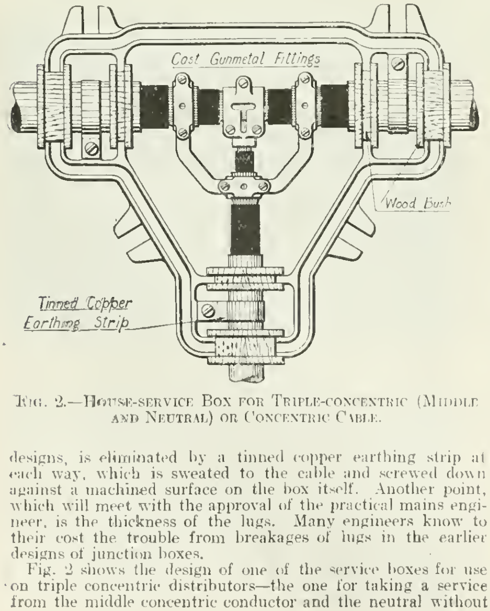


Fig. 2.—House-service Box for Triple-concentric (Middle and Neutral) or Concentric Cable.

Fig. 2 shows the design of one of the service boxes for use on triple concentric distributors—the one for taking a service from the middle concentric conductor and the neutral without exposing the middle conductor—and it will be found a convenience that the castings of these boxes are made to be interchangeable with those for use on ordinary two-conductor concentric cables. The boxes for services from the inner and neutral conductors of a triple concentric cable are larger, as the middle concentric conductor has to be cut in order to bare the inner one, and sufficient length has to be provided for the fitting to re-connect it.

In its terminal boxes the Ediswan Co. has adopted the wiping gland in preference to the compound gland. The former, although it may involve the exercise of a little more skill in fitting-up the box, always presents a neater appearance, ensures good bonding, and eliminates the drippiness and stickiness which is frequently in evidence when a compound gland is used in a vertical position. The company has departed from the nsual practice of screwing the wiping gland into a thread cut in the two halves of the box. With a screwed-in wiping gland, it is virtually impossible to have a perfect joint both between the two halves of the box from top to bottom and between the gland and the box. If one is sufficiently tight, the other is apt to be too loose. In the Ediswan pattern, the brass wiping gland has a wide flange which is bolted to a machined surface on the lower end of the box. The bonding is thus perfect, and at the same time the two halves of the box can be bolted tightly together and the compound poured in at a high temperature without any risk of its leaking. Separate bushes are provided for each of the tails, which have a straight vertical run, making short-circuiting absolutely impossible.

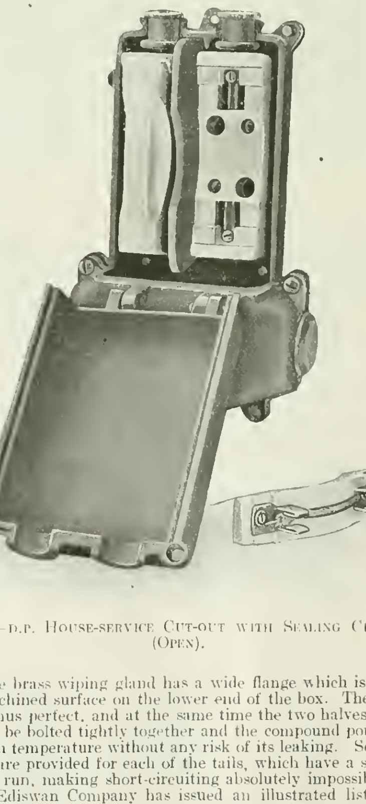


Fig. 3.—d.p. House-service Cut-out with Sealing Chamber (Open).

The Ediswan Company has issued an illustrated list of its low-pressure boxes, in which these and other patterns are described in detail. A feature of this catalogue is a list of a dozen sizes of plain cast-iron cases with iron covers with a list of extras for tapped bosses for conduits, wiping glands, sealing glands, packing glands, and filling plugs to make them adaptable to any purpose for which special boxes are required.

Together with the above list, a separate catalogue of house-service cut-outs has been brought out. This includes a neat pattern of combined double-pole cut-out and sealing chamber which should entirely remove the prejudice against placing the fuses of both poles in one case. As is seen by the illustration (fig. 3), the cover opens downwards. The fuses are of the well-known Ediswan Home Office pattern, separated by an insulating fillet, and accidental short-circuiting or earthing is virtually impossible. The cable can be led in either at the bottom or either side, as three blank bushes are provided. A similar design is adopted for the triple-pole cut-out, two patterns being made, one with three fuses for 3-phase services and the other with a link instead of a fuse in the middle for 3-wire d.c. services.

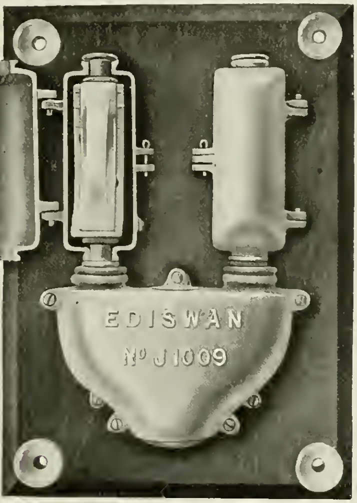


Fig. 4.—Service Fuse Board with s.p. Fuses and Sealing Chamber.

For those who still prefer to employ single-pole fuses, a well-fitting and substantial sealing chamber (shown in fig. 4) has been brought out. In this there is a separate bush for each pole, and attention has been paid to a proper fit between the two halves. Ironclad house service switches, single-pole Home Office pattern cut-outs, and house service panel boards are also included in this list.

CHEMICAL AND METALLURGICAL ASPECTS OF ELECTRIC ARC WELDING.

By J. H. PATERSON, D.Sc., F.I.C.

(*Abstract of paper read before the* Institution of Electrical Engineers, Liverpool Sub-Centre *of the* North-Western Centre.)

In this paper the author gives some account of the probable chemical composition of the metal which is filled into a weld made by the iron process, and of the variations in micro-structure which are produced. The carbon content of the metal can be neglected, as it is usually very low, and is not a dominant factor.

As a weld is made in an atmosphere rich in oxygen, the deposited metal should contain oxides of iron, but analysis shows that in addition considerable quantities of iron nitrides are also produced. The quantities of oxygen and nitrogen to be found in a weld metal may be gauged from the following curves (fig. 1).

The decrease in the quantity of oxygen with the increase in the current strength is noteworthy, and is probably brought about by the greater fluidity of the metal deposited at high current strengths owing to the general temperature of the weld being higher. This gives the globules of oxide present time to coalesce and come to the surface of the weld where they form a slag.

Whether any of the oxide present in the weld goes into solution in the iron or not is a debatable point. The microscopic examination of any weld shows the presence of quantities of small threads and globules of slag (probably iron oxides of various kinds), but whether the iron itself dissolves any iron oxides while fluid is not very clear. The necessity for knowing something definite on this point is due to the fact that if the molten iron dissolves iron oxide while fluid and then allows of its complete or partial separation during cooling, serious disturbance of the mechanical properties of the iron may be expected. If, on the other hand, the oxide does not dissolve, then the iron oxide present will be very like the slag present in wrought iron or cast steel, it will only act as a diluent to the good metal surrounding it.

Dr. Rosenheim is of the opinion that ferrous oxide is insoluble in iron, and points out the notable constancy of the melting point of pure iron by various investigators as strongly supporting this idea. Messrs. Rawdon, Groesbeck, and Jordan, in a recently published paper, give an account of work done by them in the laboratories of the U.S.A. Bureau of Standards on weld metal, in the course of which they found that, on heating a piece of weld metal in vacuo for six hours at 1,000 deg. C., the globules of iron oxide coalesced into larger particles. If it is assumed that the globules are iron oxide then the migration of the particles can only be assumed to have been caused by the solution and subsequent redeposition of the iron oxide in the surrounding iron. Other investigators have failed to find any movement of iron oxide inclusions in cases where the inclusions were known to be iron oxide only. Numerous experiments, most of them not very convincing, have been done to show the effect of nitrogen on the mechanical strength of steel, and as a result, quite a number of metallurgists are agreed that more than .01 or .02 per cent. of nitrogen in steel is dangerous. As weld metal contains normally from eight to ten times these quantities it may be assumed that, if their theories hold good, the metal produced in electric welding owes all its weaknesses to the nitrogen content.

The presence of all this nitrogen is a matter of considerable interest as iron in the molten condition is barely affected by it. Andrew, by heating iron for long periods in an atmosphere of nitrogen at high temperatures, succeeded in producing alloys of iron and nitrogen containing 0.3 per cent. of the latter element. As weld metal is only hot for a few moments, this cannot explain the production of 0.15 to 0.16 per cent. of nitrogen in weld metal.

In 1911, R. J. Strutt showed that under the influence of a high-pressure discharge nitrogen became chemically active, and would rapidly combine with metals such as sodium, magnesium, and calcium at ordinary temperatures. Later Koenig and Elod showed that active nitrogen was produced when the gas was drawn through a d.c. carbon arc, and it would appear probable that the high proportions of nitrides present in weld metal are due to the existence of this very active form of nitrogen in welds produced by the carbon-arc process, and also in steel melted in the electric furnace, which shows that either the carbon monoxide produced in the arc exercises some protective influence on the weld, or that some other not fully understood phenomena are produced.

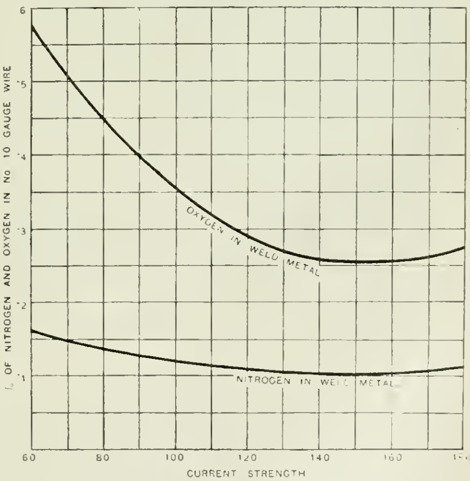


Fig. 1.—Oxygen and Nitrogen Found in Weld Metal.

The methods for the determination of nitrogen in metal are faulty, because one cannot be sure that in any given specimen the determined nitrogen is all the nitrogen the metal really contains. The author has pointed out that when weld metal is heated in hydrogen a certain amount of the nitrogen is given off as ammonia, a certain amount is given off as apparently uncombined nitrogen, and a certain proportion remains in the metal. In one case, for instance, a weld metal containing 0.095 per cent. of ntirogen when heated for thirty minutes in a current of hydrogen, gave off 30.5 per cent. of the element as ammonia, and the residue on analysis still contained 23.1 per cent., showing that 46.1 per cent. had escaped as uncombined nitrogen.

Rawdon and his collaborators found that specimens heated in vacuo lose nitrogen to the extent of about 50 per cent. As, however, their metallographic researches do not coincide with this loss, they suggest that the ordinary methods of analysis only determine the nitride nitrogen, and that the quantity apparently eliminated on heating has really been converted into another form which is unattacked by the reagents used. This is a very improbable explanation, especially in the light of the author's results, but the fact remains that a large field for interesting and informative research opens up in connection with the presence of both oxygen and nitrogen in steel. It is hoped by making specimens of weld metal in which nitrogen cannot possibly exist, by making welds in nitrogen perfectly free from oxygen, and by the study of these welds, that definite conclusions will be arrived at.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

A Generator Problem.

I have followed "Wireman's" trouble for the past few weeks. I should like to try and help him, as I had the same trouble last June. I tried reversing the shunt, then the armature; then I tried exciting one of the shunt coils off a 500-volt circuit with a set of lamps in circuit with the one shunt coil, and coupled up the other three coils across the armature, and it would generate quite all right. The only method that worked satisfactorily and overcame the trouble was to couple a wire through a switch so as to short-circuit two of the shunt coils, leaving only two of the four coils across the armature until the voltage rose, say, to 200 volts; then to switch off the short-circuit and leave the four coils in series.

Wm. John.

Crynant.
January 26th, 1921.

It is evident from the particulars given in your issue of December 17th, 1920, that the machine in question is intended for separate excitation, as, if 480 V were applied to coils wound for 60 V, they would promptly burn out.

I would suggest that "Wireman" should test the field current passed by the motor and compare this with that passed by the generator with all field resistance cut out. He will in all probability find that it is exactly, or approximately, the same. If such is the case, it clearly proves my contention *re* separate excitation.

With reference to the series winding, if this is on the main poles it should be connected in opposition to the main excitation, the reason being that this has the effect of reducing the amount of current flowing during the striking of the arc, and also contributes greatly to economy in current by reducing to a great extent the amount of series resistance needed in the arc circuit.

I should further like to point out that the reason for adopting separate excitation is that if the machine be self-exciting, it is possible for the series coils to overcome the shunt coils and destroy the excitation of the machine, if the arc is not struck quickly, and with plenty of series resistance in circuit.

I have been able on several occasions, by careful regulation of the excitation, to obtain a balance between the series and shunt coils and maintain a steady arc without the aid of any series resistance in the arc circuit.

Frank S. Rumball.

Luton, *January 29th*, 1921.

Shop Displays.

In common with many of your readers, I have read the correspondence under the above heading with interest, mingled with mixed impressions of disappointment and hope.

I dislike unidentified letters, which savour of lack of courage, and also deplore the vituperative tone of Mr. Tate's replies. It is also unfortunate that Mr. Cohen should endeavour to redress his grievances through the hospitality of your columns, seeing that more constitutional methods were available. We all have cause for complaint, and Mr. Cohen should memorise the lines of Seneca which read: "Let no man presume to give advice to others that has not first given good counsel to himself."

As a member of the E.C.A. I have for many years been known as "the Opposition," and also by the much respected Mr. Cash as the "Gadfly." Why? Because I endeavour to stimulate those silent and sluggish members who are content to let others overburden themselves with duties whilst they—the silent ones—refuse to give support by attending meetings, being content to pose as injured and ignored.

To "Retailer" and others I beg to give a few lines of advice: Primarily, they are certainly unaware of the difficulties confronting them in their endeavour to found an organisation which will create their *ideals*. Secondly, they are neglecting the excellent prospect of success and are retaining the sand but washing away the gold. I will be more explicit.

Let from 40 to 50 disappointed contractors, &c., who are legitimately entitled to membership, immediately join the E.C.A. Following this they must resolve to attend the forthcoming annual meetings. If they will do so they will have the opportunity of electing whomsoever they desire to represent their interests. They can remove from office those who are supposed to run the Association in their own interests, and in consequence will hold the reins and thereby be able to demonstrate their capability to create a strong representative and co-ordinate body. I hope they anticipate the magnitude of their responsibilities when they get the powers. Personal acquaintance is very educational at times.

In conclusion, your correspondence does not indicate the geographical source of complaint. Therefore I wish to indicate that although London seems so badly served, the numerous branches throughout the kingdom are seemingly happy and well catered for.

W. Ellerd-Styles.

London, N. 1.
January 31st, 1921.

The Life of Metallic-filament Lamps.

Several times recently I have been called upon to quote a price per annum for the maintenance of electric light installations, and, naturally, I have been very interested in the correspondence in your columns on the above subject.

Referring to the letter from "J. W. H." in your issue of the 28th inst., in which he says: "Generally speaking, the average life is about 200 hours for ordinary metal lamps, and 100 hours for half-watt types," I should be glad to know how "J. W. H." arrived at these figures, which, of course, must only be approximate, and to my mind are quite true with the lamps of the present-day standard of manufacture.

Take, for example, an installation of 100 ordinary metal-filament lamps and one of 100 "half-watt" lamps, in each case working on, say, 200 volts constant pressure, and assuming that the lamps are not subjected in any way to mechanical stress or shock, could "J. W. H." suggest a figure for average life in each of the cases just given as examples? I should be very interested to hear his opinion.

Referring to the so-called "half-watt" lamps, which I am glad to say are now beginning to be called gasfilled lamps by many, I have found when dealing with installations operating on a voltage of 200, that to install, in place of 200-volt lamps, lamps rated at 210 volts gives a considerably longer life to the lamps, and also the loss of candle power is not appreciable.

Maintenance.

January 29th, 1921.

I have followed with interest recent correspondence appearing in the Electrical Review on the above subject.

To my mind, the solution is not to reduce costs to take account of replacements, for that, surely, would tend to lower rather than raise the quality of lamps at the present time.

It is common knowledge that we have standard prices for metallic-filament lamps, and it is also the feeling of consumers that prices are on the high side. Therefore, as Mr. Aish suggests, if high prices are to remain, insistence should be placed upon an equally high standard of quality, thus prolonging the life of a lamp.

Many things enter into the life of a drawn-wire lamp, and one of the most important factors is the quality of the tungsten wire used in its manufacture. The quality of tungsten wire depends to a large extent on the way in which it is drawn, and, as a supplier of diamond dies, I know that a very great deal depends on the quality of the diamond die used. A really good diamond (not bort) die is comparatively expensive, but its apparent high cost is more than compensated by the long life and efficient service of the product. This statement applies not only to the drawing of tungsten wire for the manufacture of incandescent lamps, but also to the drawing of copper wire which enters so much into the electrical industry.

Filières.

January 24th, 1921.

The National Joint Board's Procedure.

I am desired by the employers' side of the No. 6 District Joint Board to send you the following resolution which was unanimously passed by them at their first meeting and subsequently confirmed by a full meeting of the Board held November 22nd, 1920:—

"That a recommendation be sent to the National Joint Board requesting that all future questions of conditions of employment or remuneration and other vital matters be referred to the various District Joint Boards for their consideration before definite decisions are reached."

As will be seen this resolution lays bare the root origin of the sore which ultimately festered and culminated in the employers finding themselves menaced with a situation which, to put it mildly, would not admit of temporising.

Had the above resolution been incorporated in the constitution of the National Joint Board, such an impasse would have been avoided and a considerable amount of "mud-slinging" saved. This resolution was submitted to the chairman of the Conference of Employers on January 7th, but he refused to accept it, as it had not appeared on the agenda, and he suggested that it should be brought to the notice of the re-formed Board. As is probably well known, the possibility of a new National Board being created has not matured, and is not likely to mature, and it is still within the bounds of possibility that the employers will have "slung" at them demands quite as exorbitant if not more so than the recent recommendations which have caused such an outburst of feeling during the last few months.

I respectfully submit that all schedules of salaries and working conditions should be considered by the District Boards before the final mandate is issued by the National Board (as is done in the case of the Industrial Councils). If this were the procedure, the District Boards would then be in a position to recommend to the undertakings covered by their areas the acceptance of the eventual findings of the national body. At the moment those District Boards which are set up have to press for adoption recommendations, which conscientiously they are ashamed to put forward and only do so in order to justify their existence. The No. 6 District Board would be glad to have the views of other Boards, and perhaps a united front may with tactful handling secure the adoption by the National Joint Board of the above or a stronger resolution in its constitution.

(Alderman) A. A. Senington,
Chairman of No. 6 (West of England) District Board.

Bristol.
January 31st, 1921.

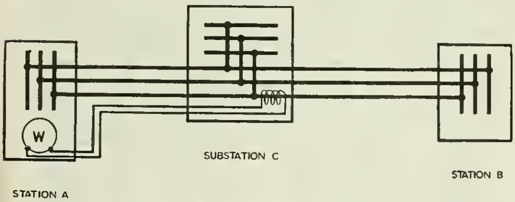
Indicating Wattmeter in Remote Position.

We notice a letter from "Inquirer" under the above title in your current issue.

As we understand the problem, it is required to indicate at the point A the power taken by stations A and C. This can readily be done by means of a current transformer (CT) installed on the incoming cable at sub-station C and connected by pilot leads with the indicating wattmeter (W) at station A, as shown in the accompanying figure.

In order to make it possible to use pilot leads of small section, the secondary current of the current transformer should be a fraction of an ampere in place of the usual 5 amperes.

It is unnecessary to run potential leads between the stations, since the line voltage at A can be utilised to excite the potential windings of the wattmeter. The potential connections have been omitted from the figure, for the sake of clearness.



We have assumed that the load can be regarded as balanced. If this is not the case, two current transformers should be installed and three pilot leads will be necessary.

If your correspondent cares to communicate with us, we would go into the scheme in detail, which is not possible without trespassing unduly upon your valuable space.

Everett, Edgcumbe & Co., Ltd.

Hendon.
January 31st, 1921.

Charging Batteries for Motor Cars.

With regard to the letter from Messrs. Rootes, Ltd., under the heading "Charging Batteries for Motor Cars," in your issue of the 28th inst., I understand Messrs. The Igranic Electric Co., of Bedford, manufacture the apparatus sought by Messrs. Rootes, their leaflet No. 780 of December, 1918, dealing with this equipment.

Marshall Tate.

London.
January 31st, 1921.

Electricity Supply from Surplus Sources.

Re your note on my letter under the above heading in your issue of the 14th inst., I realise that there are vested interests to be considered and difficulties to be overcome, but it should not be impossible to achieve at least something on the lines I have suggested. As a matter of fact, it is not infrequently done. The public supply corporations, when they get into a tight place, are glad to avail themselves of any surplus energy which a large works in the district may have available, as in this district at the present time. Also, it is done in the United States. In a recent issue of an American technical journal, in an article on "Power for Industrial Plants," it was stated that works having large demands for low-pressure steam were "producing more power than needed for their own uses, and selling the excess to power or other companies." Elsewhere in the same article it is stated that: "In some particular kinds of business, like a woollen mill, dye house, bleachery, soap factory, sugar refinery, &c., energy can be produced at rates at which it is practically impossible for the central power plant to compete."

But in the States they are accustomed to do things that we consider impossible. For instance, they supply steam or hot water for heating from the central supply stations, thereby saving at least some of the really ghastly waste involved in discarding 60 per cent. of the heat of the fuel with the cooling water. I cannot think that any system involving such a waste can be the last word in power generation. When things are wrong, as a rule it is the system and not the individual which is at fault. If a system could be arranged which would foster these small supplies of energy (large in the aggregate) by making it worth while for the individual to study them, things would alter. I know of a large works requiring a good deal of power, so much that the canal arm becomes unduly heated by the heat discarded with the cooling water, thereby impairing the vacuum and increasing the coal consumption. On the other side of the canal there is a jam factory. How much better it would be if, instead of using the exhaust steam to boil the water in the canal, it were used, or part of it, for boiling the jam.

Again, in the same power house, there is 500 kW of plant standing idle, whilst elsewhere in the same town other works cannot be supplied because the plant at the Corporation electricity works is overloaded, and the Government will not sanction further outlay. It has been suggested that the various works in the town should provide the money for the extensions, but it would be better if by adopting some such system as I have suggested, the works were to supply the power, or part of it.

It may be objected that it could not be done at the price, but if it is being done in the case of some works, why not in others.? It must be borne in mind that it is only the surplus power that is in question, and it would cost very little more than the fuel, and perhaps an extra stoker or two, to run the stand-by plant, and so the extra electricity could be developed at a very cheap rate. By linking up a number of works, as they would be if allowed to feed into the mains, it would not matter if the supply from one or two of the works were cut off, as the average would be maintained. Moreover, most of the works would be working the usual hours, so that the extra supply from the works would come on and go off just when it was most convenient for it to do so. I cannot help thinking that there is a greater possibility of obtaining cheap power by co-ordinating existing sources than by studying water power in England, and that it would be better worth while for a Government Commission to look into.

Albert Charles Pain, M.I.Mech.E.

Birmingham.
January 24th, 1921.

German Competition in the Electrical Trades.

In this matter surely the essential thing is whether Germany is better qualified for manufacturing than Britain. On this point the most essential factor is coal production, and in this Britain is better off than Germany; in fact, the largest single item of our exports to Germany was coal in pre-war days.

This country produced six tons per head per annum; Germany only three tons per head. Yet in 1913 Germany sent us £56,000,000 of manufactures and we sent only £27,000,000 to them.

In pre-war days we exported enough coal to create employment for 5,000,000 persons, that is, about 75,000,000 tons. The 10,000,000 persons employed at home requiring about 150,000,000 tons of coal to keep them employed. Germany exported very little coal—her coal exports were in the form of coal dust and clay.

Is it not remarkable that Free Trade Britain exported twice as much coal as *all* other countries together? Was it not a case of selling our *birthright*? Surely Esau ought to be our *patron saint*!

Our imports of manufactures were paid for by exports of coal, and we learn now that our foreign trade depends upon coal exports. In bulk, 84 per cent. of our exports were coal! Yet Germany exported more goods than we to protected rivals without sending them much coal!

On other points our policy seemed to be radically wrong. The three factors in wealth production are capital, labour and raw material. We exported all three in vast quantities.

In 1913 and previous years, Britishers invested less than £50,000,000 in home companies, but four times as much abroad. The rate of emigration was 250,000 a year for ten years. Yet the country could spare 80,000,000 tons of coal—a raw material that should attract all other kinds of raw material to itself!

Imports of food should be paid for by exports of manufactures, and were paid for so far as regards Empire trade.

How different our trade with our four rivals—America, Germany, France and Belgium. In 1913 we purchased £208,000,000 of food and manufactures from them, and they only bought £84,000,000 in return for these goods.

These facts prove that Free Trade was a disastrous mistake, because it hindered production by driving capital abroad.

E. Wright.

London.
January 24th, 1921.

Cost Sheets.

With reference to Mr. J. H. Whyman's letter in your last issue *re* my article on "Costing," I quite agree with him that costing to be of practical use must give as much detail as possible.

The generation cost sheet, fig. 5, did not show great detail (only the B.o.T. headings), but it will be seen by reference to the time card, fig. 2, that 12 headings appear under the item "Engines and Boilers," and this can be applied to stores sheets and all other items, also to the cost sheets.

A great deal depends on the size of the station, &c., as to the lay-out of a costing system, and I trust Mr. Whyman will see that owing to a desire to save space my article dealt more with minimum requirements than maximum.

A. Clegg.

Dewsbury.
January 31st, 1921.

LEGAL.

Norton *v.* Electrolite, Ltd.

(Traveller's Notice.)

In the Mayor's and City of London Court, on January 25th, an action was brought by Mr. H. F. Norton, commercial traveller, against Electrolite, Ltd., of Gresham Street, E.C., to recover £50 as damages for breach of contract of employment. Defendants raised a counter-claim for £89, and admitted owing plaintiff £34 subject to the counter-claim.

Plaintiff's case was that the defendant company engaged him after being a salesman in their service, to become a commercial traveller, and travel various districts for them in Oxford, Kent, Portsmouth, Birmingham, &c. He was to get orders for electric lamps, gas mantles, globes, chimneys, and everything needed in the lighting world. He began to work for them in July, 1916, at a salary of 30s. a week, and he was to have 2½ per cent. commission on the first £50 worth of orders taken weekly and 5 per cent. on the balance. He received his salary weekly as well as the commission, but the commission was afterwards paid monthly. In July last he resigned by giving a week's notice to leave on July 30th, which he did. He was paid his week's salary, and now claimed commission due to him when he left. Plaintiff maintained that he was a weekly servant and had not to give longer notice.

Defendants said that the plaintiff should have given them three months' notice or a season's notice, as they had to engage another traveller to finish his rounds which were incomplete when he left. It took the plaintiff three months to go to his various districts, and defendants had been damaged by having to engage someone else.

Frank Durants, defendants' managing director, said he thought before a traveller left he ought to take round his successor and introduce him to the customers. Defendants claimed 25 per cent. profit lost on the business which the plaintiff would have done if he had given a reasonable notice instead of a week. The terms were not very plain perhaps. Their other travellers were under contracts subject to other terms to give them one week's notice, but then they lost their commission. He did not expect travellers when they left to canvass their competitors in business as plaintiff had done. He was annoyed when the plaintiff left him and gave him a week's notice. It was just at the beginning of a season, which was the whole of the trouble. No doubt he ought to have provided for three months' notice to be given to him when a traveller left, and that was what he would have done if he had been wise. Plaintiff's practice was to call on their customers once in three months. If a traveller left in anger he would not then, of course, expect him to go round with his successor.

Judge Jackson said he thought the plaintiff should have given a month's notice, and that that would have been reasonable. Therefore, while he found for the plaintiff on the claim for commission for £34, or such sum as might be found due, he found for the defendants for £37 16s. for damages on the counter-claim.

Breach of Lighting Agreement.

On January 29th, at the Dublin Southern Police Court, the Pembroke Urban Council sued William J. Barry for a breach of a lighting contract. The terms of the agreement were that a fixed rate would be charged for a number of lights of a certain power. Defendant substituted lights of a higher wattage, and the Council therefore cut off the supply and informed Barry that he would not receive a further supply until he remitted the sum of £1. Barry refused to do this, and re-connected the lighting circuits to the mains himself. Mr. O'Reilly, for defendant, said that his client had offered to pay the cost of the excess energy used, but refused to recognise the Council's power to fine him £1. The magistrate made an order fining defendant £5, with costs amounting to £3.

Watson, Marsh & Co. *v.* Cope.

At Marylebone County Court, before Judge Sir Walworth H. Roberts, Watson, Marsh & Co., electrical engineers, of Golders Green, sued Victor Cope, an agent, of Golders Green, for £17 11s., work done and materials supplied in connection with alterations to an electric cooking set. There was a counter-claim for the return of £15 paid on the purchase of the set.

According to the evidence, the plaintiffs had organised a demonstration of the cooking sets at their premises, and the defendant was one of the purchasers. After a time defendant complained that the stove would not cook quickly enough, and plaintiffs undertook to have some work carried out which would improve it. The set was made use of for the kitchen, dining room and breakfast room. It consisted of an oven, boiling plate and grill; the price paid for it was £25, and the defendant's contention was that the £17 10s. sued for was included in the £25 originally paid for the article. The manufacturers were the British Electric Transformer Co.

Evidence given for the defence was that the cooking was so slow that the oven had to be started about an hour before it would cook anything, and it required half an hour to boil an egg and three-quarters of an hour to cook a joint.

The Judge held that the repairs to the cooking set were not included in the £25 which was given for it, and gave judgment for the plaintiffs on the claim and counter-claim with costs.

THE PROPOSED ENGINEERS' CLUB FOR LONDON.

In view of the steady inflow of letters from supporters of the proposal to establish a London club for engineers, it is considered that the time is now ripe to hold a meeting of the Provisional Committee, which is accordingly being called for February 10th. It is hoped that at that meeting an Executive Committee will be formed, with instructions to proceed with the preliminary inquiries, &c., and to report at the earliest possible date. The following gentlemen have consented to serve on the Provisional Committee:—

W. A. Agnew; A. H. Allen, M.I.E.E.; Llewellyn B. Atkinson, M.I.E.E. (president Institution of Electrical Engineers); Daniel Adamson, M.Inst.C.E., M.I.Mech.E.; Col. O. C. Armstrong, D.S.O. (president British Engineers' Association); H. E. Blain; Thomas Bolton; A. L. Churchill; Sir Dugald Clerk, K.B.E., D.Sc., F.R.S. (vice-president Institution of Mechanical Engineers; past-president Institution of Gas Engineers); A. C. Cramb, M.I.Mech.E., M.I.E.E. (hon. secretary Incorporated Municipal Electrical Association); E. C. Clark; C. T. Colpitts; J. F. Crowley, D.Sc., M.I.E.E.; Fred J. Dixon, M.Inst.C.E., M.I.Mech.E. (president Institution of Water Engineers); F. R. Davenport, M.I.E.E.; C. Dally; Howard Foulds; Alan R. Fenn; J. Fearn, A.M.I.Mech.E.; T. Goulden, M.Inst.C.E. (president Institution of Gas Engineers); Dr. E. Hopkinson, M.P., M.I.Mech.E. (past-president Institution of Mechanical Engineers); R. W. Hughman; Sir Robert Hadfield, Bart., D.Sc., F.R.S., M.Inst.C.E., (vice-president Institution of Mechanical Engineers); Edmund L. Hill, M.I.Mech.E., M.I.E.E.; Dr. H. S. Hele-Shaw, LL.D., F.R.S., M.I.Mech.E.; W. L. Hichens; W. W. Hughes, A.M.I.E.E.; Brig.-Gen. G. M. Jackson; Major C. W. Jordan, A.M.I.Mech.E., M.I.A.E.; F. W. Jennings; Bailie John King; G. Layton, M.I.E.E.; Max Muspratt; H. Mensforth, C.B.E., M.Sc. (Director-General of Government Factories); Brig.-Gen. The Lord Montagu of Beaulieu, K.C.I.E., C.S.I; S. Thornley Mott; E. Manville, M.P., M.I.E.E. (past-president Society of Motor Manufacturers and Traders); Ben H. Morgan; H. J. S. Mackay; Frank Merricks (president Institution of Mining and Metallurgy); Frank W. Mellowes; C. H. Merz, M.Inst.C.E., M.I.E.E.; Edwin L. Orde, M.I.Mech.E. (past-president N.E. Coast Institution of Engineers and Shipbuilders); F. Handley Page; P. C. Pope, A.M.I.E.E.; W. Prescott, B.Sc.; T. C. Pulman, M.I.Mech.E.; T. Peterson; Sir W. Peter Rylands (president Federation of British Industries); H. Richardson (hon. sec. The Engineers' Club, Manchester); Sir Harry Renwick, K.B.E.; H. C. B. Sainsbury, M.I.Mech.E.; J. D. Siddeley; Norman Scorgie, M.Inst.C.E.; S. Tweedale; H. C. B. Underdown (president Association of British Motor and Allied Manufacturers); J. S. Webb; H. T. Wilkinson, M.I.E.E. (The Engineers' Club, Manchester); C. H. Wordingham, C.B.E., M.Inst.C.E., M.I.Mech.E. (past-president Institution of Electrical Engineers); Ald. W. Walker, A.M.I.E.E.; David Wilson, C.B.E.; W. J. U. Woolcock, M.P. (Association of British Chemical Manufacturers); H. James Yates, M.I.Mech.E.

THE INDUSTRIAL SITUATION IN GERMANY IN 1920.

The Department of Overseas Trade has issued a "General Report on the Industrial and Economic Situation in Germany in December, 1920," by Mr. J. W. F. Thelwall, commercial secretary to H.M. Embassy, Berlin, assisted by Mr. C. J. Kavanagh, British commercial secretary, Occupied Territories, Cologne. It may be of interest to supplement the comments made in our editorial columns by the reproduction of the following additional information from the report.

The commercial secretary at Berlin, dealing with the outlook, states that at present German trade and industry are suffering severe losses through the fall in the world's prices for such commodities as cotton and copper, as the stocks, bought in the course of the year, are correspondingly depreciated. Should there be no recovery, the effects will show themselves in due course in the form of failures and financial embarrassment. Another factor which will have an adverse effect on trade in 1921 is the increasing burden of taxation, as the full force of the legislation of 1919 will begin to be felt in the first quarter of the year.

On the other hand, the commercial secretary concludes from his survey that German trade and industry are sound enough in themselves; their adaptability has seen them through the great hardships of two exceedingly difficult years, and as far as in them lay they have removed or surmounted the obstacles which impeded them. There is, however, one danger which they were not able to remove, and that is the bankruptcy of the country. Last year this was one of the several factors which warranted the assumption that Germany was threatened with collapse; this year it is the only one, but it is not likely to bring about this disaster, as neither Germany herself nor anyone else has any interest in its occurrence. It is therefore necessary to check the process of inflation.

Iron and Steel Industries.

The commercial secretary at Cologne states that Germany, with her reduced capacity of production within her present territories, will require all the pig iron and semi-finished steel produced in the country for her own requirements in working up into the most highly finished products, and will therefore in future, in contradistinction to formerly, have no materials of these kinds available for export.

The present rate of production of pig iron is not stated, as no statistics are now being published, but an analysis of such company reports for the year 1919-20 as contain any figures leads to the belief that a 60 per cent. yield is being obtained. On the other hand, the make of steel is considerably greater than that of pig iron owing to the importation of material from abroad and the utilisation of scrap iron on a large scale.

The labour situation is described as favourable. The actual productive capacity of the men has improved, and is likely further to increase given settled conditions. It is estimated that wages increases represent an advance over 1913 rates of from 10 to 15 times per ton of output, the influencing factors, beyond actual augmentation in wages, being the 8-hour day, additional holidays, decrease in working capacity, and diminution in the output.

The Engineering Trades.

Dealing with the engineering trades, the report states that the supply of raw materials has become more abundant, particularly cast iron and steel, owing to an improved home production, imports and also to a slump in the demand. The general stagnation in trade has not been without its effects in Germany, and it set in at a period of improved exchange when local products were consequently not cheap. Generally speaking, the outlook is dull, and the home demand is slack on account of the high prices.

The large increases in capital made have been due mainly to the high costs of procuring raw materials rather than to any extensions or installations of new plant. Apart from the transition of armament and munition firms to peace requirements, any reconstruction that is in progress has been chiefly in the direction of improvements to and the reconversion of boiler plant for burning lignite.

The increased importance of lignite has given rise to a brisk home demand for the special excavating and hauling machinery in use, as well as for light railway material. Boiler makers are also busy in the provision of special plant for the utilisation of crude lignite and lignite briquettes.

The export tax on engineering manufactures has been reduced to 3 per cent., which has stimulated exports. The report further mentions that the late coal strike and high prices in England and the inability of manufacturers to quote fixed prices and deliveries resulted in orders being placed in Germany for locomotives, oil mills, rolling mills and electrical plant. The tendency at one time to quote for export in foreign currency is not so much in evidence now, as with fluctuations in exchange losses have been frequent.

The annual reports of companies show that good dividends are being paid, and although shortage of raw materials and of fuel have had a depressing effect, the works in general have been fairly well occupied. The market is very receptive for foreign orders, and every effort is made to meet the requirements of customers.

A list of some of the combinations resulting from the regrouping of the industry is given in appendices, and it is also mentioned that the Augsburg-Nuremberg Engineering Co. has entered into a community of interests with the Gutehoffnungshutte (steel works), and that the Krupp Co. and the Rhenish Metal Ware Works have been added to the many existing makers of locomotives.

On the question of labour, the report states that the workmen are more or less contented in spite of the adverse conditions of living. Piece work is rather the exception than the rule, and the average wages per hour are from 7 to 8 marks, with an 8-hour day.

Non-ferrous Metals.

Concerning the branches for non-ferrous metals, the report states that the aluminium industry, which was largely developed during the war, is syndicated in the Ver. Aluminium Werke. Inland deposits of bauxite have been opened up, but it is believed that the inferior quality will be drawn upon more for chemical than for metallurgical purposes. The French export tax of 20 per cent. has diverted orders to the Dalmatian deposits, with which rail communication is still difficult, but shipments are stated to have taken place *via* Rotterdam. The demand for aluminium in the home market for domestic hardware has been brisk, and a good export trade in the former has resulted.

As a result of metallurgical research a magnesium alloy has been placed on the market under the name of "electron," which is said to contain more than 80 per cent. of magnesium, and to be suitable for light castings. The physical characteristics are a tensile strength of 12 to 15 kg. per sq. mm. with an extension of 3 to 4 per cent. It is understood that the Griesheim Elektron Co. has entered into an agreement with the A.E.G. (Department of the Oberspree Metal Works) for the manufacture of commercial articles from this metal.

The copper, lead, nickel, and tin markets have established themselves as nearly as possible on former lines, while the zinc interests, beyond picking up odd parcels of concentrates, are merely expectant with regard to future developments in Australian supplies.

Lignite Power Stations.

The report, proceeding to refer to the question of electric power stations, states that considerable attention has recently been devoted to the problem of the economic generation of electric power from the large resources of lignite, which being of low calorific power and containing large percentages of moisture, cannot be transported over long distances. A solution has been found in the use of the lignite for generating electricity on the spot and its transmission to distant consumers by means of high-pressure feeders.

It is considered that these overland power transmission schemes, which went hand in hand with the development of the war industries, will play an important part in the future, and in the economy of generation and the saving in transport they have already materially assisted in tiding over a very difficult situation. During the war one of the country's super-power stations was erected at Knapsack, near Cologne. The installation is built on the lip of the lignite mine, and the lignite is fed mechanically from the open-cut excavating machines into the boiler house. The power developed is rated at present at 88,000 kW, generated at 7,000 volts, and stepped up to 110,000 volts for overhead transmission. The station is linked up with another at Reisholz by means of overhead transmission lines. The plant at the Knapsack station includes two 50,000-kW turbo-alternator sets which will shortly be placed in service.

The Golpa station near Bitterfeld, which is also located on lignite fields, has a capacity of 97,000 kW, of which 64,000 is transmitted at 88,000 volts to a nitrate works 16 miles distant, while the remainder is transmitted a distance of 80 miles at 110,000 volts.

The following are the most important of the extra high-pressure overland supply systems which are completed: (1) The State line from Bitterfeld-Golpa to Berlin of a length of 89 miles and comprising six aluminium conductors of 120 sq. mm. section. (2) The Rhenish Westphalian Electricity Co.'s line from Knapsack to Osterrath, of a length of 53 miles and with feeders of 18.6 miles; a second line between Grevenbroich and Reisholz of a length of 12.4 miles, the conductors being of aluminium and steel. (3) The Murgkraft works line between Forbach, Carlsruhe, and Mannheim, of a length of 72.5 miles, with cables of aluminium and steel. (4) The line of the Pfalz (Palatinate) works between Mannheim and Homburg, the length being 62 miles.

In addition to the above overland transmission lines are either in course of erection or projected of a total length of 992 miles, of which the Bavarian ring will represent over 620 miles. The remainder will be accounted for by the Saxony State lines, and by further extensions of the Bitterfeld-Golpa system to Leipzic and Magdeburg and the Grossenheim-Lauta-Berlin circuit, which will have a length of 122 miles.

JOINT ELECTRICITY AUTHORITIES.

Mersey and West Lancashire Inquiry.

An inquiry into the proposed formation of a Joint Electricity Authority under the Electricity (Supply) Act, 1919, for the above mentioned district, was opened at the Town Hall, Liverpool, on January 25th, by the Electricity Commissioners. Sir John Snell presided, and was accompanied by Sir Harry Haward, Mr. W. W. Lackie, and Mr. H. Booth, with Mr. E. W. Hudson (legal adviser), and Mr. D. S. Cumberlege (clerk).

The scheme put forward by the conference of supply authorities contemplated a capital outlay of £4,500,000, and involved the erection of a large generating station, probably in the Liverpool area, which would ultimately have a capacity of 250,000 kW, and the laying of transmission lines to the various areas. Among the matters which the Commissioners had to consider were the areas to be included in the proposed district and the objections by certain authorities on account of their inclusion or exclusion. An alternative scheme was submitted by Wallasey, which had the support of Birkenhead, for a separate authority for the Wirral district.*

The scheme presented to the Commissioners for approval embraced the towns and districts mentioned in our issue of July 23rd, 1920, p. 106, the whole covering an area of 613 square miles.

Mr. Honoratus Lloyd, K.C., who represented the promoting authorities, said some of the objections did not so much deal with the subject in a comprehensive way as try to obtain recognition of the continuance of the parochial and effete system from which they had suffered too long. It might be thought that the present was an inopportune time for spending money. But it was common knowledge if the industry of the country, and of that district in particular, was to receive the means of development of which it was so badly in need, immediate expenditure of money was necessary to produce the development of trade and economic working. If the trade of this country was to hold its own, there should be an ample supply of electricity for all purposes at the lowest possible cost. The many and various industries in those areas, Mr. Lloyd added, had of recent years extended enormously. That was likely to continue, and the supply of electricity was far behind the needs of those great industries. Some of the railways had already realised that electrification of their lines must come, and he could not think they would stand in the way of a public supply which would enable them to adopt or increase the use of electricity as a means of traction. The population of the area was 1,588,000, of which 1,270,000 were on the Lancashire side. Birkenhead had consistently dissented from the scheme; the Birkenhead stations, which were to be scrapped under the Wirral scheme, were some of the most inefficient and obsolete in the whole district.

In reply to the chairman, Mr. Lloyd said the technical officials of the Birkenhead Corporation had dissented from the scheme from the beginning.

Mr. A. T. Miller, for Birkenhead, said their view had always been that the Cheshire side of the river ought to be treated separately.

Mr. Lloyd said that Wallasey formerly supported the committee's scheme, but dissented for the first time on November 22nd. Continuing his address, he said it was proposed that the Joint Electricity Authority should comprise 30 members, of whom 12 should be appointed by certain local authorities, six by local authorities entitled to supply electricity, two by local authorities not entitled to supply, four by company undertakers, one by Mersey Docks and Harbour Board, two by the railway companies, and three by large consumers. They proposed ultimately to take over the whole of the generating plant in the district. The cost of generating under the new scheme would be much less than the existing power stations could hope to attain, but for some time the latter would have to continue in operation.

They desired at the first stage the interlinking of the main stations—Liverpool, Bootle, Birkenhead, Wallasey, Warrington, and St. Helens—and the provision of a capital station and high-pressure transmission mains. There was little doubt that eventually one capital station would be insufficient, and it might be that another would be required at a later date at Warrington, or on the Cheshire side of the Mersey. At the capital station it was proposed to generate at 6,600 volts and to transmit at 33,000, which would involve the use of transformers. They wanted transmission mains from Liverpool through the tunnel to Birkenhead (which could easily be extended to Ellesmere Port) and Wallasey; to Prescot and St. Helens; and Warrington. The last main could be easily linked up with the Mersey Power and the United Alkali Cos.' undertakings. It was not proposed as part of the first stage to link up Southport; there was a large agricultural district between, and it was not desired to carry a 33,000-volt main there unless the railways were likely to take advantage of it. At the capital station it was proposed to install four sets of 25,000 kW each, but the station should be capable of extension to ten such sets, with a total capacity of 250,000 kW. The estimated capital cost of the station, with four sets, would amount to £3,000,000, and the high-pressure transmission mains and transformers to £1,461,260, a total of roughly £4,500,000.

The opposition to the scheme on the Cheshire side came from Birkenhead, Wallasey, and the Mersey Power Co. (including the Runcorn Urban and Rural Councils and the Manchester Ship Canal Co.), whereas Northwich and Lymm desired to be included. In Lancashire, Southport wanted to remain out, and the British Insulated & Helsby Cable Co. objected to the whole scheme. Subject to certain clauses, the Mersey Dock Board, the Liverpool Chamber of Commerce, and the United Traders' Association of Liverpool supported the scheme.

Mr. Tyldesley Jones, K.C., for the railway companies, said they desired to suggest certain improvements in the interests of the railways, but with the desire to co-operate in whatever scheme the Commissioners thought was the right one. They were not there in an obstructive capacity.

Mr. Clothier, for the Bootle Corporation, said its approval of the scheme was qualified. It was held that consumers of electricity in Bootle would be better served by the extension of the borough's undertaking than by the adoption of the scheme, and the Corporation solicited approval of such an extension.

Mr. F. C. Wilson, chairman of the Liverpool Tramways and Electricity Committee, and of the conference of local authorities, gave evidence in support of the scheme, and stated that the establishment of a Joint Electricity Authority would help the trade not only of Liverpool, but also of the whole of the south-west of Lancashire, and Cheshire. The Mersey could not be treated as a frontier. Cross-examined by Mr. Miller, he said the Joint Authority was intended to take over the central generating station and the existing stations as soon as possible. He could not give a date. They looked for support to the local authorities concerned, but had not obtained from them promises of financial support. They also hoped for assistance from the Ministry of Transport. In reply to Mr. E. Tyldesley Jones, K.C., he said the amount to be provided from public funds had not been stated as yet. If it were not forthcoming, they would have to reconsider their position. On the question whether an undertaking would be given to provide an effective supply, Mr. Lloyd remarked that that would be offered later. Mr. Wilson said he believed four out of six urban districts of Wirral were in favour of the scheme. He believed the public would invest in the proposed undertaking. In reply to Dr. Eastham, for the Manchester Ship Canal Co., the witness could not say when the scheme would be linked up with the Mersey Power Co. (which supplied the Canal Co.), though in the meantime the Joint Authority would be in control. He agreed with Mr. Clothier that local authorities whose representatives attended the conference could withhold their assent if they chose, and, with regard to the fact that the Corporation of Liverpool was seeking Parliamentary powers for extensions, he said the Corporation might require those powers before the Joint Authority was formed.

Mr. J. A. Jarrett, town clerk of Southport, said that borough was in no way desirous of marring a scheme essential to Liverpool, but suggested that the exclusion of that distant area would make no material difference to the prospects of the Mersey side.

Sir Harry Haward, one of the Commissioners, asked if the actual taking-over of the generating stations was essential to the satisfactory working of the scheme. Mr. Wilson replied that they must come under the control of the Joint Authority, which would have to buy them out. He did not think that control over the working of the stations without taking them over would be satisfactory. Most of the capital required would be needed for extensions even if there were no scheme.

Mr. Harold Dickinson (city electrical engineer, Liverpool) had begun his evidence in support of the scheme, when the inquiry was adjourned.

On Wednesday, Sir John Snell said the Commissioners desired to know what would be the amount required for extensions of individual undertakings if no scheme were brought into being, and he asked whether the promoters of the rival schemes had combined the actual load curves of the various undertakings, in order to ascertain the effect of bringing all the loads into one system. The Commissioners had done this in the first instance, and found that a maximum load of 51,000 kW would suffice instead of 70,000 kW.

Mr. Harold Dickinson, continuing his evidence, said the scheme would be of great assistance to the railways, and would facilitate their further electrification. It should be carried out in stages, the first step being the linking-up of the stations at Liverpool, Bootle, St. Helens, Birkenhead, Wallasey, and Warrington; as nearly all of them were short of plant, a new capital station should be provided on the river side. The Mersey Power Co. had refused to co-operate with the conference, and had not been included in the scheme; the company had furnished no information with regard to its undertaking. Mr. Dickinson proceeded to deal with the extensions which various undertakings would need to meet their estimated demands in 1925. He put the cost of providing the plant necessary for these extensions at £25 per kW, which was much below what it actually would cost. By 1925 new plant to produce 144,000 kW would be required by the various authorities in the area. The maximum load then he estimated at 156,000 kW, and the capacity with authorised extensions at 101,000 kW. The extensions necessary to produce 144,000 kW (at £25 per kW) would come to £3,600,000. The cost of the new capital station under the scheme (100,000 kW at £30 per kW) was £3,000,000, and the cost of the transmission system £1,461,260, a total of £4,461,260. The annual balance sheet under the individual extensions would show a total expenditure of £1,986,610, compared with which the capital station scheme would result in an annual saving of £276,900, chiefly in coal and working costs, the total being only £1,709,710.

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* Elec. Rev., January 7th, p. 10.

Sir John Snell pointed out that the witness had under-estimated the benefit to be derived from the scheme, and remarked that engineers should put before the Commissioners information which was more likely to be borne out in practice.

Mr. Dickinson went on to say that as time progressed, the saving would become more and more pronounced, and there were other advantages to be borne in mind, such as the saving of coal. In 1925, he estimated, the individual undertakings would be distributing about 460,000,000 units. His scheme was that the load should be carried at the New Riverside capital generating station, Lister Drive, and Warrington. The other stations would not be entirely shut down, but held in reserve.

Sir John Snell said the Commissioners would like particulars of the programme proposed; how much would be done in the first, second, and third year, how much money would be spent, and how the expenditure would be met.

Mr. Dickinson said the combined demand of 460,000,000 units would be divided as follows: Liverpool, 233,600,000; Warrington, 58,400,000; St. Helens, 52,560,000; Wallasey, 35,040,000; Birkenhead, 32,120,000; Bootle, 29,200,000; Prescot, 18,396,000; District Lighting Co., 1,000,000. In the calculations a load factor of 33⅓ had been taken, except in the case of St. Helens, where it was 40, and Prescot, where it was 30 per cent.

In reply to Mr. A. T. Miller, K.C., the witness said he had not included any figure for the capitalised interest during the period of construction of the capital station.

Sir John Snell (chairman) inquired at the opening of the third day's sitting whether the promoters of the scheme were prepared to submit a statement asked for the previous day showing the construction and financial programme of each of the first three or four years, and indicating what work would be done in each year, what money it would cost, how it would be raised, and so on.

Mr. Lloyd replied that they had had a terrible night trying to comply with the request, but they found it was quite impossible. Until the Joint Authority was established and was able to ascertain precisely the extent of co-operation to be expected from the local authorities, any figures put forward might be purely fanciful.

Sir John Snell said it had not been indicated how the transfer of generating stations would be effected, and Mr. Lloyd said it could be arranged by co-operation, but the local authorities would not be dictated to by Liverpool.

Continuing his evidence, Mr. Dickinson, in reply to Mr. Jones, said that in Liverpool the annual supply was 95 units per head of the population. Mr. Jones said that after only eight years' working the Mersey Power Co. was supplying 369 units per head in its area. In reply to Sir John Snell, who remarked that all the witnesses should give all the figures in their possession without reservation, Mr. Dickinson pointed out that he had a great mass of figures, and it was very difficult to answer questions instantly; he had no intention of withholding information from anyone. He assumed that by 1930 the Mersey Co. would have been taken over, and would be supplying 11,000,000 units per annum to the joint system, while the United Alkali Co., on the other side of the river, would supply 58,000,000 units. Unless the Joint Authority owned and controlled all the undertakings his figures would not apply. Asked by Mr. Jones whether, in April last, he told the company that if it did not come in the Commissioners would refuse permission for extensions. Mr. Dickinson denied recollection of the remark, and said that it certainly was not used as a threat. In reply to Dr. Eastham, he said the estimated saving of £120,740 on coal was based on a figure of £2 a ton. He agreed that if the Commissioners limited the area to the north side of the Mersey, they could link up with the south side at a later date.

Mr. Jalland (for the United Alkali Co.) said that the company was willing to hand over its station or to supply energy in bulk; it seemed clear that an advantage would result under the scheme. Mr. Jones pointed out that if the company's station was transferred to the Joint Authority, the latter could not supply energy to the company, because it was in the Mersey Power Co.'s area.

In reply to Mr. Clothier (Bootle) and Mr. Jarrett (Southport), Mr. Dickinson stated that he had not made allowance for payments already made for the extinction of debt. Mr. Jeeves suggested that the rateable value of the new station, to cost £3,000,000, would not be £40,000 but 5 per cent., and that the rates would amount to £120,000 instead of £21,000. No allowance had been made for rates on the transmission mains, costing £1,500,000.

Mr. Dickinson, re-examined by Mr. Lloyd, said that co-operation was the essence of the scheme; if it were to be regarded as merely providing a stand-by supply, he would wash his hands of it. In reply to Sir John Snell, he said there was no difficulty or risk in laying transmission mains through the Mersey tunnel. He thought the omission of Southport would not injure the scheme.

Mr. Charles D. Taite (engineer and manager to the Lancashire Power Co., and formerly electrical engineer to Southport and Salford) thought the scheme was very necessary for the Merseyside and West Lancashire area, which in many respects was backward in electrical development. The costs in the various stations were undoubtedly too high. The majority, if not all, of the undertakings were short of plant and were expecting a big demand on their resources. A very excellent site was available on the river side. No division could be based on the Mersey, having regard to the existence of the tunnel, and there was no reason for separating the proposed area into two districts. That would be a most unfortunate thing, for both sides of the river were part of one commercial district likely to develop simultaneously. Witness added that it was quite time parochial boundaries in these matters were abolished, and a comprehensive scheme should be prepared for the whole of a district which had a common interest.

[The inquiry was continued on Friday and Saturday, and was adjourned to a date to be fixed, not before the end of February.]

(*To be concluded.*)

BUSINESS NOTES.

Bankruptcy Proceedings. — DAVID SUCHOSTAWER, 1, First Avenue, Acton, Middlesex, engineer.—The first meeting of the creditors of the above was held on Wednesday, at the offices of the Official Receiver, 14, Bedford Row, London, W.C. According to the statement of affairs lodged by the debtor, the liabilities amounted to £1,030, of which £780 was expected to rank for dividend. The assets consisted of book-debts valued at £2, or a deficiency of £778. Book-debts of the face value of £1 058 were set down as bad. It appeared that the debtor, a Russian, came to this country some years ago, when he formed a company called the S.P. Syndicate, Ltd, for the purpose of exploiting a patent for the surface-contact system of tramways. That company, the debtor stated, was wound up six or seven years ago. He then formed another company, called Electric Magneto Motors, Ltd., for exploiting patents connected with general electrical work. That company was still in existence. The debtor attributed his present position to the failure of a company to fulfil its engagements with him. The Official Receiver (Mr. T. Gourlay), who presided, pointed out that the case was a summary one. No resolutions were passed, and therefore the estate remains in the hands of the Official Receiver.

JAMES SHERRED DENLEY, trading as Denley & Co., 69, Regent Street, Cheltenham, electrician and cycle dealer.—The receiving order in this matter was made on January 7th, on debtor's own petition. The statement of affairs showed unsecured liabilities of £113, against net assets £41, or a deficiency of £72. The debtor attributed his position to want of capital, loss on contracts, bad trade, and not having a practical knowledge of the business. It appeared that the debtor commenced business in partnership with two others on July 7th, 1919. His two partners were electricians, but except such experience as he had gained as a sapper while serving in the Royal Engineers, he had no previous experience of the business. When commencing the business, capital to the amount of £90, which was provided by the three partners in equal shares, was put into the concern. On October 7th, 1919, the debtor received £40 for arrears of Army pay, and on December 29th obtained a grant of £50 from the Civil Liabilities Fund, both of which sums were put into the business, as was also a sum of £21, part of £50 granted to the debtor in October last in lieu of pension. The two partners subsequently left the business, but there was no dissolution of partnership.

A. LORD, electrical contractor, 33, Westgate Burnley.—Receiving order made January 25th, on debtor's own petition.

WILLIAM DRYSDALE, 24, Paxton Street, Barrow-in-Furness, electrician. The public examination takes place on February 11th. The following is a list of creditors of £10 and over :—

	£	s.		£	s.
Albion Electrical Stores ..	36	12	Forman & Sons	12	12
L. Andrew & Co.	42	15	General Electric Co.	24	7
— Appletons	25	5	H. & G. O. Lewtas	10	4
Barrow Builders' Association	14	4	P. K. Lee	35	0
Baxendale Bros.	76	5	Metro.-Vickers Elec. Co., Ltd.	15	19
Belling & Co.	20	12	H. G. Mabbs & Son	25	12
Barrow News and Mail, Ltd.	24	12	Millard Bros.	108	6
Callender's Cable & Con. Co.	184	3	J. W. Osborne	217	10
Geo. Casperson	16	8	Royal Accumulator Co. ..	35	18
Carron, Ltd.	10	19	Sloan Electrical Co.	41	6
Central Supplies Co.	32	15	J. & W. B. Smith	42	17
Dowsing Radiant Heat Co. ..	27	6	W. R. Thornton & Sons, Ltd.	267	17
Drapers' Association	20	10	Underwood, Ltd.	11	13
Downes & Davies	264	16	P. Webber	17	16
English Elec. Supplies, Ltd.	18	4	Wigan Coal and Iron Co. ..	11	5
E.G.S. Co.	31	13	Ward & Goldstone	121	10
Falk, Stadelmann & Co. ..	38	11			

Company Liquidation.—ELECTRO-CHEMICAL DEVELOPMENTS, LTD.—Particulars of claims must be sent to the liquidator, Mr. E. A. Ashcroft, 65, London Wall, E.C., by March 1st.

Dissolution of Partnership. — TRIPP & CARRYATT, motor, electrical, and general engineers, 59A, Alma Road, Clifton, Bristol.—Mr. E. J. Tripp and Mr. R. I. H. Carryatt have dissolved partnership. Debts will be attended to by Mr. E. J. Tripp, who will continue the business.

Trade Announcements.—The Scottish Electric Lamp Repairing Co., Ltd., has leased premises in Paisley as a workshop and substantial stores, which will afford facilities for loading and unloading. The establishment is close to the railway. The company proposes to take the business in Scotland of the Allies Electric Lamp Repairing Co., Hammersmith. The orders at present embrace over 200,000 lamps.

The Consolidated Pneumatic Tool Co., Ltd., of 170, Piccadilly. London, W. 1, have appointed Messrs. J. A. Angus, Kaims Foundry, Strand Road, Rangoon, Burma, their agents for Burma. Messrs. Angus will handle the company's air compressors, pneumatic and electric tools. rock drills, and all the accessories connected with the use of these appliances. They will also carry a stock of machines and spare parts, in order to give adequate service to users of the company's products in Burma.

Mr. F. Husband is representing Messrs. Fillery Frères & Cie., of Paris, and all communications should be addressed to him at 4, Grange Road, Chiswick. W. 4. The French firm is making a speciality of turned-wood accessories, such as bell pushes, wall rosettes, pear pushes, and adapters, as well as moulded insulating material to customers' requirements. Mr. Husband is also specialising in switchgear and motors.

We understand that Mr. Oswald L. Record has now left the Electrical Engineering and Equipment Co., Ltd., of 109, New Oxford Street, W.C. 1. For the present all communications should be addressed to him at Dacre House, Victoria Street, S.W. 1. Telephone : Victoria 2728.

The Westminster Tool and Electric Co., of Putney Bridge Road, have appointed Messrs. R. S. Newton & Co., 29, Fountain Street, Manchester, as agents for the county of Lancashire for their "Westool" electric portable drills and blowers.

Messrs. H. W. Smith & Co. (1920), Ltd., have appointed Mr. Ashley P. Pope as sales manager. His headquarters will be at their London office, Central House, Kingsway. Telegraphic address : "Virwires - Westcent - London." Telephone number : "Regent 2368."

With reference to the dissolution of partnership of Mr. E. J. Bailey and Mr. W. N. Smart, the latter announces that the business is being carried on by him under the title W. N. Smart and Co., at 17, 19 and 19a, Cross Street, Oldham.

Kent Bros. Electric Wire Co., of Charlton, S.E. (formerly the Eastcombe Engineering and Trading Co., manufacturers of cotton-covered copper wires, have appointed the following sole selling representatives :—England and Wales :—Mr. E. H. Phillips, 172, Wardour Street, Oxford Street. London, W. 1 ; Scotland : Messrs. W. Brown & Co., 200-208a, St Vincent Street, Glasgow.

The Times states that Sir Charles Parsons, having acquired, as from January 1st, a controlling interest in the optical and scientific instrument firm of Ross, Ltd., will shortly join the board as chairman. Mr. John Stuart remains on the board.

Catalogues and Lists.—Messrs. J. & W. B. Smith, Ltd., 15-23, Farringdon Road, E.C. 1.—An illustrated price list of "Glasmi" electric fires of various sizes and types, electric irons, hot-plates and cooking apparatus.

Messrs. Thomas Broadbent & Sons, Ltd., Central Ironworks, Huddersfield.—An illustrated leaflet, showing a number of applications of automatic centrifugal clutches to mill machinery, &c.

The Wardle Engineering Co., Ltd., Manchester.—A postcard advising consultation with the firm on all matters concerning scientific illumination.

Messrs Higgs Bros., Sand Pits, Birmingham.—Monthly magazine, Vol. II, No. 11. Stock lists of a.c. motors and d.c. dynamos and motors ; notes on speed regulation of motors, as well as the usual humorous items.

Messrs. Mansell & Ogan, Ltd, 15-17, Cecil Court, Charing Cross Road, W.C. 2.—An illustrated and priced leaflet dealing with various sizes and ratings of "Cecil" fan regulators. A specification appears on the reverse of the leaflet.

The Cambridge and Paul Instrument Co., Ltd., 45, Grosvenor Place, S.W. 1.—A folder, "Instruments for Power Plants," giving a view of a power station, and showing a number of instruments in position. Separate illustrations of the instruments are also given, including distance thermometers, draught gauge, CO_2 recorder, &c.

New British Electric Supply Co., Ltd., Finsbury Court, Finsbury Pavement, E.C. 2.—An illustrated leaflet dealing with "Emcol" totally-enclosed motors. Descriptions are also given in French and Spanish.

The Lea Recorder Co., Ltd., 28, Deansgate, Manchester.—Booklet M2, "Business in the Boiler House," by J. E. Lea, B.Sc., M.I.Mech.E. (12 pp.).—This publication contains copious notes on efficient steam production, boiler testing &c. A specimen boiler log sheet is enclosed.

Messrs. Ward & Goldstone, Ltd., Frederick Road. Pendleton, Manchester.—An illustrated leaflet dealing with the "Reliable" transformer for use on bell and similar circuits, and also with the "Securitas" asbestos-lined fire preventer for attachment to flexible leads to retard the action of fire.

The Vaughan Crane Co., Ltd., Openshaw, Manchester.—Booklet No. 8 (39 pp.), a profusely illustrated list of "Vaughan" cranes of various types, including both electric and hand-power cranes.

The British Thomson-Houston Co., Ltd., Rugby.—Descriptive list No. 2420-B. (36 pp.).—A very detailed description of rotary converters manufactured by the B.T.H. Co., with a large number of illustrations and diagrams.

The British Thomson-Houston Co., Ltd., Mazda House, 77, Upper Thames Street, E.C. 4. Price list No. 10540-A, "Semi-Indirect Lighting Fittings" (16 pp.).—A well-illustrated catalogue of bowl fittings of various types with views of offices and shops in which these fittings have been installed.

The Edison Swan Electric Co., Ltd., Ponder's End, Middlesex.—List No. C C 201, illustrating and describing "Ediswan" house service cut-outs ; List No. W W 203, an illustrated booklet dealing with l.p. junction boxes, straight through and three-way, as well as terminal boxes. A circular letter announcing reductions in the price of "Royal Ediswan" vacuum and gasfilled lamps, enclosing a list showing old and new prices.

Lists of reduced prices have also been received from The General Electric Co., Ltd., 67. Queen Victoria Street, E.C. 4.

Messrs. E. Brook, Ltd., Empress Works. Huddersfield. List 52.—A leaflet giving specification, ratings and prices of "Brock" a.c. mine motors.

Messrs. Marshall & Plumtree, Ltd., 20, High Holborn, W.C. 1.—An illustrated and priced folder, describing a universal current limiter for d c or a.c. circuits.

The London Factors and Agents, Ltd., 39, Parliament Street. Westminster, S.W. 1.—A circular-letter giving the efficiency in watts per c p. and lumens per watt of various types of incandescent lamps.

The Overseas Engineering Co., Ltd., 163-5, Great Portland Street, W. 1.—List No. 66 (12 pp.) giving prices and particulars of "National" d.c. motors and dynamos for many purposes. The list is fully illustrated, and includes fractional h.p. motors. Also an illustrated price list (No. 97) of "Overseas" electric irons, grills and toasters, and hot plates ; and List No. 17 dealing with flour mills and "Overseas-Federal" ceiling fans.

Lead.—Under date January 29th, Messrs. G. Cawson and Co. report :—"Although the total turnover during the week has been fairly satisfactory, there is no improvement in price to record. The position as to supplies remains unchanged. There is very little lead coming forward, and unless Continental shipments become larger, supplies are likely to remain very restricted. As the German Exchange continues to improve, it cannot pay them to ship lead unless at higher prices. The partial destruction of the Port Pirie Smelting Works by fire is likely to retard Australian shipments for some considerable period, so that it is impossible to say at present when fresh Australian lead will reach this country. Meanwhile the demand from China and Japan is as insistent as ever. Our Government, however, still refuse to supply this demand from stock. The general trade demand remains rather poor, but electrical works continue to take lead in fair quantities, and are likely to do so. The outlook points to a steady market without much change in prices unless some fresh unforeseen development arises."

Messrs. James Forster & Co. in their report, state :—"The market has not been particularly active, transactions amounting to about 4,000 tons, as against 3,000 last week. Consumers have been more in evidence, and sales have been made to them for the Spring months as well as for prompt. On the other hand, export business is very dull. The fire at Port Pirie, which we understand destroyed the Dwight roasting plant entirely, may indefinitely delay the resumption of supplies of Broken Hill lead. In fact, we understand that a quantity of pig lead has recently been sold for prompt shipment to Australia."

Decontrol of Coal.—The Government has decided to cancel on and from March 1st next, the Directions of the Board of Trade dated August 25th, 1920, as to pithead prices. This will afford a month in which buyers and sellers can readjust their arrangements so far as these may be necessary. All allocations or directions to collieries to supply specified districts or consumers, whether made by instruction of the Government or by District Coal and Coke Supplies Committees, will be abolished from the above date, and inland consumers will be free to purchase supplies from any available source, and through any channel. They should, therefore, at once proceed to make any arrangements necessary to secure their supplies after March 1st. All questions as to price, quality, conditions of sale and delivery, &c., will be matters for arrangement directly between buyers and sellers. So far as coal for foreign bunkers and export is concerned, the position remains as shown in the official notifications published on December 28th, 1920, and January 10th, 1921.

Manufacture of Meters in Australia.—With reference to our note of June 18th last, under the above heading, in which it was recorded that extreme difficulty was experienced in securing supplies of electricity meters, and that it was proposed to commence their manufacture locally, we are informed from a reliable source that English manufacturers are now receiving a fair share of the orders for meters for Australia, and that their manufacture locally has not as yet commenced.

Receiverships.—W. A. & R. J. Jacobs, Ltd.—W. Bigland, of 171, New Bond Street, W. 1, ceased to act as receiver on January 11th, 1921. A. E. Newman, of 171, New Bond Street, W. 1, appointed receiver on January 13th, 1921, under powers contained in debenture dated July 29th, 1920.

Boxing Contest.—At the canteen of Messrs. Thwaites Bros., Ltd., electrical engineers, Bradford, a return boxing contest took place on January 26th, between the apprentices of that firm and those of the Phœnix Dynamo Manufacturing Co. (English Electric Co.), Ltd., Bradford. Seven contests of four rounds each were engaged in, and provided enjoyable sport for the contestants and a large gathering of supporters. On the aggregate, the Thwaites Bros.' fighters were the victors. Mr. Brown, of the Thwaites' Bros. trainers, gave an exhibition of ball punching.

Forthcoming Exhibitions.—The following exhibitions are being organised :—

Birmingham.—March 21st-May 21st.—National Trades and Industrial Exhibition.

London.—February 10th to 26th.—"Efficiency" Exhibition at Olympia

London and Birmingham.—February 21st to March 4th.—British Industries Fair. *Glasgow.*—February 28th to March 11th.

London.—March and October.—Society of Motor Manufacturers and Traders at Olympia.

London.—April 1st to 30th.—Building Trades' Exhibition at Olympia.

London.—June 3rd to 17th.—Rubber Trades' Exhibition at Royal Agricultural Hall.

London.—July 4th to 15th.—London Fair and Market at Royal Agricultural Hall.

London.—September 7th to 28th.—Shipping, Engineering and Machinery Exhibition at Olympia.

London.—November 17th to 25th.—Public Works, Roads and Transport Exhibition.

London.—1923.—British Empire Exhibition.

Johannesburg.—March 9th to 16th.—Chemical, Metallurgical, and Mining Exhibition.

British Dominions.—1921.— Dominions Touring Exhibition (South Africa, Australia, Canada and New Zealand).

Basle.—May 28th to June 8th.—International Automobile Exhibition.

Barcelona —April 1st to 10th.—International Samples Fair.

Bandoeng (*Java*).—September 19th to October 9th.—Netherlands East Indies Fair.

Bordeaux.—June 15th to 30th.—International Samples Exhibition.

Brussels.—April 4th to 20th.—International Commercial Fair.

Ghent.—April 16th to June 14th.—International Exhibition of Architecture, Building, and Kindred Industries.

Iceland.—June.—World's Fair.

Lima.—June 1st to October 31st.—International Industrial Exhibition.

Peking.—March.—International Exhibition.

Prague.—February 28th to March 8th.—Fair and Exhibition.

Lyons.—March 1st to 15th.—Metallurgy, Engineering, Building, &c., Fair. See below.

Mexico.—September.— Commercial and Industrial Fair.

Milan.—April 12th to 27th.—International General Manufacturers' Fair.

Utrecht.—September 6th to 16th.—International Fair.

Buenos Aires.—1922.—International Exhibition.

Rio de Janeiro.—1922.—International Centenary Exhibition.

Exhibitions.—The Committee of the Lyons Fair, at its last meeting, decided to exclude both German and Rhine-province exhibitors from the March exhibition. Arrangements have been made for a display of exhibits of electric heating and ventilating apparatus.

An electrical fair is projected at Paris, from May 10th to 25th, in two halls on the Esplanade des Invalides. Electric heating apparatus for the house and workshop will be specially catered for, alternating and continuous current being provided.

P.O. Telephone Cable Contract.—Messrs. Johnson and Phillips, Ltd., of Charlton, have just received an order from the G.P.O. Engineering Department for a duplication of the London to Brighton trunk telephone cable laid by them in 1914. This cable consists of approximately 55 miles of 104 pair 70-lb. dry core, lead-covered cable, and is an addition to a considerable mileage of trunk telephone cable which the firm have in hand for other sections of the G.P.O. telephone system.

New Spanish Company.—La Sociedad Iberica de Construcciones Electricas is the name of a new company which has lately been formed in Bilbao, with a capital of 20,000,000 pesetas.

An Industrial Relations Department.—Another example of the progressiveness of the Commonwealth Edison Co., Chicago, one of the largest central station companies in the world, is the establishment of an Industrial Relations Department. The company has been investigating for some time a plan for employé representation, with the object of ensuring mutual understanding, fairness and harmony between the employés and the management. The result of this study has been the creation of an Industrial Relations Department. One of the general duties of the department will be to supervise in an impartial manner, as between the management and the employés, the development, introduction and operation of an employés' representative plan. The manager of industrial relations will have the administrative responsibility for developing and carrying out a comprehensive personnel and employment policy in the company service, and for the management of the units of the company organisation performing functions of personnel administration. A special section of the department will be devoted to the welfare of the women employés. —*Electrical Review* (Chicago).

U.S.A. Wages.—A Central News New York dispatch appearing in the *Daily Herald* says that the General Electric Co. at Schenectady has cut down the wages of its employés by 10 to 15 per cent.

E.P.D.—At the annual dinner of the Bath Chamber of Commerce, when the hampering effect of E.P.D. on trade was criticised, Capt. Foxcroft, M.P. for Bath, explained that the Chancellor of the Exchequer might be interested to know that in Spain the letters E.P.D. (*En Paz Descansa*) were inscribed upon tombstones, the Spanish equivalent of R.I.P.—*Evening News.*

Book Notices.—"Welfare Work" (the Journal of the Welfare Workers' Institute). Vol. II, No. 13. January, 1921.—This issue contains, among a number of interesting and useful articles on welfare work and kindred subjects, the general secretary's annual report. Miss Voysey, B.A., states that the Employment Bureau has developed rapidly, and the Information Bureau is kept busy by inquiries of all descriptions. The total membership of the Institute has reached 546. The necessity for facilities for training welfare workers is emphasised, and a report of the work done in this direction during the year is given. Evidence on the subject of the employment of women and young persons in industry was collected and laid before the Home Secretary's Committee dealing with the question.

British Standard Specification No. 136—1920, "Interim B.S. Terms and Definitions for Use in Connection with Automatic Telephone Systems" (7 pp.). London : Crosby Lockwood & Son. Price 1s. net. Post free, 1s. 2d.—This list has been prepared in conjunction with the G.P.O., the Telephone Manufacturers' Association, and the Relay Automatic Telephone Co., Ltd. Where the nomenclature differs from that employed in America, the American term is given in parentheses. Common abbreviations are also indicated.

"The Mining Electrical Engineer," Vol. I, No. 4. January, 1921. (30 pp.) Price 1s. net.—This issue includes an illustrated article on "The Anderson Boyes Works and Products," papers on electrical signals and telephones in mines, as well as reports of proceedings at the branches of the Association.

"Interference of Power Circuits with Telephone Circuits" (8 pp.), "The Electrical Properties of Three-phase Transmission Lines" (16 pp.), and "On a Theory of Fluid Friction and its Application to Hydraulics" (19 pp.). By E. Parry, B.Sc., M.Inst.C.E., M.I.E.E. Reprinted from the *English Electric Journal.*—In the first of these papers the engineer-in-chief of the English Electric Co., Ltd., gives curves and calculations of the effects of electrostatic and electromagnetic induction on telephone lines. The second paper has been prepared "primarily for the use of departmental officers in designing transmission lines, with the object of economising time and of standardising the method of calculation." A number of valuable tables are appended.

"Electrification of Railways." By H. F. Trewman. Pp. ix + 75, 13 figs. London : Sir I. Pitman & Sons. Price 2s. 6d. net.

"*Journal* of the American Institute of Electrical Engineers." Vol. XL, No. 1. January, 1921. New York · The Institute. Price $1.

"*Proceedings* of the South Wales Institute of Engineers." Vol. XXXXI, No. 2. Issued January 21st, 1921. Cardiff : The Institute. 10s.

Callender's Hospital Fund.—We have received a copy of the 18th annual report and statement of accounts of Callender's Hospital and Distress Fund, which were approved at a meeting held at the Belvedere Works on January 29th. A record sum was received in subscriptions during the year, and it was possible to increase amounts given to the various hospitals and other institutions. A large number of hospital and nursing home letters were issued, surgical appliances were distributed in cases of necessity, and financial and other assistance was given. The weekly subscription realised £762, against £362 in the previous year, largely due to the higher rate (2d. per week instead of 1d.).

The company gave a donation of £50, and several guineas apiece were subscribed by the directors and others. The awards to hospitals and other institutions were £640, as against £376 in the previous year.

Fall in Lamp Prices.—We are pleased to see that the prices of the lamps sold by "Association" firms are being substantially reduced, several new price lists having been sent us recently. The alteration took effect as from February 1st. The most noticeable feature is probably the decline in the prices of gasfilled lamps, the fall being as great as 28 per cent. in one case, that of the 100-W size.

The types affected are "Royal Ediswan," "Mazda," "Britannia," "Xcel," "Foster," "Osram," "Cosmos," "Elasta Pope," "Stearn," and "Z" lamps.

Birmingham and Midland Institute Exhibition.—At this exhibition, held from January 11th to 14th, the Edison Swan Electric Co. displayed an extensive range of X-ray apparatus, including their X-ray couch and complete equipment and other electro-medical apparatus, all of which was described in our issue of January 14th (p. 40).

Stoker Orders.—Amongst the more important of the Underfeed Stoker Co.'s recent sales, are the following to electric power stations :—Travelling grate stokers.—Manchester (4), Bradford (12), Melbourne (2), Falkirk (1), Midland Power Co. (3) ; various industrial concerns (21). Underfeed stokers, industrial concerns (17). Ash conveyors are being supplied to the Lancashire and Yorkshire Railway and other companies ; and air heaters to the Northampton Electric Light Co.

Copper and Lead Prices.—Messrs. F. Smith & Co. report, February 1st :—Electrolytic copper bars, £77, £3 decrease ; ditto sheets, no change ; ditto wire rods, £93, £3 decrease ; ditto h.c. wire, $11\frac{5}{8}$d., $\frac{7}{16}$ decrease ; silicium bronze wire, 1s. $7\frac{5}{8}$d., $\frac{3}{8}$d. decrease.

Messrs. James & Shakespeare report, February 2nd :—Copper bars (best selected), sheets and rods, no change. English pig lead, £24 10s. ; 10s. decrease on last week's quotation.

Sale.—At the Georgetown Factory disposal sale, concluded on Wednesday, last week, four 400-h.p. electric motors for submarines realised £400 each.

British Industries Fair (Birmingham), 1921.—This Fair, which is to be held at Castle Bromwich from February 21st to March 4th, shows every sign of being an even greater success than that of last year. Large numbers of inquiries are being received from Colonial and foreign buyers, and all indications go to show that the Fair will be well patronised from abroad. The exhibits themselves will be more comprehensive and far more representative of the various trades allotted to the section of the Fair than was the case in 1920. The Duke of York will be present on March 1st. The visit of a number of official foreign commercial missions invited to this country as guests of the Government, coincides with the date of the Fair, to which a visit will be paid on March 2nd. These missions represent about 16 foreign countries, and will be—while in Birmingham—the guests of the Council of the Fair. Intending visitors are recommended to make immediate application with regard to hotel accommodation, to the General Manager, 95, New Street, Birmingham.

Social.—The Southport Tramway and Vehicle Workers held a successful concert in the Tramway Workers' Hall, on January 27th, Mr. Lawrence presiding. The programme was a capital one, and much enjoyed. Additional pleasure was added to the evening's proceedings by the serving of refreshments kindly provided by Mr. H. Marshall.

For Sale.—By order of the Disposal Board, Ministry of Munitions, MESSRS. EADON & LOCKWOOD will offer by auction, on March 8th and following days, at H.M. Factory, Langwith, Derbyshire, valuable chemical and electric power plant, engineers' tools, electrical and other stores, including 1,000 and 1,500-h p. vertical gas engines. The Disposal Board, Ministry of Munitions, is inviting public tenders for a 675-h.p. steam-driven electric generating plant lying at Ellesmere Port, Chester; and a semi-Diesel electric generating plant, lying at Chattis Hill Aerodrome, near Stockbridge, Hants. For particulars, see our advertisement pages to-day.

New French Companies.—The Etablissements Galopin et Cie. have been formed into a company, under the style of Société Nationale d'Entreprises Electrique, with a capital of 1,000,000 fr., and offices at 126, Rue de Province, Paris.

With a capital of 3,500,000 fr., the Etablissements Dieny et Lucas, have been constituted a company at Paris (Rue Taitbout, 50).

R. Despessailles, R. Labanowski et Cie. is the style of a company constituted at Paris (3, Rue Lenbonnet) for the importation and exportation of electrical material and specialities of all kinds. The capital is 150,000 fr.

The Société Française des Machines Marelli is a newly constituted branch of the Milan firm of Ercole Marelli, formed with a capital of 1,000,000 fr., to manufacture in France the specialities of the Italian firm in motors, dynamos, transformers, alternators, electric ventilators, centrifugal pumps, &c. Its offices are at 56, Boulevard Voltaire, Paris.

With the title of the Société Hydroélectrique "La Valentinoise," has been formed at Paris (Rue de Vienne, 5) a company with a capital of 1,000,000 fr., in 1,000 fr. shares, of which 250 are apportioned to MM. Saint Paul and Pellegrin, and 175 to Marshal Foch, G. Foch, and Mlle. J. Foch, as consideration for their assets.

There has been established at Paris (94, Rue de la Victoire) the Société de Production et d'Exportation "Siderurgiques," for the purpose of carrying out undertakings associated with the mining and the ironfoundry businesses, and the manufacture of electro-mechanical and other apparatus. Its capital is 200,000 fr.

There has been formed at Paris (10, Rue Mogader), the Société d'Electricité de la Région de Dunkerque, with a capital of 5,000,000 fr. in 500 fr. shares, of which 4,000 are allocated to the Compagnie Générale pour l'Eclairage et le Chauffage par le Gaz de Bruxelles as consideration for its assets. A strong French and Belgian board of management has been appointed.

At Saint Chamond (Loire), J. B. Perrin, Gargaire et Cie., have been constituted a company, with a capital of 140,000 fr., to carry out electric installations.

There has been formed at Paris, under the designation of the Appareillages Electriques Peerless, a company with 250,000 fr. capital, to undertake electric installations and the sale of electric apparatus and accessories. Its offices are at 29, Rue de Mont Cenis.

With a capital of 2,500,000 fr. the Société Anonyme des Etablissements Guinier has been registered a company at Paris (38, Rue de Trévise).

The Société des Forces Motrices de l'Ariège has been established at Paris (5, Rue Blanche), to develop the water power of the river Ariège in every possible way for the generation of electricity. Its capital is 12,000,000 fr.

Calendar.—MESSRS. CHARLES CHURCHILL & CO., LTD., of 9-15, Leonard Street, London, E.C. 2, have sent us a wall calendar with a block of daily date slips below a picture representing a works interior wherein machine-tool equipment and contented labour secure "production, the secret of prosperity."

Workshops Available.—A correspondent has room available at his works in Putney—shops of 147, 275, and 500 sq. ft.—for the manufacture of electrical appliances, such as meters with electric power, and would supervise the work if desired, or let the space. Inquiries sent to us will be forwarded.

Norwegian Cables for Russia!—It is reported from Drammen, Norway, that a local firm of agents, acting on behalf of the Soviet Government, is in negotiation with the Norsk Katelfabrik in relation to the suggested delivery of a considerable quantity of telephone cable to Russia.

LIGHTING AND POWER NOTES.

Barrow.—ELECTRICITY SCHEMES.—The provision of electricity at Barrow is being debated by the Electricity Committee, which has already considered the suggestion to obtain power from the river Leven at Backbarrow, and also a proposal to make overtures to Messrs. Vickers, Ltd., for any surplus electricity from their new power station at Buccleuch Dock. The former scheme is estimated to cost £90,000. A third scheme has now been proposed to harness the tides at Walney Island, by which it is estimated a supply of electricity could be generated sufficient to supply Barrow and the whole area between Lancaster and South Cumberland. The main factor, however, is one of cost, which would be heavy. A report is being prepared, and this will come before the Committee.

Bedford.—LOAN.—The Town Council has applied for sanction to a loan of £1,600 for transformers, switchgear, &c., for extended supplies to the works of Messrs. J. & F. Howard, Ltd., and a sub-station is to be provided for the Queen's Park district, at a cost of £720.

Birkenhead.—LOAN.—The Town Council has decided to create the necessary stock for raising the sum of nearly £1,000,000, of which £28,000 is expenditure authorised by the Electricity Commissioners for the purpose of the electricity undertakings.

Blackpool.—HOUSE-WIRING.—The Corporation Housing Committee took no action with regard to a request from the Electrical Contractors' Association, London, that in connection with the work of wiring the Corporation houses for electric light only tenders from members of the Association should be considered. The tenders have been let to the Blackpool Electrical Association.

Bolton.—LOAN SANCTIONED.—The Electricity Commissioners have sanctioned the borrowing by the Town Council of the sum of £50,000 for mains and £50,000 for sub-stations on consumers' premises.

PROGRESS OF EXTENSIONS.—In a report on the progress of extensions at the Back-o'-th'-Bank station, the electrical engineer states that the 6,000-kW turbo-alternator is in course of erection. The engine-room for the first 12,000-kW set is well in hand, and a large part of the boiler-house steelwork is erected. The material for the four boilers in connection with this set is practically all ready on the site or completed at the makers' works. The 12,000-kW turbo-alternator is expected to be erected and ready for load in August. It is estimated that the total plant capacity will be 34,000 kW by next winter, including stand-by plant. The maximum load is estimated at 18,000 kW. The total cost of the extensions is given as £821,380, and expenditure to the date of the report amounted to £154,766.

Cassop.—PUBLIC LIGHTING.—The Council has accepted the offer of Messrs. Bell Bros., Ltd., of Bowburn Colliery, to erect poles, lamps, &c., for public lighting and supply electricity at £5 per lamp per annum.

Colchester.—PROPOSED PRICE INCREASE.—The Town Council has applied for an order to increase the price of electricity to 1s. per unit, with a quarterly payment of 15s. for any quantity up to 15 units for the winter quarters, and 10s. for any quantity up to 10 units for the summer quarters.

Continental.—FRANCE.—An official inquiry is being held into a scheme for establishing a high-pressure network for the distribution of energy from the waterfalls in the Tarentaise, Albertville and Beauges valleys, in the Lyons and Stephan districts. Two main lines are contemplated, which, with their several branches, will serve some 42 towns.

The Société des Forces Motrices de la Vienne is about to start working the station which has been in course of construction since 1917 at the Ile Jourdain, designed to supply at 60,000 volts on the various centres of the departments of Charente, Charente Inférieure and Deux Sèvres. The station only forms a part of the company's programme, which includes the erection of two other stations, one at Chardes, of 6,000 h.p., and the other at Joussand, of 9,000 h.p. capacity.

BELGIUM.—The municipal authorities of Ostend have taken over the concession for the electric lighting of Mariakerke from the Compagnie du Tramway Electrique d'Ostende-Littoral (in liquidation), and also the whole of the company's installation.

CZECHO-SLOVAKIA.—The Moravian Provincial Committee has decided to carry out a scheme for establishing a large power station on the River Thaya, which will generate 80,000,000 kWh per annum. The financing of the scheme, which will take several years to carry through, is now assured, a Swiss banking group having promised its assistance.—*Economic Review.*

Ealing.—LOAN.—The Town Council is applying for sanction to a loan of £30,000 to cover the following items of capital expenditure for the ensuing three years:—H.p. feeders, £12,500; l.p. distributors, £7,000; services, £3,000; meters, £5,000; and transformers, £2,500.

Fermoy.—ELECTRIC LIGHTING PROPOSED.—Owing to the excessive cost of gas—12s. 6d. per thousand cb. ft.—the Urban Council is to institute inquiries regarding an electricity supply for the town.

Hebden Bridge.—LOAN.—The Council is seeking sanction to the borrowing of £5,000 for the provision of additional mains and meters.

Kingston-on-Thames.—Loan Sanctioned.—The Town Council has received sanction to a loan of £14,230 for electricity purposes, and a further loan of £19,750 to meet excess expenditure on plant extensions has been applied for.

Lancaster.—Proposed Extensions.—In order to cope with the greatly increased demand for electricity, the electrical engineer has been instructed to prepare a report on the plant and suggestions for its extension. Inquiries are also to be made as to the possibility of obtaining a supply from the National Projectile Factory.

Leeds.—Street Lighting.—The Street Lighting Committee has decided that commencing September 30th next, three-quarters of the total number of the public lamps in the city shall be lighted. This will be equivalent to the lighting in pre-war days. Any special cases, where extra light is required, will be dealt with as deemed necessary.

London.—Stepney.—Under the general conditions of supply, "restricted" supplies have hitherto been given by separately-metered circuits provided with a time switch cutting off supplies between sunset and 7 p.m. from Monday to Friday during six winter months. Many premises, therefore, have double circuits, and the Electricity Supply Committee reports that it has discovered cases of consumers who have endeavoured to connect their supply to obtain electricity at the reduced "restricted" rate during the rest of the day. On this account it is recommended that the "restricted" supplies should be confined to certain classes of consumers, such as places of worship, shop exterior lighting, &c.

A scheme of extensions has been drawn up by the borough electrical engineer, which it is proposed to proceed with in three parts. The first instalment will cost £281,160; the second, £128,480; and the third, £82,500; making a total of £492,140. The Finance Committee recommends application to the Electricity Commissioners for sanction to a loan to cover the cost of the first part of the scheme.

Hammersmith.—With regard to the Council's application for sanction to a loan of £21,693 for electricity purposes, the Electricity Commissioners have consented to the borrowing of £16,635. An item of £305 is to be charged to revenue, while items of £500 for a sub-station site, and £400 for buildings have also been omitted, the first pending the settlement of negotiations, and the second because the Commissioners consider the amount should be charged against the amount of £900, sanctioned for the linking-up scheme.

St. Pancras.—Reporting to the Borough Council on the subject of supplying electricity to rooms in tenement houses, the Electricity Committee states that the chief electrical engineer, in accordance with instructions, has submitted three schemes for the extension of the public street lighting by electricity in different districts of the borough, and at the same time to provide small dwellings with electricity in accordance with the Council's scheme. Unfortunately these schemes do not provide for much labour, the greater proportion of the cost being for materials. The Committee has, however, adjourned the consideration of the matter in order that a canvass may be made of the districts to ascertain the extent of the demand for electricity for household lighting, particularly concentrating on those streets where mains are already laid or are in the immediate neighbourhood. The Council's scheme at the present time provides only for small dwellings, and is based upon six lights being used, whereas a large proportion of the streets now under consideration are composed of tenement houses in which each family occupies two or three rooms.

Monasterevan (Co. Kildare).—Sale of Plant.—Mr. T. Tynan, merchant, Ballybrittas, has purchased the plant of the Monasterevan Electric Light Co. for £1,500.

Morecambe.—House Lighting.—The Corporation has sanctioned the expenditure of £3,000 upon the laying of new mains to supply electricity to the houses in course of erection under the borough housing scheme.

New Zealand.—Wairoa Development.—H.M. Trade Commissioner in New Zealand reports to the Department of Overseas Trade that the ratepayers of the Wairoa district have approved the proposal of the Wairoa Electric Power Board to borrow the sum of £100,000 for the .purpose of erecting main electric transmission and feeder lines between Waikaremoana and the Borough of Wairoa, including sub-stations and equipment (£35,000); erecting subsidiary transmission lines, feeders, and sub-stations from the main transmission line to outlying districts in Wairoa County (£60,000), and purchase of electric motors, machinery, fittings, &c. (£5,000).

Salford.—Issue of Stock.—The Town Council, at a special meeting, has decided to create stock for the raising of £750,000, £100,000 of which is for electricity purposes.

Southend.—Proposed Extensions.—At the Electricity and Light Railways Committee, the electrical engineer submitted a short report upon the question of the extensions of plant which he had advised should be carried out in order to be available by the summer of 1925, by which time he estimated that the load would be approximately 6,960 kW (the existing plant capacity, including the six new Diesels now in course of erection, being 5,960 kW), but that allowing for stand-by plant of 1,340 kW, the plant available at maximum load would only amount to 4,620 kW, which, in his opinion, would only be sufficient for the summer load of 1922. He reported that to provide for the summer of 1925, 8,200 kW, including stand-by plant, would be required, an addition of 2,240 kW to the plant now in course of erection, either by the purchase of four 540-kW Diesel sets, or the installation of one 2,000-kW or three 750-kW steam generators in the main station, with the necessary extension of the boiler-house plant, in order to raise its capacity to 120,000 lb. steam per hour. A special meeting of the Committee was to be held to consider the scheme, together with a scheme for the provision of turbo-alternators presented to the Committee in November last, the estimated cost being £300,000.

Stoke-on-Trent.—Extensions and Finance.—The Electricity Committee having recommended the borrowing of £200,000 for extensions, which the Finance Committee suggested should be deferred until after the end of the present financial year, owing to the serious financial position of the Council, the matter was discussed at a meeting of the Town Council. It was pointed out for the Electricity Committee that with the existing plant, the requirements of the district could not be adequately catered for beyond 1922, and that if the borrowing of the amount named were deferred, the responsibility for failure to meet the demand would be with the Council and not with the Committee. After discussion, it was decided to refer back the Finance Committee's proposal, and the matter is to come up again for consideration by a joint committee of the Finance Committee, and other committees concerned.

Todmorden.—Loan Sanctioned.—The Electricity Commissioners have given permission to the Corporation to borrow £31,000 for plant and mains in connection with a bulk supply from the Yorkshire Electric Power Co.

Wareham.—Special Order.—The Wareham Electric Supply Co., Ltd., is applying to the Electricity Commissioners for a special order authorising the company to distribute electrical energy for public and private purposes within the Borough of Wareham, and parts of the parishes of Arne and Wareham St. Martin.

Wrexham.—Loan.—The Town Council is seeking the permission of the Electricity Commissioners to borrow £20,176 for mains extensions, &c., including the provision of cables to the new houses at Acton Park.

TRAMWAY AND RAILWAY NOTES.

Burnley.—Fare Increase.—The Council has approved of a proposal of the Tramways Committee to raise the fares on the long distance journeys, with a view to reducing the anticipated deficit on the year's working. The Council has received an interim order from the Ministry of Transport sanctioning the increase.

Chester.—Condition of Track.—It was reported at the meeting of the Town Council that to put the tramway track in order would entail an expenditure of £70,000, and that some other method of conveyance, such as railless trolley cars or motors, was the only alternative. Tenders are to be invited from firms for running a motor-'bus service.

Continental.—Norway.—Information has been received in the Department of Overseas Trade that the Norwegian Government has granted a concession to A/S Akersbanerne to construct an electric railway from Majorstuen through Taasen to Sognsvandet, and from Taasen to Sagene, a suburb of Christiania. Preliminary work in connection with the levelling of the route is to be put in hand immediately. This will not, however, be concluded until next autumn, and invitations to tender will not be issued until the end of the year. Opportunity will then arise for British firms to submit tenders. It is estimated that the rails will be required at the end of 1922, and the cars in the autumn of the same year.

A/S Akersbanerne recently applied to the Norwegian Government for a further concession in respect of a prospective line from the centre of Christiania to Ostensjo, a distance of about 8 km. In the event of the concessions being granted, both lines will be built simultaneously, and further material will be required.

Spain.—The contract for the supply and erection of the installations in connection with the electrification of the Pajares incline on the Norte Railway between Gijon and Leon has been awarded to the Compagnie Française Thomson-Houston, of Paris, together with the General Electric Co., of New York. These two companies, in agreement with the Caminos de Hierro del Norte, are expected to obtain from Spanish industries as much of the material needed as possible. The railway company, moreover, is to contract, if possible, for the supply of power by the companies of the Pajares region, in order to dispense with the steam power station proposed by the French company, or at least to simplify it and use it only as a reserve in case of interruption in the supply of power from the hydro-electric establishments.—*Reuter's Trade Service* (Madrid).

Dewsbury.—Report on Improvements.—The Tramways Committee is to make a report to the Town Council as to possibilities and costs of alterations with a view to doing away with the present congestion of tramway termini in the centre of the town.

Durham County.—Transport Scheme.—At a special meeting of the County Council on January 26th, it was formally decided to proceed with the promotion of the Parliamentary Bill permitting the Council to inaugurate a large transport scheme. A great deal of opposition to the scheme had been put forward by local authorities in the area, as well as by business men who consider the project will merely be a further burden to the ratepayers. Owing to the consent of local authorities to the construction of certain tramways being withheld, it is probable that the Examiner will refuse to permit the inclusion of these provisions in the Bill. If they are dropped, the cost of the proposals will be lessened by about £200,000.

Halifax.—Anemometer Stations.—Following upon the reports of Government inspectors on the recent blowing over of two tramcars on the high and exposed section of the tramway route at Queensbury, the Tramways Committee is making inquiries as to the cost of installing an anemometer station on one or more of the exposed routes of the town, to record the maximum wind velocities in the neighbourhood. A decision, in the meantime, that no double-deck cars shall be run on the Queensbury and other similarly exposed routes, has called forth a protest from the Queensbury District Council, which suggests that covered cars should be used when weather permits, and advocates the provision of a loop to the single line at a point less exposed than Stocks Gate, where the cars were blown over whilst standing. For the present, however, the Committee is adhering to its decision as to covered cars.

Distribution of Materials.—With a view to effecting economy and obtaining speedy delivery, the Tramways Committee has recommended the Municipal Tramways Association to purchase a bulk supply of rails for distribution amongst the authorities requiring them.

Loss in Working.—A financial statement for the nine months ending December 31st, 1920, shows that the Corporation tramways have been run at a loss of £5,959, as against a profit of £1,918 during the corresponding period of 1919.

Ipswich.—Electric Vehicles.—The Ministry of Health, on January 25th, inquired into the circumstances in which the Corporation is seeking sanction to a loan of £2,951 for the purchase of electric dust-collecting vehicles. In his evidence the borough surveyor said the present weekly cost of the horsed vehicles was £6 11s. for cart, horse, and man. The amount of refuse collected by each vehicle averaged just over seven tons per week, and the cost of collection was 18s. 3d. per ton. With the electric vehicles 85 tons of refuse could be collected per week, at a cost of £48 9s. 3d., or 11s. 4d. per ton. The annual saving was estimated at £1,500.

Leeds.—Proposed Increased Fares.—The Corporation is seeking powers to advance the tramway fares from 1d. to 1½d. per mile. Workmen's tickets will be abolished. The alterations are rendered necessary by the continued daily loss; for the nine months ending December 29th there was a deficit of £30,495, averaging £111 per day; latterly the position has improved a good deal, but the loss is still about £50 per day.

Liverpool.—Express Tramway Track.—The Tramways Committee, after reconsidering the scheme for the express tramway along Princes Road, which had been referred back by the City Council, confirmed its previous decision. The Council will, therefore, be recommended to lay the Princes Road tramway track on sleepers, at an estimated expenditure of £24,057, which is £2,800 less than would be incurred by laying the present track with setts.

London.—Report on Collision.—Major G. L. Hall, R.E., has submitted a report to the Ministry of Transport on the collision which occurred between an electric train and a steam train near Waterloo Station on November 26th last. The collision was only a slight one, the damage was small, and no personal injuries were sustained. From the evidence given it would appear that the responsibility for the accident rests with the driver of the steam locomotive, who either failed to observe the correct signals, or took those of another line to be his own. Major Hall concludes his report by saying that "The case is a typical example of an accident which would have been prevented by a system of automatic train control, and, as such, has been brought to the notice of the Committee."

A New "Tube" Device.—The Underground Companies have installed an "Automatic Stentorphone" at Oxford Circus Station. This device is a kind of gramophone which directs passengers ascending or descending by means of the escalator to keep moving, instead of standing in one position.

Newcastle-on-Tyne.—Loan.—At a meeting of the City Council on January 25th, the town clerk was instructed to make application to the Minister of Transport for sanction to borrow the following sums:—£42,740 for excess expenditure on the Benton tramways, and £16,000 for doubling a portion of the Longbenton track. Mr. G. G. Elliott, in moving the instruction, stated that the only alternatives to a loan were payment out of revenue, or out of the tramways reserve, neither of which was practicable.

Southport.—Stoppage of Traffic.—Traffic was held up for some time on the electric railway between Liverpool and Southport, on January 27th, as the result of the derailment of two wagons. Whilst the obstruction was being cleared, steam trains were run from Liverpool to Bookhall, and in this way, passengers were able to proceed to Southport and intermediate stations.

Warrington.—Extension.—At its February meeting the Warrington Town Council will be asked to accept tenders for the linking up of the Stockton Heath and Cemetery tramway routes. The greater part of the track was laid some years ago, and to effect the improvement in the tramway services all that is required is the laying of a curve extension, and the erection of the overhead equipment.

TELEGRAPH AND TELEPHONE NOTES.

France.—Wireless Communication with Bulgaria.—Wireless communication between Bulgaria and France has been established for private and Press correspondence. The fees are the same as those levied on ordinary lines, the messages bearing the words "non taxée: voie T.S.F." In case of overburdening or interruption of the wireless route, the offices concerned reserve the right of making use of the ordinary telegraph lines.

Italy.—Strike.—The postal and telegraph employés at Rome ceased work on January 27th.

Montevideo New Telephonic System.—The only tender received for the construction of a telephonic system in Montevideo was that of the International Eastern Electric Co., Inc., which offers to construct the underground telephonic system, together with the necessary works, offices, &c., for a maximum price of 6,943,500 pesos, and a minimum price of 6,647,000 pesos, according to the variations which it might be necessary to introduce in the course of the work. The initial lines would provide for a service to 16,500 subscribers, while extensions are in view providing for 46,500 subscribers and a connection with the telephone system of Buenos Aires.—*Reuter's Trade Service* (Montevideo).

New Telephone Exchanges.—A scheme which will take about 20 years to complete, proposes the equipment of 60 additional telephone exchanges in the London area. According to the *Evening News* the 30,000-line Tower exchange in Great Tower Street is nearing completion, and will probably be the first to be placed in operation. A temporary exchange, which is being constructed to relieve the congestion, will be out of the architects' hands this month. The Stratford exchange will be finished so far as the builders are concerned, in April, when its equipment will begin. The Holborn exchange, near Chancery Lane, is in an early stage of construction, but a temporary exchange near by will be in commission in a few months' time. The Berkeley exchange will relieve the pressure on Mayfair; it is being equipped, and sites have been selected for 13 other exchanges, including the Strand, Sloane, Golder's Green, Langham or Marylebone, Battersea, and Woolwich. The Strand exchange will deal with 30,000 lines, and will be situated near Covent Garden; a temporary Langham exchange is being erected on top of the Western District Post Office, and another is to be built in Queen's Road, Hendon, whilst a 30,000-line exchange is to be in installed in Wood Street, Cheapside.

A new automatic exchange is to be established at Blackfriars, and if successful it will be widely extended.

Last week the telephone services of Milnsbridge, near Huddersfield, were transferred from the old exchange in Armitage Road to the new building in George Street. This exchange should have been in operation long ago, but the work was held up by the war.

Norway.—Photo-telegraphy.—The newspapers at Christiania recently published detailed accounts of a demonstration, given at Sandefjord, of an improvement in telegraphy invented by M. Hermod Petersen, chief manager of the Radio Department of the Telegraph Service. According to *The Times*, the invention consists of a new system based on alternating current, instead of the d.c. system hitherto used. One of the many benefits which this invention is expected to bring is a big reduction in the number of operators needed. It is estimated that work which now requires 117 of the best operators in Norway could be done by 16. The new system eliminates errors, and reproduces with photographic accuracy, at practically unlimited distances, all sorts of handwriting, type, drawings and photographs.

Ships' Wireless.—New Emergency Device.—The Marconi Co. has produced a compact emergency wireless set with a transmitting radius of 50 miles which it is proposed to install on motor-driven lifeboats. The set has been designed to work under rough-weather conditions and to remain reliable even if left inactive for a long period. The necessary operating adjustments have been reduced to a minimum, and the electrical and mechanical details have been made as simple as possible; the aerial is supported on two masts. The White Star Co. has ordered one of the newly-equipped motor-boats for the *Olympic*, and the Union Castle Co. is to install one on the *Arundel Castle*.—*Evening News.*

Wireless Telegraphy.—Railway Communication.—Experiments with wireless telegraphy as an auxiliary means of communication on railways have been conducted by the Marconi Co. between Euston and Crewe, and as soon as the Post Office grants a licence, apparatus will be submitted to the London and North-Western Railway Co. for the purpose of making extended trials under commercial conditions.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Aberdeen.—February 21st. Corporation Waterworks Department. Electrically-driven pumping machinery. Specifications, £5 (returnable), from Water Engineer's Office, 41½, Union Street, Aberdeen.

February 21st. Electricity Department. Temporary and permanent coal conveyors and shoots in connection with the reconstruction of the boiler house at Ferryhill. (January 21st.)

Australia.—Melbourne.—March 2nd and 9th. Victorian Railways. Reactances and condensers (for power signalling), electric crabs and equipment for cranes.*

Adelaide.—February 23rd. P.M.G.'s Department. Electric lamps, as per Schedule 561. (January 21st.)

Sydney.—March 21st. P.M.G.'s Department. Telephone and telegraph apparatus, testing instruments and switchboard parts, Schedule 814. (January 28th.)

Perth, W.A.—March 29th. P.M.G.'s Department. Telegraph accumulators, Schedule 333. (January 21st.)*

April 5th. P.M.G.'s Department. Accumulators, &c., for Eucla, W.A. (January 28th.)

Brisbane.—March 30th. P.M.G.'s Department. Switchboard apparatus and parts.*

Batley.—Co-operative Society. Electric lighting of Clerk Green store. Specifications from Secretary.

Belfast.—February 26th. Tramways Committee.—Tramway stores, including electrical accessories, cable, lamps, carbon brushes, &c. (January 28th.)

France.—Paris.—February 17th. The supply and installation of a multiple commutator table at the Central Telephonic Bureau in the Boulevard Raspail. Particulars from the Direction de l'Exploitation Téléphonique, 4e Bureau, 103, Rue de Grenelle, Paris.

Great Yarmouth.—February 11th. Electricity Department. Supply and erection of h.p. switchgear. (January 21st.)

Leicester.—February 19th. Electricity Department. Two 10,000-kW, 3-phase turbo-generators, with condensing plant; also screens for straining condensing water. (See this issue.)

London.—Battersea.—February 9th. Electricity Department. E.h.p. and d.c. switchgear for two 450-kW converters. (January 28th.)

Manchester.—February 14th. Electricity Department. 33,000-V trunk feeder, pilot and telephone cables. (January 21st.)

February 15th. Tramways Committee. Tramway stores. including meters, cable, lamps, bells, insulators, &c. (January 28th.)

Middlesbrough.—February 9th. Corporation. Double line of tramways from Albert Road to Linthorpe Road. Particulars from Mr. S. E. Burgess, Borough Engineer, Municipal Buildings.

New Zealand.—Wellington.—March 1st. Public Works Tender Board. Seven 4,000-kVA single-phase transformers, with accessories, for Lake Coleridge electric power scheme.*

March 5th. Government Railway Department. Two overhead travelling cranes.*

Salford.—February 14th. Tramways Committee. Twelve months' supply of miscellaneous stores. Particulars from General Manager, 32, Blackfriars Street.

South Africa.—Pretoria.—March 10th. Municipal Council. One 20-ton overhead crane, six boilers (350-lb. working pressure), three 3,000-kW steam turbo-generators with condensing plant, five 750-kW converters. Further particulars can be obtained from Mr. T. C. Wolley-Dod, general manager, electric lighting department. Specifications (five guineas) from the town clerk.

February 16th. One 1,000-kW rotary converter with transformers and switchgear.*

Swinton-Pendlebury.—Urban District Council. Electric lighting of houses on Temple Lodge estate. Specifications from J. Knight, architect, 5, Cross Street, Manchester.

Uruguay.—Monte Video.—March 29th. State Power House. Single and three-phase meters.*

February 21st. State Power House. Electrical accessories, including plug fuses, branching blocks, cut-outs, keys and switches.*

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—Telephone material for the various States for the P.M.G.'s Department:—

8,340 magneto wall telephones, £36,046; 240 do. table do., £4,433; 150 c.b. wall do., £1,461; 50 c.b. table do., £236; 100 automatic party line do., £283; 23 Stromberg-Carlson portable do., £90.—L. P. R. Bean.

10,836 automatic wall telephones, £42,532; 3,489 automatic table do., £20,817; 2,705 c.b. automatic table do., £11,363; 5,501 calling dials, £6,944.—Siemens Bros. & Co., Ltd. —*Tenders.*

France.—La Société la Canalisation Electrique, of St. Maurice, has lately secured a contract from the French State Railway authorities in Paris for the supply of 60 kilometres of rubber-insulated, single-conductor cable. The same authorities have also placed a contract with the Société Industrielle des Téléphones, of Paris, for the supply of 50 kilometres of single-conductor cable.

London.—Hammersmith.—The Electricity Committee has decided, in view of the probable increased demands for electricity in the near future, that an order for the second 10,000-kW set, with condensing plant, should be placed at once, particularly as delivery cannot be obtained until the summer of 1922. Messrs. A. C. Parsons & Co.'s price for the first set was £42,470, and Messrs. Hick, Hargreaves & Co., for the condenser, £14,952. Owing to increased cost of raw materials, &c., Messrs. Parsons' and Hargreaves' prices for the second 10,000-kW turbo-generator and condenser are £47,570 and £15,800 respectively. The Committee recommends acceptance of these estimates.

Copes, Feed-water regulator, £51.—Scholey & Co. (recommended).

Stepney.—Electricity Committee. The following offers of coal have been accepted:—

450 tons Northumberland nut smalls, at 46s. 6d. per ton, E. Foster & Co. 150 tons Scotch-washed trebles, 56s. 5d. ton; 150 tons do. doubles, 55s. 5d. ton; 150 tons do. singles, 54s. 5d, Bradbury, Son & Co. (1920), Ltd. 140 tons Northumberland nuts, 51s. ton, J. Hudson & Co., Ltd.

50 tons pitch, £519.—J. Smart & Son (recommended).

2 tons plumbers' solder, £170.—G. W. Neale (recommended).

¼ mile ·0225 sq. in. lead-covered and armoured cable, £136.—W. T. Henley's Telegraph Works Co., Ltd. (recommended).

2 tons sheet lead, £76.—Newsome & Co., Ltd. (recommended).

700 fuse boxes, £253.—Reason Manufacturing Co., Ltd.

Stoke Newington.—Electric Lighting Committee. For mains in connection with the extension, also distributing mains, five tenders were received. The Committee recommends acceptance of the tender of Messrs. W. T. Henley's Telegraph Works Co., Ltd., of £18,668, based upon standard prices of £100 per ton for copper and £30 per ton for lead, and increasing or decreasing with the price of these metals.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, February 4th. At Caxton Hall. At 8 p.m. Lecturette, "Surface Tension and some of its Industrial Applications," by Mr. W. H. Ballantyne.

February 11th. "Notes on Some Limit Gauges," by Mr. F. A. Simpson.

Chief Technical Assistants' Association.—Saturday, February 5th. At Anderton's Hotel, Fleet Street, E.C. At 3 p.m. Paper on "Adjudication of Tenders for Turbo-alternators," by Mr. J. R. J. Bowden.

Society of Engineers.—Monday, February 7th. At Burlington House, Piccadilly, W. At 5.30 p.m. Presidential address by the Right Hon. Lord Headley, and presentation of Premiums awarded in 1920.

Dynamicables.—Tuesday, February 8th. At the Trocadero Restaurant. At 7.30 p.m. Dinner. Sir Jas. Devonshire, K.B.E., in the chair.

Institute of Marine Engineers.—Tuesday, February 8th. At the Institute, the Minories. At 6.40 p.m. Paper on "The Internal Combustion Engine Installation," by Mr. W. Pollock.

Institute of Metals.—Tuesday, February 8th. At 39, Elmbank Crescent, Glasgow. At 8 p.m. Lecture on "Aluminium, Production and Uses," by Dr. G. H. Bailey.

Royal Society of Arts.—Tuesday, February 8th. At John Street, Adelphi, W.C. At 8 p.m. Paper on "Some Notes on the Problem of Unemployment," by Mr. E. C. de Segundo.

Association of Engineers-in-Charge.—Wednesday, February 9th. At St. Bride's Institute, Bride Lane, E.C. At 7.30 p.m. Paper on "The Super-Diesel Internal Combustion Engine," by Capt. W. P. Durtnall.

Institute of Cost and Works Accountants.—Wednesday, February 9th. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Address on "The Position of the Cost and Works Accountants in Co-ordinating the Aims of Capital and Labour," by Mr. H. W. Allingham.

Manchester Wireless Society.—Wednesday, February 9th. Paper on "Searchlights and their Work during the War," by Mr. J. C. A. Reed.

Chelmsford Engineering Society.—Thursday, February 10th. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Electric Welding," by Mr. J. H. Johnson.

Efficiency Exhibition.—Olympia, W. February 10th to 26th.

Institution of Electrical Engineers.—Thursday, February 10th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Discussion on "Electric Appliances for Domestic Purposes." To be introduced by a paper by Mr. E. Griffiths and Mr. F. H. Schofield on "Some Thermal Characteristics of Electric Ovens and Hot Plates."

Liverpool Sub-Centre.—Monday, February 7th. At the University, Liverpool. At 7 p.m. Discussion of Report on Research on "The Heating of Buried Cables." To be opened by Mr. E. B. Wedmore.

Western Centre.—Monday, February 7th. At the Merchant Venturers' Technical College, Bristol. At 7 p.m. Paper on "The Application of the Electric Locomotive to Main Line Traction on Railways," by Lieut.-Col. O'Brien.

North-Midland Centre.—Tuesday, February 8th. At the Hotel Metropole, Leeds. At 7 p.m. Paper on "Temperature Limits of Large Alternators," by Mr. G. A. Juhlin.

North-Western Centre.—Tuesday, February 8th. At the Engineers' Club, Manchester. At 7 p.m. Address by the President, Mr. Ll. B. Atkinson.

Scottish Centre.—Tuesday, February 8th. At 207, Bath Street, Glasgow. At 7.30 p.m. Paper on "Automatic Protective Devices for Alternating Current Systems," by Mr. A. E. McColl.

North-Eastern Centre.—Friday, February 11th. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Conversazione.

Scottish Centre (Students' Section).—Friday, February 11th. At the Royal Technical College, Glasgow. At 7.30 p.m. Paper on "Mercury Arc Rectifiers," by Mr. R. L. Morrison.

Roentgen Society.—Thursday, February 10th. At the Royal Society of Medicine, Wigmore Street, W. At 7.30 p.m. Conjoint meeting: The Institution of Electrical Engineers and the Electro-therapeutic Section of the Royal Society of Medicine.

Electro-Harmonic Society.—Friday, February 11th. At the Great Hall, Cannon Street Hotel, E.C. At 8 p.m. Concert. Ladies' night.

Institute of Industrial Administration.—Friday, February 11th. At the Central Hall, Westminster. At 8 p.m. Address on "Present Day Industrial Psychology," by Sir Lynden Macassey, K.B.E., K.C.

Faraday Society and the Manchester Literary and Philosophical Society.—Friday, February 11th. At 36, George Street, Manchester. At 6.30 p.m. Lecture on "Studies in Capillarity," by Drs. A. Ferguson and P. E. Dowson.

Manchester Association of Engineers.—Friday, February 11th. Anniversary dinner.

Physical Society of London.—Friday, February 11th. At the Imperial College of Science, South Kensington, S.W. At 5.15 p.m. Discussion on "Absolute Measurements of Electrical Resistance and Instruments based on the Temperature Variation of Resistance."

Birmingham and District Electric Club.—Saturday, February 12th. At the Grand Hotel, Colmore Row. At 7 p.m. Paper on "Reminiscences of the Test Bed," by Mr. J. A. McDonald.

NOTES.

Why Not Electricity ?—A correspondent to the *Bradford Daily Telegraph* says :—" In these days when so much progress has been made with electric power, it is surprising to find mill chimneys still being built within the city boundaries. We get occasional glimpses of what Bradford would be like without its canopy of smoke, and we are all looking forward to the time when mill chimneys will be abolished entirely, thus making Bradford as healthy as Harrogate. Perhaps it would help towards this end if there was some system of co-ordination between the city engineer's department and the electricity department by which, before plans were passed for the erection of a new mill chimney, efforts would be made to induce the mill owner to adopt electric power."

Kelvin Medal, 1920.—At a meeting of the Award Committee, consisting of the presidents of the principal representative British engineering institutions, held in London on January 25th, the first triennial award of the Kelvin Gold Medal was made to Dr. W. C. Unwin, F.R.S., who, in the opinion of the Committee, after its consideration of representations received from leading engineering bodies in all parts of the world, is the most worthy to receive this recognition of pre-eminence in the branches of engineering with which Lord Kelvin's scientific work and researches were closely identified. The arrangements for the presentation of the Medal will be announced shortly. The Kelvin Gold Medal was established in 1914 as part of a memorial to the late Lord Kelvin, and in association with the window placed in Westminster Abbey in his memory by British and American engineers.

Scottish Motor Show.—The Scottish Motor Show, which opened in the Kelvin Hall at Glasgow, on January 28th, proved one of the most popular exhibitions ever held in that city. Besides motor cars, light cars and industrial vehicles, electric lighting systems, dictaphones, electric heaters, &c., are also on view. The attention of all motorists interested in the electrical equipment of cars will be directed to the C.A.V. exhibits on Stand No. 69, which is the Scottish Show headquarters of Messrs. Thomson & Brown Bros., Ltd. New departures in C.A.V. productions are shown, including the new starting and lighting batteries with the Willard threaded rubber insulation. The latest wing lamps of "Streamline" form, adapted for focusing, are worthy of special attention, as also the "D.H." headlamps and the new "Model 10" C.A.V. horn. Light-car, touring-car, and commercial lighting sets will demonstrate the improvements in dynamo and lamp manufacture, and the combined dynamo, lighting, and coil ignition units will amply prove that this method of ignition is becoming extremely popular.

The Ministry of Transport.—It is reported that the Cabinet has decided to reduce the staff of the Ministry of Transport at an early date. The civil engineering and development branches are to be more or less scrapped, involving pay rolls, apart from war bonus, of respectively £19,300 and £10,400 per annum. The much-discussed Area Transport Commissioners are to be dispensed with *en bloc*, but the finance, statistical, roads, traffic, public safety, and general purposes departments are to be retained, although the subordinate staff is to be curtailed as much as possible. It will be remembered that the civil engineering department was responsible for the proposed Severn estuary tidal power scheme.

A Safety Celluloid.—With reference to the note in our January 21st issue concerning the Celluloid Act. 1915, and the London County Council regulations which provide that not more than 112 lb. in weight may be stored, the new product of the British Cellulose and Chemical Manufacturing Co., Ltd., called "Celastoid," is a safety celluloid which has been approved by the London County Council for use in theatres, &c., where hitherto ordinary celluloid has been prohibited. We have found the new product very difficult to ignite, and even when alight the flame extinguishes itself immediately the source of heat is removed. There is no reason at all why premises should be filled with the explosive nitro-celluloid when a British-made safety celluloid is available.

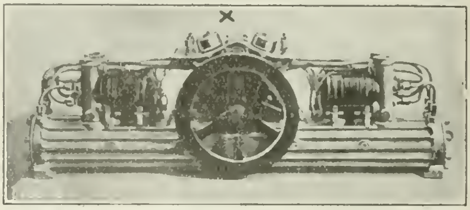
French Summer Time.—It is announced that summer time will commence in France on the night of March 14th-15th.

The E.P.E.A. Award.—On January 31st, the Wolverhampton Town Council refused to adopt the schedule arranged by the National Joint Board for payment of the technical staffs of electricity supply works. As a result, the engineers resolved to stop work at 10 o'clock on February 1st to enforce the adoption of the rates which have been accepted by practically every undertaking in the country. The Mayor counselled acceptance, pointing out that the extra £2,000 per year would not "pave the way to ruin." Local manufacturers held a meeting protesting against the short-sighted action of the Council, which would lead to the unemployment of thousands.

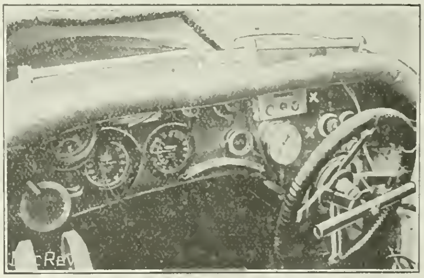
Eventually the Council acceded to the adoption of the schedule, and the strike was averted.

Appointments Vacant.—Mains foreman for the Corporation of Wrexham Electricity Department; electrician, for the Worcestershire Mental Hospital, Bromsgrove: resident power station engineer, for the Clyde Valley Electric Power Co.; shift engineer, for the Borough of Burton-on-Trent Electricity Department; engineering draughtsman, for the Salford Corporation Electricity Department; lecturer in electrical engineering (£536), for the Bradford Technical College. For particulars see our advertisement pages to-day.

An Automatic Aeroplane Stabiliser.—We are informed by Messrs. Handley Page, Ltd., that for some weeks past an aeroplane from the Cricklewood aerodrome has been flying long distances for the purpose of thoroughly testing a new automatic device which it is claimed will relieve the air pilot of the strain upon his nerves and sight now involved in long-distance flying, particularly when passing through heavy clouds or fogs. The device, which is marked X in the accompanying illustrations, will also greatly facilitate night-flying. At present the pilot must give his undivided attention to ensure the perfect equilibrium of his craft when in the air. The object of the new device, which is the invention of M. Georges Aveline, a French engineer and former military pilot, is to control automatically every movement of an aeroplane with the exception of steering. That is to say, it ensures perfect stability of the aeroplane, and any tendency to a list or plunge is immediately rectified by automatically moving the mechanical appliances which the pilot would have to adjust in order to level up his machine. Briefly, the device consists of the utilisation of compressed air combined with an electrical current. The air is automatically compressed by two small air pumps which are fitted beneath the forepart of the fuselage, and are actuated by small air-propellers. The air is conveyed to a reservoir connected to a pressure gauge fitted in the pilot's cockpit, so that he can see that the necessary pressure of 60 lb. to the sq. in. is maintained. Above the pressure gauge is a small electrical switchboard with a tiny lamp fitted to the right and to the left. The air is conveyed to a circular tubular container half-filled with mercury and so contrived that as the level of the fluid metal rises to the left or to the right with the movement of the aeroplane, it causes a contact to take place which permits an electric current to act on valves which set in motion the mechanical gear connected with the pilot's controlling mechanism. Simultaneously, the right or left-hand lamp on the switchboard lights up to indicate the variation of the equilibrium, the current being cut off and the lamp automatically extinguished as the aeroplane is brought up to the correct level. By merely raising a small lever in the cockpit, the whole of the mechanism is thrown out of gear and the pilot is free to take full control of the machine again. One of the flights referred to included a trip to Paris and back, when Major Brackley, who is responsible for the tests, allowed the aeroplane to fly for two hours consecutively under the sole control of M. Aveline's invention. The British Government has adopted the invention after exhaustive tests, and 14 Handley Page bombing machines have already been fitted with it for the Royal Air Force.



Air Compressors and Mercury Contact Makers.



Cockpit Switchboard and Pressure Gauge.

Costing and Industrial Relations.—On Wednesday, February 9th (7 p.m.), at the Institute of Chartered Patent Agents, Staple Inn Buildings, Holborn, Mr. H. W. Allingham, M.I.Mech.E., will deliver an address to the Institute of Cost and Works Accountants on "The Position of Cost and Works Accountants in Co-ordinating the Aims of Capital and Labour." Readers may obtain tickets from the Secretary of the latter Institute, at 38, Grosvenor Gardens, S.W. 1.

Regan Train Control System.—The French Ministry of Public Works and representatives of the French railways intended to carry out tests on January 28th of the Regan automatic train control device, which was tried last September on the Great Eastern Railway system in this country, and was described in our pages at the time.

Freemasonry.—At the regular meeting of the Kelvin Lodge, which was held at the Mark Masons' Hall, London, on Friday last, the reigning master, Mr. H. Porter-Cox, presided over a gathering of 98 members and visitors, including three Grand Lodge officers, namely, Messrs. Charles F. Quicke, E. J. Reid, and P. P. Kipping, as well as others of Provincial and London rank, and all present enjoyed the speeches and the musical entertainment which was provided after dinner. Applications to join the Lodge are coming in steadily, and each year the support given to the great masonic charities seems to exceed that of the previous year.

An X-Ray Martyr.—The *Daily News* states that Mr. Ewart Henry Harnack has entered Southampton Hospital for the amputation of his right hand. This gentleman, who with Dr. H. P. Dean was the inventor of protective lead glass, has already lost his left hand as a result of his devotion to the science of radiography. Mr. Harnack states that when, in the early days of the science, he found that his fingers were being affected, he attributed it to the use of strong chemicals, but on ascertaining the true cause he set out to devise a means of protection for X-ray workers.

R.A.F. Dinner.—The Electrical Section, E.R.S., R.A.F., re-union dinner was held at Pinoli's Restaurant on January 29th, the arrangements by Mr. P. B. O. S. Webb, Committee chairman, being admirably carried out. Mr. H. Mason, in a short speech, thanked the Committee for organising the gathering of a highly successful section at E.R.S. Ponte d'Larche. Mr. Webb, in reply, dwelt on the spirit of comradeship shown by the large attendance of provincial men, and stated that Mr. H. Mason will preside at the next dinner, which will be held in Birmingham. An impromptu concert followed, items being given by Messrs. Lewis, Hill, Eldridge, Sorginson, and Athill.

Electro-Harmonic Society.—The next concert (Ladies' Night) will be held at the Cannon Street Hotel, in the Great Hall, on Friday, February 11th, commencing at 8 p.m. The artistes will be:—Miss Violet Openshaw, contralto; Mr. Sydney Pointer, tenor; Mr. Edward Dykes, bass; Miss Gladys Millage, songs at the piano; Mr. Ernest Rutherford, concertina; Mr. Lloyd Shakespeare, cornet; Mr. Wilson James and Mr. Joe Pearson, humorists; Mr. Bernard Flanders, A.R.A.M., solo pianoforte and accompanist. Chairman, Capt. R. J. Wallis-Jones, O.B.E., T.D.

The Electrification of the Belgian State Railways.—Some supplementary details with regard to the electrification of the Belgian State railways were contained in the 1920 Budget report presented to the Belgian Parliament. As briefly mentioned in a recent issue, it is proposed that the work shall be undertaken in three sections. The first to be dealt with will be the Brussels-Antwerp line; the second, the Luxemburg section; and the third, the lines in the Brussels district not included in the first two sections.

The *Moniteur des Intérêts Matériels* states that with regard to the Brussels-Antwerp lines it has been recognised that it will be necessary to undertake the work in three divisions owing to the large amount of track work which will have to be carried out. It is intended to commence with the provision of electric passenger trains, which will be hauled by a combined electric locomotive and passenger coach. The train will consist of three coaches with a total of 550 seats. The coaches will be of steel or part-steel construction and mounted on bogies. The motor coach will be provided with four motors of 275 H.P. each. It is proposed to provide for 38 trains per day in each direction between Brussels and Antwerp (direct, semi-direct, and omnibus trains). On this section, the length of main track to be electrified is 54½ miles and of secondary track, 9½ miles.

The second division of the work on the Brussels-Antwerp section will be that of providing a more frequent service, and the third division of the work will be the electrification of further portions of the track, so that all traffic—goods as well as passenger—between Brussels and Antwerp will eventually be electrically hauled.

The Brussels-Midi junction will be electrified, and a double track between Brussels-Midi and Antwerp will be specially reserved for direct and semi-direct trains as well as for the international trains. The slow passenger and also the goods trains will use a second double track, so that by avoiding the mixing of the two classes of traffic a more frequent service will be possible. It is contemplated that eventually there will daily run between Brussels and Antwerp in each direction 54 express trains, at intervals of 20 minutes; 18 semi-direct trains starting every hour, and 22 omnibus, or as we term them, Parliamentary trains. The express trains are expected to do the journey between Brussels Nord and Antwerp Central in 32 minutes, equal to an average speed of 83 km., or nearly 52 miles per hour, the maximum speed attained being 56 m.p.h. The times for semi-direct trains will be reduced from 54 to 37 minutes, and those of the omnibus trains from 72 to 56 minutes.

For the haulage of the international trains it is proposed to use an electric locomotive of 2,200 H.P., while for the haulage of goods trains electric locomotives capable of hauling trains of a total load of 1,000 tons at a speed of 28 m.p.h. are contemplated.

In the third division of the work the electrification of the double track between Malines and Antwerp South will be undertaken, as well as the train-forming yards at Schaerbeek, Muysen, Zurenborg, Austruweel, Kiel, and Antwerp South, although the actual shunting will continue to be carried out by steam locomotives.

For the supply of the necessary energy three large substations will be established at Schaerbeek, Malines, and Berchem, the latter place being near Antwerp. The annual consumption of energy on the Brussels-Antwerp section is estimated at 100,000,000 kilowatt-hours, equal to 30 watt-hours per ton-kilometre.

The second section of the electrification work is that of the Luxemburg and neighbouring lines. For the ordinary service motor-trains similar to those on the Brussels-Antwerp line will be employed, while the international and goods trains will be hauled by electric locomotives, average and maximum speeds of 44 and 56 m.p.h. being provided for. Owing to the heavy gradients on these lines it will be necessary to use two electric locomotives for each goods train, which will, however, attain an average speed of 25 m.p.h. as against 20 m.p.h. by steam. For this division it is estimated that 400,000,000 kilowatt-hours per annum will be necessary.

The final section of the work to be undertaken will be the electrification of the whole of the lines in the Brussels district, which will obviate the present delays due to the necessity of changing from electric to steam traction and *vice versa* which at present obtains.

INSTITUTION NOTES.

Institution of Electrical Engineers.—The arrangements for the second part of the 1920-21 session are as follows: February 10th, discussion on "Electric Appliances for Domestic Purposes," to be introduced by a paper on "Some Thermal Characteristics of Electric Ovens and Hot Plates." Prof. E. Wilson on "Feebly Magnetic Materials," February 17th, Lecture I "Instrumentation"; February 24th, Lecture II "Results of Scientific Research"; March 10th, Lecture III "Practical Applications"; March 3rd, annual dinner at Hotel Cecil. March 17th, paper by Sir W. Noble on "The Long-distance Telephone System of the United Kingdom." April 7th, subject to be announced later. April 14th, paper by Mr. E. A. Watson on "Magnetos for Ignition Purposes in I.C. Engines." April 28th, discussion on "Tariffs"; papers by Mr. J. R. Blaikie—"Electricity Supply: Present Conditions and the Hopkiuson Principle," and J. W. Beauchamp, "Multi-part Tariffs for Domestic Electricity Supply." May 5th, continuation of discussion on "Tariffs."

Informal Meetings.—Febuary 14th, discussion on "Some Notes on the Design of a Large Power Station," opened by Mr. J. W. Cowie. February 28th, informal social evening. March 14th, discussion on "Rectifiers," opened by Mr. R. L. Morrison. April 11th, discussion on "Some Characteristics and Applications of Multi-speed a.c. Motors," opened by Mr. F. Creedy. April 25th, discussion on "Engineering in Russia," opened by Mr. C. L. Lipman.

North-Eastern Centre.—February 11th, conversazione. February 14th, "Temperature Limits of Large Alternators," by Mr. G. A. Juhlin. February 28th, lecture on "Thermionic Valves," by Mr. W. D. Owen. May 9th, annual general meeting.

North Midland Centre.—February 8th, "Temperature Limits of Large Alternators," by Mr. G. A. Juhlin. April 26th, annual general meeting.

North-Western Centre.—February 8th, address by the President. February 22nd, "Magnetos for Ignition Purposes in I.C. Engines," by Mr. E. A. Watson. March 8th, "Electric Driving in the Paper Mill on Heat-economy Lines," by Mr. A. B. Mallinson. April 12th, annual general meeting and smoking concert.

Scottish Centre.—February 8th (Glasgow), "Automatic Protective Devices for a.c. Systems," by Mr. A. E. McColl. March 8th (Edinburgh), "The Long-distance Telephone System of the United Kingdom," by Sir W. Noble. April 12th (Glasgow), lecture on "Wireless," by Dr. J. Erskine-Murray.

South Midland Centre.—February 23rd, discussion on "Electric Appliances for Domestic Purposes," to be introduced by a paper by Mr. E. Griffiths, D.Sc., and Mr. F. H. Schofield, B.A., B.Sc., on "Some Thermal Characteristics of Electric Ovens and Hot Plates." April 27th, paper by Mr. E. A. Watson on "Magnetos for Ignition Purposes in I.C. Engines," and annual general meeting.

Western Centre.—February 7th (Bristol), "The Application of Electric Locomotives to Main Line Traction on Railways," by Lt.-Col. H. E. O'Brien, D.S.O. May 2nd (Bristol), address by the President.

Membership.—At the ordinary meeting on Thursday last week the balloting list for the election of new members and for the transfers from one class to another contained a total of 616 names, of which 556 are the names of new members. This constitutes a record, and raises the membership figure to the 9,000 mark. The new members of the various classes were divided as follows: Members, 4; associate members, 116; graduates, 42; students, 333; and associates, 3. The figures in the last list were respectively 6, 52, 30, and 181, or a total of 269.

Students' Section.—An interesting address on "Magnetos" was given before the Students' Section of the North-Eastern Centre on January 21st, by Mr. W. Bayliss, who detailed the various parts of the magneto and explained their functions.

Chelmsford Engineering Society.—On January 26th, Mr. C. S. Buyers read a paper on "Electric Winding for Collieries." The lecturer divided his paper under the following heads: (1) Nature of work and general requirements to be fulfilled. (2) Types of winding drum and their effect on the power demand, and (3) Systems of electric drive and their applications.

Edinburgh Electrical Society.—On January 28th, Mr. E. C. Catford, of the Edinburgh Corporation Tramways, delivered a lantern lecture on "The Electrical Wonders of Guernsey." The lighting and tramway system of the island and the very admirable telephone system were described. On February 11th the Society will meet at the North British Rubber Works.

Physical Society of London.—On February 11th, at the Imperial College of Science, South Kensington, there will be a discussion on "Absolute Measurements of Electrical Resistance, and Instruments based on the Temperature variation of Resistance." The speakers will include Sir Richard Glazebrook, F.R.S., Mr. F. E. Smith, O.B.E., F.R.S., Prof. H. L. Callender, F.R.S., Prof. C. R. Darling, Mr. C. Jakeman, Major W. S. Tucker, Capt. E. J. Paris, Prof. J. T. McGregor Morris, Dr. J. S. G. Thomas, Mr. A. H. Davis, Dr. G. A. Shakespear, Prof. Leonard Hill, Mr. E. A. Griffiths, Dr. Daynes, and Dr. Ezer Griffiths.

Institute of Physics.—The recently incorporated Institute of Physics has issued a booklet setting forth the objects of the Institute and regulations for the admission of members, students, associates and fellows. Full details of the necessary qualifications, examinations and exempting degrees, &c., are given.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.

The *Financial Times* says that the following appointments have been agreed by the directors of the Underground group of companies, which includes the Underground Electric Railways Co. of London, Metropolitan District, London Electric, City and South London, and Central London Railways, and London General Omnibus Co.: Assistant managing directors, Mr. H. E. Blain and Mr. F. Pick; director for construction (railways), Mr. Z. E. Knapp; chief engineer (omnibuses), Mr. G. J. Shave; chief engineer (railways), Mr. A. R. Cooper; secretary and treasurer, Mr. J. C. Mitchell. At the same time, the management of the London and suburban traction group, namely, the Metropolitan Electric, London United, and South Metropolitan Electric Tramways, has been brought into direct connection with the Underground management, and the following appointments have been agreed upon: Mr. C. J. Spencer, general manager; Mr. E. Boys, secretary and treasurer.

Mr. E. J. Nally, president of the Radio Corporation of America, arrived in England on January 30th, and is staying at the Ritz Hotel, London. He has come over to attend a conference between representatives of wireless telegraphic interests in England, France, and Germany to discuss the commercial development of wireless telegraphy.—*Daily Mail.*

After 26 years of continuous service, Mr. Percy R. Allen, O.B.E., has retired from the active engineering management of the Castner-Kellner Co.; he is being retained by the firm in a consultative capacity. At a dinner given to Mr. Allen by the staff of the company, at which the managing director presided, the presentation of a gold cigarette box, suitably inscribed, was made. Later Mr. Allen was the recipient of a silver tea service from the staff and employés. Mr. Allen will continue to practise as a consulting engineer for steam and gas plant work and the electrification of mines.

The question of increasing the salary of Mr. P. P. Wheelwright, the electrical engineer to the Blackburn Corporation, is under consideration by the Electricity Committee, which is obtaining information as to salaries in other towns. The present salary is £1,000 a year.

Mr. W. Morries, B.Sc., who has been the chief electrician at the Blackley works of the British Dyestuffs Corporation for the past three years, is resigning that position in order to enter business as an electrical engineer and wiring contractor, at 35, Cheapside, Middleton, Manchester. On January 27th the electrical staff presented him with a rose bowl. The presentation was made by the chief engineer of the works engineering department (Mr. C. E. S. Place). Mr. W. Morries, in responding, asked the staff to co-operate closely with his successor, Mr. J. H. Davies. Mr. W. Morries wishes to receive price lists and catalogues from makers of electrical equipment for both power and lighting.

Mr. A. J. Giffin left the Western Electric Co., Ltd., at the end of January to take up an appointment with the Bradford Dyers' Association, Ltd.

Mr. H. C. Waters has been appointed managing director of A.G.E. Electric Motors, Ltd., of Stowmarket, having served the company previously as technical director.

Obituary.—Mr. S. T. Smith.—The death occurred on January 26th of Mr. S. Trow Smith, gas and electrical engineer to the Malvern Urban Council.

Sir Ralph Percy Ashton.—The death occurred on Friday last, at his home at Beechwood, Reigate, of Sir R. P. Ashton, who was a director of the Indian Electric Supply & Traction Co., Ltd., the Enfield Ediswan Cable Works, and other companies, and a partner in the firm of Kilburn, Brown & Co. Sir Ralph, who was 60 years of age, had not enjoyed good health of late, and business matters depressed him. The verdict was "Suicide while of unsound mind."

NEW COMPANIES REGISTERED.

Electrical Apparatus Export Corporation.—Particulars of the Electrical Apparatus Export Corporation have been filed pursuant to Section 274 of the Companies (Consolidation) Act. The company was incorporated in Delaware, U.S.A., on December 24th, 1919. The capital stock is $50,000 in shares of $100 each. The British address is at 408-9, Bank Chambers, High Holborn, W.C., where J. A. Campbell is authorised to accept service of process and notices on behalf of the company. The list of directors is not yet filed.

Practical Machines Co. (A. T. Gadsby), Ltd. (172,826).—Private company. Registered January 27th. Capital, £10,000 in £1 shares (1,000 preference). To adopt an agreement with A. T. Gadsby, and to carry on the business of electrical and general engineers, manufacturers of and dealers in electrical and other machinery, founders, metal spinners and merchants, &c. The first directors are: A. T. Gadsby, 119, Wells Street, Camberwell, S.E. (permanent director, chairman and sole managing director); H. Berry, 10, Greenholm Road, Eltham, S.E., engineer. Qualification, £100. Registered office: 39, Avenue Chambers, 4, Vernon Place, Bloomsbury, W.C.

Duttons (Southport), Ltd. (172,755).—Private company. Registered January 24th. Capital, £3,000 in £1 shares. To take over the business of electrical engineers and accumulator manufacturers, carried on by H. Dutton and A. Dutton as "H. and A. Dutton," at Southport. The permanent directors are: H. Dutton, Ansdell Road North, Lytham: A. Dutton, Marlborough Road, Southport. Registered office: 1a, Marlborough Road, Southport.

Graham & Sons, Ltd. (172,842).—Private company. Registered January 28th. Capital, £5,000 in £1 shares. To carry on the business of electrical engineers, manufacturers of electrical machinery, instruments, cable, glass and porcelain ware, insulation materials, mechanical, marine, constructional, internal combustion and general engineers, &c. The first directors are: J. P. Graham (permanent), Hillcroft, Stocksfield; C. P. Graham, Hillcroft, Stocksfield; S. E. Graham, Hillcroft, Stocksfield. Qualification, 100 ordinary shares. Secretary: Jessie Bryce. Registered office: Sun Insurance Buildings, Collingwood Street, Newcastle-on-Tyne.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Ignitions, Ltd.—Particulars of £5,000 debentures authorised December 3rd, 1920, present issue £1,400; charged on the company's undertaking and property, present and future, including uncalled capital.

Sphinx Manufacturing Co., Ltd.—Mortgage dated January 4th, 1921, to secure all moneys due or to become due from company to London Joint City and Midland Bank, Ltd., charged on 243, Bradford Street, and 187-199, Alcester Street, Birmingham.

Lithanode Co., Ltd.—Particulars of £3,000 debentures authorised December 31st, 1920; present issue £1,000 charged on the company's undertaking and property, present and future, including uncalled capital.

C. A. Vandervell & Co., Ltd.—Debenture dated December 31st, 1920, to secure £200,000 charged on the company's undertaking and property, present and future, including uncalled capital, and freehold and leasehold property. Holders: D. J. H. Cunnick, Sir Frederick Eley, Bt., and A. G. Hopewell, 15, Bishopsgate, E.C.

Leonard W. Holmes and Partners, Ltd.—Debenture dated January 19th, 1921, to secure £3,000 charged on the company's undertaking and property, present and future, including uncalled capital. Holder: S. P. Powell, 53, Wynstay Gardens, Kensington, W. 8.

Norwegian Electric Smelting Co., Ltd.—Particulars of £10,000 debentures authorised December 30th, 1920, whole amount issued, charged on company's undertaking and property, including uncalled capital and goodwill.

CITY NOTES.

Melbourne Electric Supply Co., Ltd.

Delays in the mails delayed the completion of the accounts for the year ended August, 1920, but the final dividend, making the total 10 per cent., free of British income tax, was approved at a meeting in December, and the borrowing powers were increased from £750,000 to £1,000,000. The accounts are now published, and they show a gross profit on the Melbourne and Geelong undertakings of £221,388 (against £180,161 for the previous year, an increase of 23 per cent., which, in view of the conditions, is satisfactory). After providing for management and general expenses, debenture and other interest and services, £10,149 is written off capital expenditure, £30,000 is put to reserve for British income tax, Corporation tax, and E.P.D., £10,000 to Gold Bonds Redemption account, and £35,000 to general reserve. After paying the 7 per cent. dividend on the first cumulative preference shares, 10 per cent., free of British tax, on the consolidated ordinary stock on the ordinary shares, £4,691 is the remaining balance, plus £50,051 brought forward, making the total to be carried forward £54,742. In order to facilitate the provision of further capital necessary to cope with the continued expansion of the business, resolutions will be submitted at a meeting on February 7th for the purpose of increasing the rate of dividend on the whole of the authorised issue of 100,000 first cumulative preference shares of £5 from 7 per cent. per annum to 8 per cent. per annum as from March 1st, 1921. In consideration of this increase the holders of the 70,000 preference shares already issued will be asked to consent to the premium of 10 per cent. to which they are entitled upon repayment of capital on the winding up of the company being reduced to 5 per cent. The development figures are as follows:—

Melbourne.	Consumers.	Lighting in kW.	Motors in rated h.p.	Total connections, kW.	Total units sold.
Year ended Aug., 1919 ...	42,430	36,189	30,318	66,507	35,069,000
" " " 1920 ...	51,675	44,006	34,478	78,485	44,444,000
Geelong.					
Year ended Aug., 1919 ...	3,374	3,082	2,415	5,497	1,551,042
" " " 1920 ...	3,862	3,384	2,509	5,894	1,627,276

Light and power was made available in 62 additional miles of streets at Melbourne during the year, and 9,245 new consumers were connected (increase 22 per cent.); power supply increased by 14 per cent.; total connections by 18 per cent.; total units sold by 26 per cent.; and gross revenue by 24 per cent. Notwithstanding the heavy increase in the cost of labour, fuel, and materials generally, an increase in charges to consumers has been avoided.

Yorkshire Electric Power Co.

During the year ended December, 1920, there was a substantial increase of revenue and profit. The net profit, after payment of interest, was £64,740, against £54,133 for 1919, and £46,536 for 1918. Including £17,596 brought forward, the amount is £82,336. Preference dividend 6 per cent.; dividend on the ordinary at the rate of 5 per cent. for the six months, making a total of 8 per cent. for the year; to general reserve (making it £89,000), £15,000; carrying forward £20,939. The works have been fully maintained out of revenue. During the year the costs of coal, wages and materials showed further increases, which were met to some extent by the economies arising from the increased output. The extensions of the company's power stations which are now proceeding, and which include a 12,000-kW turbo-alternator, should produce still further economies when they come into use in the present year. A large number of new connections have been made, the full revenue from which will not be secured until the present year. Further agreements for supply have been made which will also produce a substantial increase of revenue. The unification of the supply of electricity in the West Riding which has been made possible by the existence of the company's system, continues to grow. Out of a total of 62 undertakings of authorised distributors in the company's area, 40 are taking or have agreed to take a supply of electricity in bulk from the company and negotiations are proceeding with others which should lead to a complete co-ordination of the supply of electricity in the company's area. The Electricity Commissioners appointed by the Electricity (Supply) Act, 1919, have given notice of their intention to hold inquiries into the present and future position of electricity supply in certain districts, which together include the company's area of supply, and it is hoped that the Commissioners' action may lead to the removal of the legislative obstacles which have retarded the development of the company's undertaking. The issue in February last of £230,000 of 5½ per cent. redeemable debenture stock and £400,000 of ordinary shares was utilised for the purpose of repaying existing mortgages and loans and to provide capital to meet growing demands for power. The company has power to borrow by the issue of debenture stock to the extent of one third of the issued share capital, and in view of the further demands for power already in sight, a resolution authorising the issue, from time to time, of further debenture stock within the scope of this authority will be submitted at the close of the annual meeting on February 15th. The company has recently purchased premises in Leeds to be used as head offices. Mr. Hardman Arthur Earle, who has been a director of the company since its formation, has resigned through ill-health.

The Siemens and Schuckert Group.

The *Siemens & Halske Co.*, of Berlin, reports gross profits and balance forward amounting to 26,844,000 marks for 1919-20, as compared with 15,736,000 marks in the previous year. After defraying general expenses and interest on loans, and transferring 4,000,000 marks to the benevolent fund jointly created with the Siemens-Schuckert Works, the accounts show net profits of 16,435,000 marks, as contrasted with 11,457,000 marks in 1918-19. It is proposed to pay a dividend at the rate of 12 per cent. on the old shares for 63,000,000 marks, as in 1918-19, and one at the rate of 6 per cent. on the new shares for 63,000,000 marks. As the financial year has now been transferred to September 30th so as to harmonise with the other companies forming the recently constituted community of interests, accounts are also submitted for August and September, 1920, showing net profits of 4,829,000 marks, and a dividend at the rate of 2 per cent. is proposed on the total capital of 126,000,000 marks. The report of the directors states that the scarcity of coal and other raw materials caused great difficulties, which were to some extent overcome by the end of the financial year. The uncertainty in calculating reliable sale prices specially influenced export business. Nevertheless it was possible profitably to increase the export of electro-technical manufactures partly in consequence of the scarcity of goods in the world's markets down to the close of the financial year, and partly owing to the quality of the manufactures and the confidence shown in the technical efficiency of the industry. Dealing with the labour problem, the report mentions that further large interruptions in working had not taken place since the Berlin strike of metal workers in November, 1919. The efficiency of the workmen had satisfactorily increased, particularly in the case of piece work; the number of workmen was about the same, although the ratio of productive wages to unproductive wages became more favourable, and the number of officials had grown. The company was interested in the Osram Co. to the extent of 40 per cent., and the first year's results of the latter already showed that the aims of the association were being achieved both technically and economically. It is stated in conclusion that the works are abundantly supplied with materials and orders.

The accounts of the *Siemens-Schuckert Werke*, including the balance forward, indicate gross profits of 37,287,000 marks for the year ended on July 31st, 1920, as contrasted with 27,650,000 marks in the previous year. After meeting general expenses, interest on loans and depreciation, and allocating 8,000,000 marks to the benevolent foundation jointly maintained with the Siemens & Halske Co., the net profits are returned at 12,769,000 marks, as compared with 15,293,000 marks in 1918-19. It is intended to pay a dividend at the rate of 10 per cent., as in 1918-19, and place 2,500,000 marks to the reserve fund, as in the preceding year. The net profits in the intermediate year from August 1st to September 30th, 1920, amount to 2,806,000 marks, permitting of the payment of 10 per cent. *pro rata* for this period. Dealing with the past year, the report of the directors states that at the beginning it was impossible for the production to meet the requirements of the market. The scarcity of manufactures and the increases in prices due to depreciating currency produced a speculative impetus in the demand. Orders came to hand far in excess of the actual absorbing capacity of the market, and led to a great accumulation of stocks in connection with the sudden change in the economic conditions at the close of the financial year. As a consequence, some circles of customers got into great financial difficulties, and the company had to extend a helping hand in order to overcome them. The economic crisis which threatened to develop from this sudden change was only avoided by a systematic co-operation of the entire electrical industry.

The financial statement of the *Elektrizitats A.G. vorm. Schuckert & Co.*, of Nuremberg, shows gross profits of 13,612,000 marks for the year ended on July 31st, 1920, as compared with 9,640,000 marks in the preceding year, the net profits being 7,228,000 marks and 6,370,000 marks in the two years respectively. During August and September, 1920, the net profits amounted to 1,848,000 marks. The directors recommend the payment of a dividend at the rate of 9 per cent. for the complete financial year, and at the rate of 10 per cent. for the two months forming the new year and resulting from the transfer of the date of the financial year.

The report, dealing with the company's investments in 1919-20, states that it was possible to accommodate the prices for the supply of energy to the conditions of the times so that the supply works were able to maintain their economic situation. This was, however, not the case to the same extent with the tramways and light railways, and many lines became so unsatisfactory that they had to suspend working partly or altogether. The creation of new supply works, and the extension of existing works were greatly prejudiced by the high degree of saturation already reached through the present uneconomically high costs of erection, as well as through the efforts in the direction of socialisation and municipalisation. On the other hand, profitable activity in other countries was still obstructed by the existing well-known conditions. Under these circumstances the company continued to devote attention to the working up of other branches of work. The report further states that a favourable influence was expected to result from the community of interests established with the Rhine-Elbe-Union.

Sunderland District Electric Tramways, Ltd.—The report for the year ended October 31st, 1920, states that after charging the expenses of operation and administration for the year and providing for depreciation of rolling stock, &c., the balance is £16,187, plus £1,209 brought forward. After providing for interest on bonds and debentures and sinking fund, also £1,800 for reduction of investments, 5 per cent., less tax, is paid on the first and second income bonds, and 5 per cent., less tax, on the preference shares, leaving £1,542 to be carried forward. Traffic receipts increased by £7,821, but the expenses increased in greater proportion, so that the decrease in operating profit was £4,427.

City of Buenos Aires Tramways Co. (1904), Ltd.—For the year ended December, 1920, a balance dividend of 1s. 3d per share (making 5 per cent. per annum), less income tax £3,000 to general amortisation fund, and £3,911 carried forward.

Westminster Electric Supply Corporation, Ltd.—Final dividend at the rate of 12 per cent. per annum, less tax, making 10 per cent. for the year.

Stock Exchange Notice.—The following have been ordered to be officially quoted:

Indian Electric Supply and Traction Co., Ltd.—120,000 7 per cent. non-cumulative (convertible) preference shares of £1 each, fully paid (Nos. 1 to 120,000).

Dublin United Tramways Co. (1896), Ltd.—Final dividend at the rate of 7 per cent. per annum, less tax, making 5½ per cent. for the year; £30,000 to deferred renewal of rails; £2,000 written off investments; £13,331 carried forward.

Provincial Tramways Co.—Net revenue for the year ended September, 1920, £40,016, plus £10,804 brought forward. To reserve and depreciation account £10,000; dividend of 10d. on the ordinary shares, making 1s. 6d. for the year (7½ per cent.). £3,008 carried forward.

St. James's & Pall Mall Electric Light Co., Ltd.—Dividend of 8s. 6d. per share on the ordinary shares, making a total of 12 per cent. for the year 1920.

Greenwood & Batley, Ltd.—An interim dividend of 2½ per cent. on the ordinary shares is announced.

Tucuman Tramways, Light & Power Co.—Loss of £8,383 for the year ended June, 1920. Debit balance £69,524.

STOCKS AND SHARES.

Tuesday Evening.

Main discussion in this week's Stock Exchange markets has focused on two points: one the reparations question and the other the Bank Rate. While it was not generally expected that the latter would be lowered on Thursday, there were some hopeful folk who looked for this step to be taken at once, and in most quarters it is generally assumed that February will certainly see the rate down to 6 per cent. The principal satisfaction felt with the decision arrived at with regard to reparations is concerned with the cordial relations re-established with France, inasmuch as, a week ago, fears were raised that friction might ensue from differences of opinion arising over the negotiations. The investment markets strengthened after their somewhat sharp reaction, and this had its effect upon the best-class issues throughout the Stock Exchange. The flatness in railway stocks passed over the Underground group, although prices here are dull rather than depressed.

The Westminster Electric Company has declared its final dividend, making 10 per cent. for the year, the same as that for 1919. It was expected that the company would repeat its previous performance, and the declaration had the effect of raising the price ⅛ to 5¼. Charing Cross rose sharply to 4. Other shares in the electricity supply list are quiet, as they are bound to be in any case on the eve of dividends, the issue of which is a trifle uncertain. Newcastle Electric preference stiffened to 13s. 9d. Melbourne Electric preference improved to 4⅝ on the raising of the dividend. The new issue is expected to make its appearance some time this month. Auckland debenture advanced to 90, and in the foreign market, Anglo-Argentine Tramways 4 per cent. debenture stock at 59½ is a point better. Rio Tramways Firsts at 89½ and Sao Paulo Firsts at 88½ are both higher.

The firmest market in the Stock Exchange apart from the purely gilt-edged stocks is that for cable shares. Eastern Telegraph ordinary has risen to 157½. Globes, Westerns and Eastern Extensions are nominally 15¾ middle, but actually are rather better than they appear, inasmuch as the seller can get on at the middle price better than the buyer. The chance of taxation being increased when the next Budget is produced serves to underline the interest taken in these stocks and shares upon which dividends are paid free of tax. The yields now come to about 6¼ per cent. on the money, equivalent to 9 per cent., allowing for tax at 6s. in the £. The Henley issue was, of course, a success, and dealings started in the new shares 14s. paid on the basis of 6d. premium. To anyone who is on the lookout for a good industrial investment with reasonable chances of appreciation in future, Henley's will make an appeal as deserving a place amongst shares of this class. The old shares are 1/16 down at 28s. 9d. Anglo-American Telegraph deferred has risen again, this time to 15⅞, and the preferred stock added another point to its price. Chili Telephones are up to 5¾, and United River Plates to 6¼; but Monte Video Telephones drooped to 1⅞. Great Northerns have hardened to 22, a gain of 10s., and the only really weak spot in the market is that for West India and Panama shares, which have gone back to 11s. 3d. Marconis are lower at 1 15/16, the market having no friends at all at the present time. Indeed, since the dividend disappointment of six weeks ago, Marconis have been out of popular favour, although holders await with keen interest the final dividend for the year. Radio Common at 8s. 6d. and the preferred at 11s. 6d. are inactive.

British Aluminium improved to 18s. 3d., and General Electric preference at 18s. 6d. are also a few pence harder. Cromptons remain weak at 13s. 9d. There is not much doing in manufacturing shares, owing to the various industrial and financial difficulties that prevail. The public are fighting rather shy of such shares at the present time. Various speculations and rumours are already rife in respect of the next Budget, and as none of them carry consolation to the taxpayer, he is likely to play for safety in his Stock Exchange transactions until, at any rate, money becomes cheaper.

The three non-assented ordinary stocks of the Central London Railway are now quoted again, after a considerable interval, at the common price of 27½. The assented stocks remain between 43 and 47. East Londons have not moved; the meeting produced a vigorous protest from the Chairman at the way in which the company is circumscribed by Government control. Metropolitan Consolidated relapsed to 22 after being a point more, and Districts have fallen back to 15½. The Underground Electric issues are easier.

British Columbia Electric Railway stocks are now ex dividend, and the yield on the deferred comes to 12 per cent. on the basis of the last distribution. Mexicans are lower again.

The rubber share market gives no sign of animation, so prices are naturally disposed to sag. Armaments are dull, with Vickers down to 15s. Babcock & Wilcox have receded to 2⅛. The engineering group, with shares of iron, soal and steel companies generally, are slipping back by degrees, the daily declines being as small as they are persistent.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Feb. 1, 1921.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	5⅞	-	£10 4 4
Charing Cross Ordinary	4	7	4	+ ½	8 15 0
do. do. do. 4½ Pref. ..	4½	4½	2¾	—	8 8 8
Chelsea	8	4	3⅛	—	6 8 0
City of London	8	10	$1\frac{3}{16}$	+ $\frac{1}{32}$	8 8 5
do. do. 6 per cent. Pref. ..	6	6	17/6	—	6 17 2
County of London	7	8	7½	—	10 13 4
do. do. 6 per cent. Pref.	6	6	7¾	— ⅛	7 15 0
Kensington Ordinary	6	7	3⅞	—	9 0 6
London Electric	Nil	2½	¼	—	10 0 0
do. do. 6 per cent. Pref. ..	6	6	2¾	—	10 18 2
Metropolitan	5	6	2¾	— ⅛	10 18 2
do. 4½ per cent. Pref. ..	4½	4½	$2\frac{9}{16}$	—	8 15 8
St. James' and Pall Mall	10	12	6¼	—	9 12 0
South London	5	6	2½	—	9 12 0
South Metropolitan Pref.	7	7	13/9	—	10 8 8
Westminster Ordinary	6	10	5¼	+ ⅛	9 10 6
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	79½	+1	17 11 0
do. Def.	83/6	1½	15⅞	+ ½	9 8 6
Chile Telephone	8	6	5¾	+ ¼	*5 4 4
Cuba Sub. Ord.	7	7	6½	—	*10 15 4
Eastern Extension	8	10	15¾	+ ¼	*6 7 0
Eastern Tel. Ord.	8	10	157½	+3	*6 7 0
Globe Tel. and T. Ord.	6	10	15¾	+ ½	*6 7 0
do. do. Pref.	6	6	8¾	—	6 17 2
Great Northern Tel.	22	22	22	+ ½	10 0 0
Indo-European	13	10	80	-	8 6 8
Marconi	25	26	$1\frac{15}{16}$	— ⅛	—
Oriental Telephone Ord.	10	12	$2\frac{5}{16}$	—	*6 4 0
United R. Plate Tel.	8	8	6¼	+ ⅛	*6 8 0
West India and Panama	1/9	Nil	$\frac{9}{16}$	— ⅛	Nil
Western Telegraph	6	10	15⅞	+ ⅜	*6 6 0
Home Rails.					
Central London Ord. Assented ..	4	4	43½	—	8 4 0
Metropolitan	1	1¼	22	—	6 16 4
do. District	Nil	Nil	15½	—1	Nil
Underground Electric Ordinary	Nil	Nil	1⅞	— ⅛	Nil
do. do. "A" ..	Nil	Nil	6/-	—	Nil
do. do. Income ..	6	4	65½	—1	—
Foreign Trams, &c.					
Anglo-Arg. Trams, First Pref. ..	Nil	6½	2¾ xd	—	10 0 0
do. do. 2nd Pref. ..	Nil	Nil	8½	—	Nil
do. do. 5 % Deb. ..	5	6	62½	+1	8 18 10
Brazil Tractions	Nil	Nil	38½	—	Nil
British Columbia Elec. Rly. Pfce.	6	5	55	—	9 1 10
do. do. Preferred	2½	6	63½xd	—	*8 16 0
do. do. Deferred	Nil	8	61½xd	— ½	*12 2 8
do. do. Deb. ..	4½	4½	54½	—	7 16 0
Mexico Trams 5 per cent. Bonds..	Nil	Nil	40½	—	Nil
do. 6 per cent. Bonds .	Nil	Nil	26½	—1	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	21½	—	Nil
do. 1st Bonds	Nil	Nil	62½	—2	Nil
Manufacturing Companies.					
Babcock & Wilcox	15	16	2⅛	— ⅛	*7 1 2
British Aluminium Ord.	10	10	18/3	+9d.	10 19 2
British Insulated Ord.	12½	15	1⅝	—	9 5 10
Callenders	25	15	1⅜	—	10 18 2
,, 6½ Pref.	6½	6½	17/6	—	7 8 7
Castner-Kellner	20	17	2⅞	—	7 12 9
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	10	12/6	—	—
do. do. 5 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	⅞	—	11 8 6
Gen. Elec. Pref.	6½	6½	18/6	+6d.	7 2 6
do. Ord.	10	10	$1\frac{7}{32}$	—	*8 4 8
Henley	25	15	$1\frac{7}{16}$	— $\frac{1}{16}$	10 5 0
do. 4½ Pref.	4½	4½	3¼	—	6 18 6
India-Rubber	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	$1\frac{13}{16}$	—	8 16 4
Siemens Ord...	10	10	$1\frac{1}{16}$	—	*9 8 2
Telegraph Con.	20	20	21½	—	*5 11 8

* Dividends paid free of Income Tax.

ON STATUTORY EARTHING: SOME CRITICISMS.

By S. LEES.

(*Concluded from page* 101.)

The primary function of the enamel protective coating on metal conduit is to shield the metal beneath from any outside disturbing influences which would produce a deteriorating effect on the metal externally as well as inside the bore. An excellent provision surely, but is it not somewhat inconsistent to deliberately and intentionally mutilate splendidly sound enamelled conduit by flaying its healthy skin, and thereby the more quickly encompassing its premature decay by providing weak spots in its system extremely liable to attack from the many outside disturbing influences? Doubtless it will be maintained that a man knowing his job will take care that conduit enamel is not intentionally damaged by providing a sufficient length of threaded surface at a convenient point, say, next to a fitting, the earth device being clasped to the additional screwed surface of the tubing. This method obviously makes a bad joint and, moreover, has other objections; it is well known that a screwed joint should always abut right up to the termination of the thread, and no bared metal should be left exposed. It is distinctly wrong and inimical to its best interests to destroy the enamelled surface of conduit and a little consideration will show that it is neither necessary nor desirable. Formerly the usual method of attaching an earth conductor to steel conduit (before drawing-in) was to wrap tightly a sufficient number of turns of copper wire round the tubing, previously tinning the wire and surface of tube, and finally soldering the wrapped joint. A sound joint of this kind would be passable, and if finished with a coating of enamel would, indeed, leave little room for criticism. But to paint over some of the abortive arrangements passing as earth devices to-day would be simply covering up still more sins. The writer is reminded of an amusing incident that occurred some twenty odd years ago. An earth connection of the sweated kind just described was being made to a biggish water main, and although the jointer had been playing on the joint for over an hour, he "couldn't get the solder to stick." And no wonder either, for, as was discovered *afterwards*—"the water was on"! It must be allowed, however, that such methods of making earth connections would be considered rather elaborate and too expensive in these competitive days. Still, if it were practicable and commercially possible to render the earthed system an integral and not readily separable part of the conduit or other system, it would be an ideal consummation. The writer, for one, believes that this laudable object can be achieved with the utmost regard to efficiency, and without prejudice to due economy. Following somewhat on the lines of old-time soldering, autogenous welding can be applied with success, and it is at least surprising that this method has not as yet made any advance beyond the experimental stage. Even supposing that welding offered insurmountable difficulties in its practical applications, another method is available in which the metal conduit system carries its own earthing connection integral with the whole, of unquestionable and unalterable 100 per cent. conductivity. With this method the usual ordinary fittings, slightly modified, are employed, which fulfil the dual function of fitting proper, and earthing connection. Hence, it seems strange and surprising that ancient and inefficient methods continue in use to-day which do not attain the object prescribed in the Regulations.

Ironclad (so-called) switch and fuse fittings, particularly of the unit type, are often indifferently adapted for earthing, any handy point being used to attach the earth wire, without due consideration of the suitability or otherwise of the frame or case of the fitting. It is obviously not sufficient to drill and tap the case and fit any odd size of screw at any casual point; the connection should be integral with the frame, sound electrically as well as mechanically, and all moving parts, *i.e.*, doors, covers, &c., should be efficiently bonded to the stationary portion of the apparatus. The writer has yet to come across a commercial example of the type of gear referred to which complies with the Regulations in this respect. Again, it is not sufficient to build up switch-fuse gear on the (so-called) unit system depending upon the natural contact between the metal framework and the fittings. Light rolled sectional iron bar as generally used for this purpose should always be faced at all points of attachment with earth conductors and switch and fuse fittings, the latter, of course, being treated likewise. The all too common practice of twisting the earth wire around the head of an ordinary wood screw, which also serves to hold the fitting in position, should be condemned. In quite a number of makes the fittings are provided with "earth screws" of absurdly small proportions and of B.A. type, placed in altogether inaccessible positions and, therefore, useless. The Home Office Rules are wise ones in this respect, and do not overestimate the importance of a good earth connection.

It is becoming quite common to find no regard given to the conductance of the earth conductor to the apparatus connected, the rule, or rather misrule, being apparently to use any casual tag end of scrap stuff which happens to be handy. The 50-amperes rule might for all intents and purposes be non-existent, nor does the sight of a mazy network of wires seem to excite much comment nowadays. Given a good earth connection, and that surely is a straightforward piece of engineering, what could be easier than to effect a sound connection of 100 per cent. conductivity electrically and mechanically thereto?

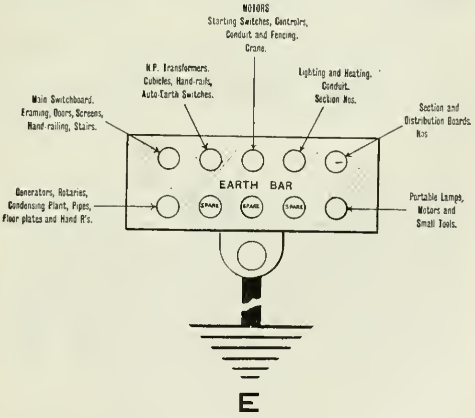


Fig. 7.

In dealing with apparatus and installations of all but the very smallest sizes, the writer would advocate, with due consideration to the circumstances of each individual case, the provision of one or more earth connecting points, these being situated as centrally as possible in relation to the apparatus connected thereto. Preferably made of copper bar or plate of ample capacity, the "earth bar" would be provided with a sufficient number of connecting points, all contact surfaces being accurately faced; the conductors of incoming circuits, if of standard cable, should terminate in properly-fitting soldered thimbles having ample contact area. After naming, the circuits should be labelled suitably in an easily read position. The method referred to has many advantages over the usual network of innumerable lengths, jointed and otherwise, of multi-sized conductors and loop connections as commonly used, and, further, is more elastic and less expensive to install than the "ring main" or any of its modifications. The sketch, fig. 7, shows in diagrammatic form the arrangement described.

The indiscriminate use of water pipes for electrical earthing purposes, especially on large power systems, is open to many objections, and possibly in the not distant future their employment as such may be more stringently regulated than at present. Curiously, very little information of an authentic kind concerning the effects of electrolysis on underground water and gas-pipe lines or other subterranean media liable to attack is readily available, the published matter on this interesting subject being both scarce and meagre. Rarely are buried earth connections examined visually, or even tested, until perhaps occasion demands through trouble arising. When brought to light the condition of earth plates after long service is invariably interesting, and not infrequently past unsolved problems become readily explained, as likely as not without the aid even of the simplest arithmetic. A wider use might with advantage often be made of independent earthing apparatus, not only the best forms of the conventional earth plate, but of the lesser known proprietary devices. A good connection with "earth" is often difficult, but not impossible, to attain, and the location should always be carefully chosen to ensure as far as possible permanent and suitable strata, natural if possible, the earth device being preferably sunk upright, and the "bedding" properly packed, and if artificially maintained, means taken to obviate undue mechanical strain being put on the earth conductor and connections.

The time would seem not very far distant when some radical change may come about in the methods of installing interior wiring at any rate. Metal conduit in its many different forms as used to-day may then find its way into the melting pot, so to speak. Admittedly the best of the existing methods of enclosing wiring, it cannot be denied that screwed steel conduit has many inherent disadvantages; it lacks flexibility as regards adaptability to existing architectural structures, is complicated and unwieldly, and is open perhaps to criticism from an æsthetic point of view. Even with the many ingenious devices and accessories provided, the system does not facilitate fault-finding, renewals, and repairs. Moreover, on the score of first cost, the screwed conduit system of to-day is expensive often to a prohibitive degree. One feels moved to ask: Is not extreme mechanical strength for conductor protection somewhat of a fetish, and must we perforce always clothe wiring with steel?

The past decade or two has been singularly lacking in evolving a really practicable system of wiring on original lines, meeting modern requirements efficiently and economically. We do not seem to get very far beyond the conventional metal tube or some variation or other of the lead or alloy-wrapped methods of running wires, except the ancient and barbarous "open" method which periodically crops up in re-christened guise. The early 'nineties saw the birth of various concentric systems, wonderful inventions of their kind, and although now obsolete and out of fashion, examples are not wanting of their lasting qualities which are working satisfactorily to this day. An ideal system would seem to lie upon lines at once affording safety of working and sufficient and ample internal protection to the wiring without the aid of external secondary protection. Such a consummation would then probably pass from the purview of Regulation 21, or at least the decree would undergo considerable revision, and thereby be rendered easier of understanding by those who have to work to it.

The writer has attempted to deal critically with the earthing of apparatus from a practical standpoint, and has purposely avoided making reference to the special Mining Rules, as these hardly come within the range of the foregoing notes.

THE TEMPERATURE LIMITS OF LARGE ALTERNATORS.

By G. A. JUHLIN, M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers.)

Report No. 72, by the British Engineering Standards Association, deals comprehensively with the whole of the above subject. Comparatively few specifications for electrical plant are, however, based on these Rules. It is not uncommon to find that the methods of measurement laid down in the Rules are adopted, but that the limiting temperatures specified are generally very much lower. This may be due partly to the temperature rises allowed in the Rules being higher than those that engineers are familiar with, and partly to a doubt whether insulation will safely withstand these temperatures. Experience has shown that such doubts are groundless and that mica insulation is capable of withstanding considerably higher temperatures than those laid down in the Rules.

In considering temperature conditions of the stator, we shall neglect the influence of the rotor upon the stator temperatures. The change in temperature of the different parts of the stator with the load, as shown in fig. 1, is typical of large turbo-generators with long cores. In machines with short iron lengths, the temperature of the stator copper embedded in the iron may, at no load, be considerably below the temperature of the iron, due to the heat from the latter being conducted from the embedded portion to the end windings with a very small drop in temperature. Fig. 1 shows that the temperature of the iron increases with the load, due to the fact that in large turbo-generators the greater portion of the losses caused by the load current is generated in the laminations and the surrounding iron, the losses in the copper itself being a comparatively small portion of the total load loss. The temperature rise of the iron at any given load will then be a function of the total losses in the iron at this load and of the volume of cooling air.

Figs. 2 and 3 show the conditions obtaining with radial and axial ventilation respectively. The situation of the hot spot changes with the type of ventilation, but it will be somewhere in the embedded portion of the winding, unless the ventilation of the end windings is abnormally bad. The heat will then flow from the hot spot along the conductors towards the end windings. The amount of heat to be transmitted becomes greater towards the ends, due to each unit of length generating heat, which must be added to that of the preceding part of the conductor.

The amount of heat generated per unit length is not constant, on account of the varying temperature of the copper, and the temperature drop, therefore, increases very rapidly with the length of the conductor. Fig. 4 shows the temperature gradient for varying lengths and current densities. These curves are based on the formula of Prof. Miles Walker and also on the assumption that all the heat is conducted along the copper. Such large temperature differences do not actually exist in practice, as a considerable amount of heat is transmitted through the insulation, but the curves indicate the comparatively small amount of heat which can be conducted along the copper without excessive temperature differences.

In calculating these temperatures no account has been taken of eddy-current losses. The temperature drop would be greater than indicated by the curves if there should be no heat transmission through the insulation, and in machines with long cores practically all the heat generated in the centre of the conductors must pass through the insulation into the lamination. In taking into account the losses caused by eddy currents, it should not be overlooked that these losses diminish with increasing temperature, whereas the normal I^2R losses increase. Accurate calculations are, therefore, very complicated and tedious.

Experimental work has been carried out to determine the thermal conductivity of different classes of insulation. The difficulty in applying the data thus obtained to a completed machine lies in the fact that the thermal conductivity depends to a great extent upon how tightly the insulation is applied on the coils, and on the clearance existing between the outside of the insulation and the laminations. No definite values which may be applied generally can be given. Tests made on complete machines in actual service show that a thermal conductivity of 0.003 to 0.0035 watt per cu. in. per deg. C. may be taken as an average figure. These values were obtained on coils insulated with mica wraps applied under heat, by a special wrapping machine. Having fixed the value of the constant, the temperature drop $T=(W \times t)/c$, where $W=$ watts per sq. in., $t=$thickness of insulation in in., and $c=$ thermal conductivity.

To determine the watts per sq. in. it is necessary to include the eddy-current losses in the copper, as these may be very large if the winding is not properly constructed. For this reason it is impossible to judge the rating of a machine by simply specifying that the current density must not exceed a certain value, because one machine may be run with, say, 2,000 amperes per sq. in., and yet have a lower temperature rise than another machine of similar size having a density of only 1,500 amperes per sq. in. Moreover, the proportions of the slot have considerable influence on the temperature rise which will be obtained with a certain current density, so that this value is no criterion as to liberality of material in a certain design.

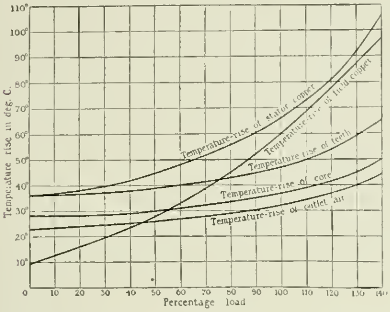


Fig. 1.

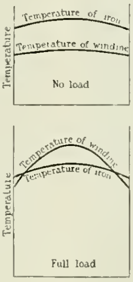


Fig. 2.

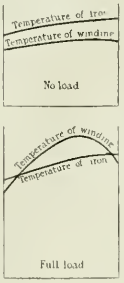


Fig. 3.

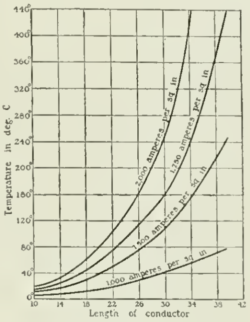


Fig. 4.

Fig. 1.—Variations in Temperature Rise of Different Parts of a Large Alternator, due to Change in Load.

Fig. 2.—Axial Temperature Distribution in Stator, with Radial Ventilation.

Fig. 3.—Axial Temperature Distribution in Stator, with Axial Ventilation.

Fig. 4.—Temperature Drop for Different Lengths of Conductor.

Consider a slot, fig. 5, and assume that all the heat generated in the copper conductors at the centre of the core has to be transmitted laterally through the insulation from point A to point B. Assume a temperature rise of 40 deg. C. on the laminations, as measured on the surface, and allow 10 deg. C. for the difference of temperature between the point B and the surface of the laminations. If the temperature of the inlet air be taken as 15 deg. C, the final temperature of the point B will then be 65 deg. C. Assuming the watts per sq. in. of surface to be 0.7, and the thickness of the insulation to be 0.12 in., the temperature drop from A to B would be :—

$$T=(0{\cdot}7 \times 0{\cdot}12)/0{\cdot}033 = 28 \text{ degrees C :}$$

the total temperature of point A would be 93 deg. C., and the temperature rise 78 deg. C. above the cooling air. For a 10,000-volt machine, we should obtain a temperature drop from A to B of 48 deg. C., and a total temperature at A of 113 deg. C. The temperature rise would be 98 deg. C. above the cooling air. These figures may seem high as compared with the conventional figure of 40 deg. C. measured by thermometer, but in reality they are not in any way excessive, for if the temperatures of existing machines were measured they would probably be found to be in the neighbourhood of these figures, if not higher.

Higher internal temperatures will be met with in high-voltage machines than in low-voltage ones, if the same surface temperatures are specified. This has been recognised by the British Engineering Standards Association, and it follows that higher surface temperatures may be permitted for low-voltage machines than is the case for high-tension machines, without exceeding the internal temperatures of the latter. In addition to the temperature drop through the insulation there will be a temperature gradient in the stator laminations, the temperature decreasing towards the outer periphery.

The difference in temperature between the iron at the root of the teeth and the outer periphery depends on the losses in the laminations, and on the radial depth of the core and the system of ventilation adopted. The temperature conditions of the stator winding in the slot and of the laminations as regards the radial direction are shown in fig. 6.

The thermometer method of temperature measurement is the simplest and, so far as surface temperatures are concerned, the most reliable.

A closer approximation of the true internal temperatures can be obtained by the use of the increase-of-resistance method, which will only indicate the average increase in temperature of the whole winding, but it will nevertheless give a very close indication of the internal temperatures of the winding. The discrepancy between the internal temperatures of the copper and those obtained on the external surface is frequently lost sight of in preparing specifications, for manufacturers are not infrequently asked to quote for machines having a temperature rise of 40 deg. C. as measured by resistance. Machines built to meet such conditions would be very expensive and wasteful as regards material, besides being inefficient on account of their size for a given output as compared with those built for a higher temperature rise. The margin of safety on such machines would be beyond the requirements of even ordinary cotton insulation.

Embedded temperature detectors have received comparatively little attention in this country as a means for determining the temperature of machines in commercial operation. In America this method has been adopted as a standard, and machines are now generally provided with embedded temperature detectors during construction. Special instruments are provided, so that the temperature of the different parts of a machine can be read at any time. Some of the advantages from the operating point of view of such an arrangement are obvious, whereas others are not so apparent. For example, consider a machine the stator winding of which is insulated with mica on the embedded portion and by fibrous material on the ends. The limits for the temperature rise laid down by the British Engineering Standards Association for fibrous insulation are 55 deg. C. measured by resistance, or 50 deg. C. by thermometer, with certain reductions for high voltages, and as a portion of the winding is insulated by fibrous material these limits must be applied for a machine insulated as described. The temperature rise permitted for mica insulation is 75 deg. C. by resistance method, but it is not possible to take advantage of this higher limit owing to the fact that, as the end windings are insulated with fibrous material, the temperature rise for the whole winding must not exceed that specified for fibrous material. In such a case it would be advantageous to measure the temperature rise of each portion of the winding independently.

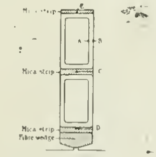


Fig. 5.—Section of Slot.

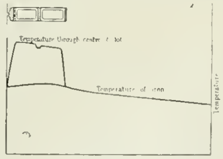


Fig. 6.—Temperature Distribution in a Radial Direction.

The effect of short-time overloads is of importance from the temperature point of view. Referring to fig. 1 the drop of temperature through the insulation increases very rapidly with the load; at the same time, the temperature drop through the iron is increased to some extent. Consider a machine required to give 50 per cent. overload for half an hour. Experience has shown that the windings reach their maximum temperature in less than an hour, starting from cold, and would reach a steady temperature due to the overload in well under the half-hour, starting hot. The large temperature gradients in the insulation and the iron cannot be measured by thermometers, but by the use of embedded temperature detectors we shall be able to determine very closely the actual temperature of the copper, and thus prevent the machine being overheated. Similarly they will enable operating engineers to take full advantage of the capacity of a machine and operate it up to the ultimate hot-spot temperature permitted for the class of insulation employed. When embedded temperature detectors are used, the temperature guarantees should be based on the total temperature and not on a specific temperature rise based on a given air temperature. The advantage obtained by operating large turbo-alternators on this basis deserves consideration. Consider two identical machines, one operating on the basis of a given temperature rise with a fixed value for the air temperature of 40 deg. C., and the other on the principle of a maximum total temperature. The average air temperature in this country is less than one-half of the assumed air temperature of 40 deg. C., and it is obvious that we are not taking advantage of the permitted temperature limit of the insulation when operating on the temperature rise basis. By providing embedded detectors it is possible to take full advantage of low cooling-air temperatures, as readings can readily be taken at any time.

During the winter months the difference between the actual air temperature and the basis temperature will be still greater and, when it is considered that the load usually is heavier at this time of thė year, the advantage is of considerable value in augmenting the output of a station at a time of heavy load. Taking fig. 1 as a basis, we should reach the maximum permissible temperature rise based on an air temperature of 40 deg. C. at 115 per cent. full load. Assuming an air temperature of 15 deg. C., which is, if anything, rather high for the winter months, we should be able to run at 140 per cent. full load without exceeding the total temperature on which the temperature rise reached at 120 per cent. load was based, *i.e.*, 120 deg. C. In operating on the temperature rise basis we lose 18 per cent. of the output the machine would be able to give if run up to the limiting total temperature.

Basing the increase on the average air temperature throughout the year, the increase in output would probably be not more than 10 per cent., but even at this figure the saving in capital expenditure on a 20,000-kW set would be very considerable. The possible increase in output depends largely on the design, and the increase in load given above may not always be realised, but the air temperature is frequently lower than 15 deg. C., and the lower this value the greater is the increase it is possible to obtain from the alternator. The rating of large plant on the basis of ultimate temperature is standard practice in America, both for turbo-alternators and for water-wheel generators. The practice is also becoming general in Scandinavia. The thermo-couple is the most satisfactory means for measuring internal temperatures, owing to the small space occupied which makes it possible to measure the temperature of any particular spot in a machine.

A detector placed at the point B, fig. 5, between the coil and the slot lining, which is generally introduced between the coil and the lamination, would indicate a temperature between that of the copper and the iron. If it were placed between the two coils at the point C, the reading obtained would closely approximate to that of the copper itself, for the reason that there is practically no heat flow between the two coils, except the very small amount which will flow through the edges of the packing strip between the two coils. This amount will be almost negligible, unless the strip is very thick, and for this reason it is desirable to reduce this packing to a minimum. The temperature at point D will also approximate to the copper temperature, although not so closely as at C. A certain amount of heat will be transmitted through the wedge, but, if this is thick as compared with the coil insulation, the drop through the insulation will be comparatively small. By providing substantial insulation between the coil and the lamination at the bottom of the slot, and placing the detector between the strip and the coil at E, we should obtain a temperature varying but little from the true copper temperature. American standard rules specify that, when there are two coils per slot, detectors are to be placed between the coils, *i.e.*, at C, and if only one coil per slot is used it must be located at the bottom of the slot. It is hoped that operating engineers will encourage the provision of detectors, and thus put manufacturers in a position to gain experience which cannot be obtained by running machines light at the works. Insulation which, if not disturbed, would last almost indefinitely, would fail very quickly if subjected to vibration or shocks.

(*To be concluded.*)

ELECTRONS.

By SIR WILLIAM BRAGG, K.B.E., F.R.S.

(*The twelfth Kelvin Lecture, delivered before* THE INSTITUTION OF ELECTRICAL ENGINEERS.)

(*Concluded from p.* 127.)

Keeping the foregoing results in mind, we can now appreciate a very remarkable development of electron theory which has been made in the last few years. Spectrum analysis has long been occupied with the extraordinary complications of the radiation emitted by the various atoms. As a result it appears that the frequencies of the lines in a spectrum often display curious and exact numerical relations, in the form generally involving differences of frequencies of similar lines or groups of lines. For instance, the famous Balmer equation

$$\text{Frequency} = v = N\ (1/n_1^2 - 1/n_2^2) \text{ where } N = 3.290 \times 10^{15}$$

gives the frequencies of series of lines in the hydrogen spectrum. When n_1 is put equal to 2, and n_2 to 3, 4, 5 in succession, the series of values for v represent the frequencies of the lines in the visible spectrum. If $n_1 = 3$ and $n_2 = 4, 5, 6, \ldots$, in succession, we have the frequencies of lines in the infra-red (Paschen) and if $n_1 = 1$, $n_2 = 2, 3, 4, \ldots$, we have the frequencies recently shown by Lyman to exist in the ultra-violet.

Now there is nothing in our older conception of the origin of radiation within the atom to give us a clue as to why differences of frequencies should come into these empirical though most useful formulæ. We have pictured to ourselves vibrating systems, mechanical or electric, and waves arising therefrom. But what connection between masses or electricities gives us in any simple way equations involving the addition or subtracting of frequencies? We are in a blind alley. Let us, therefore, abandon our preconceptions as to the origin of those lines which we find in the light spectrum and suppose that here also they arise in the same fashion as we actually know that they arise in the cases we have considered above. Suppose that the energy of an emission of radiation is derived from the energy of an electron. It may be the only way in which radiation ever does arise, but it is not necessary to suppose so much at present. It is enough that we carry into the atom the whole process which in X-rays and the photo-electric effect we have observed to take place in part outside. Suppose that within the atom there are certain positions or conditions in which electrons *may* be, each postulating a certain energy content for the electron; and suppose that sometimes an electron slips from one position to another of lower energy, and that the difference in energies is transformed into wave radiation according to the same law as before, *i.e.*, energy transferred $= h \times$ frequency. Let the energy in these states be Nh_1; $Nh/2^2$; $Nh/3^2$; &c., and so on. Then Balmer's is accounted for and the other series at the same time, and the peculiar form of these equations.

What may these states be? Why not, as Bohr suggests, so many different orbits in which electrons can move round the central positive nucleus in the atom, the nucleus whose sure existence Rutherford has established? At one time if we had presumed the existence of these orbits we should have been inclined to connect them with the direct emission of radiation, and the frequency of that radiation would be the number of revolutions in a second. But now, we assume these orbits to persist without radiation, and that radiation arises where the electron steps from one orbit to another; moreover, the frequency of the issuing radiation is determined by the simple rule, frequency is equal to change of electron energy divided by h. We are not picturing any new process here, or evolving new ideas to fit awkward facts; we are supposing a process to exist in one place which we already know to exist in another.

It is a very remarkable fact that the number N is equal to $2\pi^2 me^4/h^3$ within small errors of experiment. Spectrum measurements show that N is equal to 3.29033×10^{15} and $2\pi^2 me^4/h^3$ is equal, taking the most recent determination of m, e, and h, to 3.289×10^{15}. An electron revolving about the central positive nucleus of a hydrogen atom (having a positive charge), and possessing the amount of energy Nh or $2\pi^2 me^4/h^2$ moves with a velocity $2\pi e^2/h$ and has an angular momentum equal to $h/2\pi$. The electron if it moves in the next ring does so with an angular momentum $2h/2\pi$ and so on. We can, therefore, following Bohr, define the necessary separate states as those of motion in circular orbits in which the angular momentum is an integral multiple of $h/2\pi$ The simplicity of these expressions is very attractive. But the matter is far from ending here. During the last few years Bohr and Sommerfeld have led an inquiry into the possibilities of this theory which have led to very remarkable results. These are due to a slight modification in the original conception. The different circular orbits which Bohr first pictured have become groups of orbits fixed by laws which are somewhat arbitrary, but not without foundation. A group contains a limited number of orbits in which the electrons may move, and each group corresponds to one of the original circular orbits. Some of the orbits in each group are elliptical. It appears that the energy of the electron would be the same in all the orbits of any one group were it not that when an electron moves in an ellipse its velocity is not always the same. Now a fast-moving electron shows a variation in mass when its speed alters, and this does affect slightly the energy of the orbit. Consequently, the electron that steps from an orbit belonging to one group to an orbit belonging to another group may part with an amount of energy which is not always exactly the same. The frequency of the consequent radiation may, therefore, have two or more values differing slightly from each other; the single spectrum line is doubled or trebled. This is what Sommerfeld calls the "fine structure" of the lines.

Now there is far more than mere speculation in this. The formula which Sommerfeld gives as the result of an analysis which is as reasonable as can be expected, does more than account for known effects; it has predicted the existence of numerous lines, and even their intensities, and the predictions have been verified by experiment in the most remarkable way. The story is told in Sommerfeld's work on "Atom-building"; a story of the work of himself, Bohr, and others during the last six years or so.

We see that in this fundamental inquiry into the nature and properties of radiation, the electron plays a very direct and important part. Our eyes are designed to detect waves, not electrons, and so our first attention is directed to radiation in wave form. But we now find that radiation energy may alternatively be carried by electrons, and that many things become clearer when we appreciate this fact. We can only make further progress in our understanding of radiation, and indeed in our understanding of the electron, by getting to know more about the reciprocal conversion of one form of energy into the other, since evidently it is one of the most frequent and most fundamental operations in nature.

So far our conception of the structure of an atom would consist of a positive nucleus, and electrons attached thereto in the same way; with the further idea that the energy attached to these electrons can only have certain definite values. Bohr assumes that they have these values because they can move round the core in certain orbits only; and Sommerfield enlarges this idea as already explained. But, of course, this can only be a partial picture of the whole atomic structure. The atom so conceived cannot fill the part required of it in the building of molecules and crystals.

When we come to examine these structures we find atoms attaching themselves to each other through the action of forces which cannot always be considered as acting from centre to centre. For instance, the arrangement of the carbon atoms in a diamond, as recently determined by X-ray methods, is such that every atom is at the centre of gravity of four others, arranged round it in tetrahedral fashion. The representation of an atom by a smooth sphere and nothing more would be in agreement with the idea that the properties of the atom in any one radial direction are exactly the same as in any other radial direction, and that any forces between two atoms are between centre and centre. For instance, it has been suggested by Born and Laudé that the force between two atoms may be of the form $a/r^2 - b/r$. This gives an attraction at great distances and a repulsion at small distances, so that the atoms close up together but stay at a certain distance apart as if they possessed surfaces which pressed together. But if that were the case, the carbon atoms would pack themselves together more closely than they do. As a matter of fact, just twice as many atoms could be packed into any volume as there are already there. We must conclude that there are definite sub-centres of force on the outskirts of the atom; and that in the carbon atoms of which the diamond is composed there are four such sub-centres arranged symmetrically, that is to say, in tetrahedron fashion round the core.

Must not these sub-centres be electrons? And if so, must we not take them to be circulating in small orbits about a local centre? Or, perhaps, as Parson has suggested, the electron is ring shaped, the electricity revolving round the axis of the ring. In this way we should have electromagnetic forces to link the atoms together.

It is very interesting to observe that in any case the carbon atoms in the diamond are not all oriented in exactly the same way. Taking a cleavage or tetrahedral plane as that of reference, half the atoms will be pointing towards the plane and their neighbours will be pointing away. This ought to make a difference to the X-ray spectra; and it has been looked for at various times, but without success. Lately, however, the improvement in the X-ray spectrometer has been considerable, and I now have no difficulty in finding the expected effect. It is clear, I think, that the carbon atom in the diamond is to be represented as to its properties by a tetrahedron; and that the atom has different properties in different directions, or, as the chemist would say, has directed valencies. There can be little doubt that this is so in all atoms. The suggestion is that some of the electrons are tied down to certain regions on the surface, and that not all, if indeed any of them, are at all times revolving round the central core.

When atom joins up to atom it is these sub-centres that are at work; and since atom to atom and again atom to atom make in the end the crystal, and since the crystalline structure is the basis of all solid structure, and is fundamentally concerned with the strength of materials and their temper and all their physical properties, it is easy to see how great is this minute study of the electron.

If this conception of fixed electrons seems to clash with the orbital motions of Bohr and Sommerfeld, we must remember that the clash is between two pictures both of which are, we know, imperfect. We may expect that on the next occasion when a lecturer tries to tell you what advance has been made in the study of electrons some of these contradictions will have disappeared. Whether this is so or not, I am sure of this, that in the attempt to realise the properties of nature's unit, the electron, we are working in the true direction towards an understanding of the great problems of radiation, and of materal structure.

REVIEWS.

The Electricity (Supply) Act, 1919, with Notes. By W. S. Kennedy, Barrister at Law. Pp. 96. London: Electrical Review, Ltd. Price 3s. 6d. net.

This is a small book giving the text of the Act with conveniently arranged footnotes and comments. The author, in the preface, states that the Act "appears to be an honest attempt to get rid of obsolete barriers and to bring together those responsible for the supply of energy" so that it can be "more freely and easily created and distributed"; and he later states, "When the legislature, not content humbly to pave the way for the scientist and practical engineer to tread, ventures to attempt creation on its own account, the result is sometimes not harmful because it is ludicrous." The "attempt to provide cheap electrical energy by Act of Parliament is one beside which Canute's task was a hopeful one."

The notes in the book follow each section, and they are more useful and intelligible to the lay reader than is the case with many legal works. The reviewer's notes are bracketed.

Section 1 of the Act deals with the Commissioners and their powers. The author points out that it is the first of the Electric Lighting Acts which recognises the value of electricity "supply" for purposes other than illumination; also that the Act does not point out the source from which the Commissioners' office and other expenses are to be paid, and it is presumed that these will be paid by the industry generally. (It is to be hoped in the interests of the industry that the staff will not be extended like that of the rest of the Transport Ministry, otherwise the fees will have to be much greater than those found necessary, under somewhat similar circumstances, by the French Government.)

Section 2 provides that the powers of the Board of Trade under the Electric Lighting Acts may be exercised through the Commissioners, and it is pointed out that by Section 39 of the new Act, by Order in Council, the powers shall be transferred to the Transport Ministry, which can apparently refer matters to the Commissioners or not as it thinks fit. Section 3 gives power to the Commissioners to conduct experiments. (In France a Committee supported by electricity supply authorities and manufacturers, with the assistance of the Government, is at present conducting experiments regarding the construction and ageing of high-pressure insulators; similar experiments would be of great value here.)

Section 4 enables one or more Committees to be appointed by the Commissioners to advise and assist on matters connected with development and supply, the members being drawn from "Joint Electricity Authorities," authorised undertakings, or other specially qualified persons. (It is to be hoped that sound business men and not popular political busybodies will be asked to assist on such a Committee.)

Section 5, dealing with the reorganisation of supply, is one of the most important in the Act, as it deals mainly with authorities and areas of supply. The notes on this section are of a detailed and useful character. It is pointed out that Sub-section 3, if the Commissioners do not approve of any scheme, empowers them to evolve one of their own; but that an undertaking cannot be transferred to a Joint Authority without the consent of the owners except by means of an indirect method through the use of Section 24, which will be noted later.

By Section 6 representative Joint Electricity Authorities, with wide powers, may be set up in districts, the members being drawn from local bodies and large consumers. Notes extending to four pages are given regarding the powers of Joint Electricity Authorities. Past obstacles to co-operation are pointed out, especially the Electric Lighting (Clauses) Act, 1899, which practically prohibited the "associating of local authorities and companies." (In France, for example, where somewhat comparable conditions exist, it has been recognised that the advantage of co-operation by suppliers outweighs the dangers of electricity "combines," even where the bulk of the electricity supply is in the hands of companies.) The new Act removes this obstacle. Some useful proposals regarding the formation of Joint Authorities are given in the notes. The author states that there are three practicable schemes: Where the authority takes over the whole of the undertakings; where it generates, but does not distribute; and where it distributes only. The scheme does not allow of the taking over of part of an undertaking except with the consent of the owners. A transfer to the authority can take place on agreed terms, but the source of the fund from which the price is to be paid is not stated. Apparently no compensation is to be given to directors of companies for loss of fees on transfer to an authority. (This policy differs from that adopted when the London water supply companies were dissolved on the formation of the London Water Board; perhaps if company directors formed a trade union and made a noise, their claims would be considered.)

Section 7 deals with the confirmation of schemes which must be subject to a resolution of Parliament. By Section 8 it shall be the duty of the authority to provide a "cheap and abundant supply of electricity." In the notes it is rightly pointed out that the cost of electricity will be largely determined by the cost of fuel and labour, though it is stated that the substitution of modern systems and the scrapping of obsolete plant may produce considerable economies and that the removal of legislative restrictions may lead to a more abundant supply. (In this connection it is not usually remembered that owing to the enormous capital cost of new plant as compared with old, and the high capital charges therefore involved, the advantages of scrapping old plant are not as great as would appear at first sight.)

Section 9 deals with the powers of a Joint Electricity Authority to acquire "any generating station." (In Section 36 of the Act, which is devoted to definitions, that of a "generating station" and that of a "private generating station" are given, and apparently the former includes the latter, so it looks as if an authority can take over a private generating station by agreement.) Section 10 deals indirectly with liability for nuisance. In Section 11 the establishment or extension of public or private generating stations or main transmission lines is dealt with, and also the supply and sale of surplus power. It is pointed out that it is not competent for existing statutory undertakings to purchase or install new plant without the consent of the Commissioners, and further that in the event of the sale of surplus power the prices to be charged must be those which the Commissioners think fit and proper. (The powers of the Commissioners in this section are distinctly arbitrary, and as there is a fashionable bias in official circles against private enterprise, it is not altogether desirable that such powers should be exercised without the right of appeal to the Law Courts.)

Section 15 deals with condensing water; the utilisation of water power, waste heat, and other forms of energy; the erection of by-product plant; and the handling of residual products. By this section it appears that power gas, low-pressure steam, or even hot water could be supplied by a Joint Authority. (It might be noted that in the Ruhr Valley in Germany power gas from coke ovens is being distributed through many miles of mains over a large area, to the material relief of railways, and this is probably a very economical form of distribution of heat energy.)

Section 16 deals with the compensation of officials for loss of employment or variation of conditions due to the transfer of any undertakings under an improvement scheme. By Section 17 a Joint Authority, before exceeding some prescribed capital expenditure, must obtain permission of the Commissioners and submit plans and estimates. In Section 18 permission is given to the Board of Trade during the transition period to construct any generating station or transmission line, and exercise the powers of a Joint Electricity Authority to the capital cost, if required, of twenty million pounds. Useful notes are given regarding this section. (Considering the policy recently adopted by the Transport Ministry regarding the Severn power scheme, it is to be hoped that this permission will not lead to the duplication and multiplication of officials.)

Section 19 gives powers by which, during the transition period, two or more undertakers may mutually assist one another. The notes point out that this removes one of the oldest and most vexatious restrictions to electricity supply. Section 21 practically removes the right of veto by local bodies to the construction of overhead lines. (It is to be hoped that the Electricity Commissioners will show more sympathy in this respect than the Board of Trade did not so long ago. Perhaps in case of doubt Mr. Pearce, of Manchester, might now be willing to assist.) Section 22 provides facilities for wayleaves over any land except gardens, across or along any railway or canal, subject in cases of dispute to the approval and conditions of the Board of Trade.

Section 23 allows a Joint Electricity Authority or any local municipal or urban supply undertaking to let out on hire wiring, fittings, and apparatus, but not to manufacture or sell the same unless expressly authorised. Section 24 deals with the powers of the Commissioners to alter the type of current, frequency and pressure of supply to be employed by an undertaking. It is pointed out that this is one of the few compulsory powers in the Act. (In the past undertakers have spent large sums in capital and maintenance for rotary substations required for the supply of direct current in areas distant from generating stations; presumably this clause will facilitate the supply of three-phase energy to customers.)

Section 22, sub-sections 4 and 5, and Section 25 deal with the protection of lines controlled by the Postmaster-General, the existing law being confirmed. (In view of the developments which have taken place regarding power transmission, the preference given to the Postmaster-General should be abolished, and the unfair action taken in the recent case of the P.M.G. *v.* The Blackwood and Fleetwood Tramroad Co. shows that he is anxious to claim his legal rights. Electricity supply is as much a public utility as the telegraph or the telephone system, and where interests clash they should be decided, not by any statutory preference, but by balance of public convenience. The time is past when the Post Office should demand that its rights should be enforced and continued under Acts drafted before electric power was thought of. The claims of the Post Office should stand on their own technical merits; in these days any favoured position demanded by a local or national bureaucracy is a confession of weakness if not incompetence.)

Section 26 deals with provisional and special orders, the veto of local authorities being practically removed. Section 27 deals with statistics, 28 with finance, and 29 with expenses of the Commission. The remaining clauses of the Act are comparatively unimportant. (As with the housing question, it may be very much easier to make programmes than to find money and get work carried through, and while the Act removes many obstructions and gives many facilities, improvements will probably have to take place regarding interest on capital and output of labour before very much can be done under it.)

The book is well printed, although it would have been easier to refer to if a different print or width of column had been used for the explanatory notes. Many legal books have been written which are little more than reprinted Acts of Parliament with the help of a little "scissors and paste," but in this book the notes have the merits of being useful and somewhat original in style. The book should be on the shelves of lawyers and laymen who are interested in electricity supply.

T. R.

EXTRA-HIGH-TENSION DISTRIBUTION BY UNDERGROUND CABLE.

Discussion at Newcastle-on-Tyne.

At Newcastle-on-Tyne, on January 24th, Mr. R. O. Kapp's paper on the above subject, which was abstracted in our issue of December 17th, was discussed before the North-Eastern Centre of the Institution of Electrical Engineers.

Mr. G. L. Porter opened the discussion, and said that their cables had been laid with a view to the future, but that future was with them now. He drew attention to the statement by the author that the principal point on which the e.h.p. distribution differed from l.p. distribution was that in the former case the limit to the capacity of the cables was almost always set by heating, whereas in the latter case it was more usually determined by voltage drop. In that district they frequently came up against voltage drop, but not heating, and that would seem to be what they might expect from Mr. Kapp's suggestion that cables not larger than 0.075 in. should be used because the heating was so much greater with larger cables. The contention that the cost of cable per kVA transmitted was less the higher the voltage was true, assuming that the cable was fully loaded, otherwise they would have to take into account other factors. Mr. Kapp suggested that the highest pressure at which they could sell power was 6,600 volts, but the speaker did not regard that figure as sufficiently high, for in that district power was sold at up to 20,000 volts. Referring to the cost of e.h.p. transmission in bulk, he suggested that the cost of step-down transformers should be taken into account. He drew attention to the illustration of the cost per kVA per mile and said it was rather a peculiar curve, because it looked as if it were approaching the horizontal. As a matter of fact, if the line were continued in a larger section it would start to rise.

Mr. Townley took some figures given by Mr. Kapp to be an argument against "super-stations." He showed some figures which made the charges for sinking fund and interest almost equal to the cost of coal. Mr. Kapp said that a supply undertaking would have to include in the average charge per unit a figure which might be as low as 0.05d., or as high as 0.22d., to cover capital charges on e.h.p. distribution, and for very large power schemes it might be considerably higher; by comparison it might be hoped that the cost for very large power schemes might be 0.28d. per unit. Taking coal at 30s. per ton, not an unreasonable charge now, it worked out at 1.75d. per unuit. Was it the unit at the busbars, or the unit that was sold, that was taken as a basis in those calculations? In many areas the water supply decided the position of the station; water was often supreme in importance.

Mr. C. Turnbull pointed out that the location of the station was not only interesting, but important. Often when they were laying out a scheme they did not really know whence the load was coming, but the station was placed on a site that was thought to be suitable, and then someone came along and built works in close proximity. Speaking of the amount of copper in a cable, he said that at present the cost of laying and reinstating cables was very serious, and they might be justified in putting in more than they really needed for the time being. The heating of cables was much the same as the heating of transformers, &c. The speaker criticised the "clover leaf" cable; the design was a complete mistake, it was not much cheaper and carried, in his opinion, less current; the conductors were far too close together, and they could not get rid of the heat in any way. With regard to tariffs, for consumers, he supposed that all had felt in the past that they had no right to penalise the consumer just because he did not happen to be situate near the power station. At first it seemed just that they should get off any extra charge, especially persons building works, but he thought they might come to the point where they would have to create a tariff according to the cost of supply. At the same time he suggested that putting down a power station in such a site as would enable works to be built around it was a point worthy of consideration.

The Chairman (Mr. J. R. Beard) explained that the present state of affairs called for the greatest possible economy in their work. It was almost impossible to get money at reasonable rates; therefore, they had to use to the fullest extent the plant they had. He spoke of the high cost of apparatus made in England compared with that made in Switzerland.

Mr. R. O. Kapp, in his reply, said he was not in favour of "super-stations"; they got the cheapest electricity where the plant installed was about 100,000 kW, that was, taking the cost of cables and other capital charges into account. If they got much beyond 100,000 kW there was generally great additional cost for distribution, &c.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

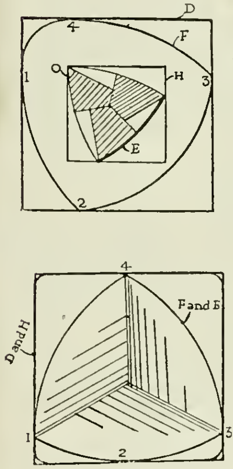
Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Radbore Drill Head.

The following brief description of the Radbore drill head, which is an attachment for drilling *square* holes, and is being placed on the market by The Lanston Monotype Corporation, Ltd., of 43, Fetter Lane, E.C. 4, will be of general interest.

After mounting the head, a simple operation consisting of clamping the head to the column of a milling machine, a drill of the required size is set in the jaws of the head and properly adjusted. The drilling of the square hole is done in only one operation and differs from that of drilling round holes in that the work is advanced against the drill. Two different sized heads are made, each taking a certain range of drills, and so arranged that the Nos. 4 and 5 heads together take all drills from ⅜ in. to 2 in. inclusive. Any hole drilled by the Radbore head may extend through the material, or may be of any desired depth with a flat bottom. Such work neither requires additional appliances nor consumes extra time. The drills are of two classes, one of which drills holes with sharp corners, fig. 1, and the other holes with filleted corners, fig. 2; the radius of the fillet is one-eighth the size of the hole. The life of these drills is exceptionally long, as all sharpening is done on the end; the flutes are never ground and therefore the size of the hole is never reduced. After the work required has been finished, the head can be removed and the machine put on other work. In the case of rectangular holes there is very little difference in the operations as compared with drilling a square hole. Either the drill is fed across the stock (for soft metals) or two holes are drilled overlapping one another. Hub keyways may be drilled from the end as there is no tendency for the drill to be led off, that is, half holes may be drilled as readily as square ones. The basic feature of the "Radbore" principle is that of cost reduction, and a skilled mechanic is not required to set the head. Proper sharpening of Radbore drills is absolutely essential; the three cutting edges must lie in one plane and meet in the centre at the proper angle. Sharpening is simple when the drill is held at the proper angle, and a special vice can be supplied, the jaws of which will hold either round or oblong stock, and the vice can be clamped on any standard milling machine table.

For cutting square holes with sharp corners line D represents the square opening in the chuck jaw (fig. 2); line F is the outline of the shank of the drill—note contacts 1, 2, 3, and 4; H is the hole being cut, and E is the cutting blade. The sharp corner is possible because the centre of the rounded one of the three corners of F is at O, exactly in line with one of the cutting edges of the blade E. This means that one of the three cutting edges finishes the periphery of the square hole. The cutting edge is led in straight lines parallel with the sides of D, and at each corner is pivoted about itself, leading out at right angles to its entering direction. For square holes with rounded corners the shank and drill are of the same size and made in one piece (fig. 3). Note the outline of the shank in this case and the four points of contact 1, 2, 3, and 4, which are always present at any stage of the revolution of the drill.



Figs. 1 and 2.—Diagrams Representing Drill Heads.

Fig. 3.—Radbore Drill Head.

The "Trump" Electric Soldering Iron.

In the case of electric soldering irons as commonly designed for from 200 to 250 volts the attempt is made to concentrate all the resistance necessary for the circuit in the heating element itself. The result is that the heat generated within the iron is in excess of that which it can radiate away, consequently the temperature of the iron is continually rising during use until, if left in circuit long enough, the fusion point is reached, and in any case the element is being overrun all the time, shortening its life. In the case of the "Trump" iron, which is a new product of the Ardea Vulcaniser Syndicate, Ltd., of 318, King Street, Hammersmith, W. 6, for the above-mentioned range of voltage either two irons may be used in series or an external resistance may be permanently placed in the circuit. The resistance is contained in a neat case which can be fixed to the wall or may stand upon the bench; it is shown in fig. 4, and is claimed to be a fool-proof device, there being no need to place the iron on a special stand or to actuate a switch. The iron becomes hot in a few minutes, and all the excessive loading is carried by the resistance. For 100/110 volts the element takes safely the whole loading and the external resistance is not required. The heating element is easily replaceable; after removing the three screws on the iron (two of which are visible in fig. 4) a new element (also shown) can be slipped in right away. The elements are not of the usual construction, inasmuch as mica is only used as auxiliary insulation, and then in such a manner as to make no severe demands on it. The first layer of heating ribbon is wound on a solid porcelain cylinder, the second layer being separated from the first by porcelain strips. Fig. 4 depicts the light-weight iron, the weight of the tool complete being just under 1 lb. The copper bit is drawn down from ¾ in. bar, and stands out 5 in. from the chamber containing the element terminals. The total length of the iron is 14 in., and the weight of the resistance case about 1.5 lb. On a 100-volt circuit the iron is connected direct to the mains and takes 2.7 amps., that is, 270 watts; the heavy-weight iron on a 200/250-volt circuit has a loading of 540 watts on the circuit, half of this, however, is expended in the external resistance or in the second iron when two are wired in series, giving the actual loading of each iron as 270 watts, which makes the bit just red hot when seen in the dark; the element is identical for all voltages.

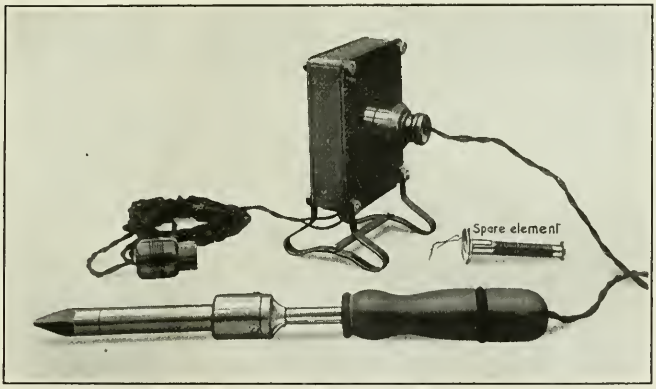


Fig. 4.—"Trump" Soldering Iron Outfit.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

1,293. "Determining distances by wireless telegraphy." W. Burstyn. January 10th. (Germany, December 15th, 1919.)

1,368. "Relays, and synchronised clocks, &c., operated thereby." Soc. Anon des Ateliers Brulle Frères. January 10th. (Belgium, December 13th, 1918.)

1,384. "Means for extinguishing arcs." Schweitzer & Conrad. January 10th. (United States, September 18th, 1916.)

1,486. "Crystal detector for wireless telegraphy." A. Bonnefont. January 10th. (France, November 13th, 1919.)

1,605. "Electrically-heated boilers." E. Meystre. January 10th. (Germany, December 5th, 1918.)

1,612. "High ohmic resistance." F. Kruger. January 10th. (Germany, November 27th, 1919.)

1,616. "Electric ignition apparatus for internal combustion engines." F. L. Mader. January 10th. (Germany, May 7th, 1919.)

1,633. "Electric welding." R. Mack. January 10th. (Germany, November 5th, 1919.)

1,635. "Strengthening electric oscillations by incandescent cathode tubes." Dr. E. F. Huth Ges. January 10th. (Germany, March 22nd, 1919.)

1,639. "Apparatus for production of undamped oscillations for telegraphy, &c." Dr. E. F. Huth Ges. and B. Rosenbaum. January 10th. (Germany, July 24th, 1919.)

1,649. "Telephone installations." Siemens & Halske Akt.-Ges. January 10th. (Germany, November 18th, 1916.)

1,653. "Device for electrically recording or reproducing motions." H. Meusser and E. Waltz. January 10th. (Germany, December 22nd, 1919.)

1,654. "Device for working power installations." Siemens-Schuckertwerke. January 10th. (Germany, December 12th, 1919.)

1,674. "Telephone indicators for central batteries." F. Mostovoy. January 10th. (France, January 9th, 1920.)

1,678. "Control of electric motors." Soc. des Ateliers de Constructions Electriques du Nord et de l'Est. January 10th. (France, December 13th, 1918.)

1,679. "Electric systems of ship propulsion, &c." Soc. des Ateliers de Constructions Electriques du Nord et de l'Est. January 10th. (France, May 25th, 1915.)

1,688. "Visible representation of electric signals." Neufeldt & Kuhne. January 10th. (Germany, May 12th, 1919.)

1,709. "Electric lamps for vehicles." G. Hookham and Kynoch, Ltd. January 11th.

1,720. "Sparking plugs." P. D. Peterson. January 11th. (Sweden, June 29th, 1920.)

1,740. "Swivelling shoe collector for collecting electric power from overhead conductor." F. H. Briggs. January 11th.

1,748. "Electric ceiling roses." J. Y. Fletcher and F. G. Quance. January 11th.

1,749. "Electric terminal couplings." W. J. Polyblank. January 11th.

1,750. "Plug-and-socket electric couplings." W. J. Polyblank. January 11th.

1,792. "Manufacture of telephone cables." C. F. Street and Johnson & Phillips, Ltd. January 11th.

1,795. "Incandescent electric lamps." F. Harrison. January 11th.

1,803. "Electric incandescent lamps." J. A. Ramsden. January 11th.

1,829. "Apparatus for electric ignition of flash powders." M. S. Dawson and J. G. Whittle. January 12th.

1,844 "Well globe fittings for electric lamps." T. Pons and Veritys, Ltd. January 12th.

1,845. "Wall fittings for electric lamps." T. Pons and Veritys, Ltd. January 12th.

1,870. "Automatic electric light switches." A. G. E. Electric Motors Ltd., Crompton & Co., Ltd., W. F. Jones, and H. C. Waters. January 12th.

1,891. "Means for preventing sagging of heating elements of electric fires." J. Y. Fletcher and R. J. H. Hill. January 12th.

1,920. "Platinum alloys." British Thomson-Houston Co., Ltd. January 12th. (United States, March 5th, 1914.)

1,934. "Means for unlocking magnetically locked lamps." C. Dawson and Davis & Son (Derby), Ltd. January 13th.

1,945. "Electro-magnetic accumulator charging switch." J. Taylor. January 13th.

1,960. "Telephone transmitters, microphones, &c." S. Hockly. January 13th.

1,985. "Step-by-step electrical motors." A. P. Addison and C. R. Payne. January 13th.

1,986. "Step-by-step electrical motors." A. P. Addison and J. F. B. Carslake. January 13th.

1,989. "Electric gas lamps with glow discharge." Studien. Ges. fur Elektrische Leuchtrohren. January 13th. (Germany, June 16th, 1920.)

2,016. "Single deck tramcars." W. E. Hall. January 13th.

2,017. "Tramway vehicles." W. E. Hall. January 13th.

2,018. "Current regulator for automobile headlights." H. E. Wallace. January 13th.

2,032. "Means for electrically indicating vacant seats in theatres, &c." D. L. Robertson, R. Robertson, and R. C. Robertson. January 14th.

2,071. "Apparatus for recording calls made by telephone subscriber." E. Webb and H. J. Webb. January 14th.

2,080. "Devices for sparkless disconnection of inductive resistance." F. Krupp Akt.-Ges. January 14th. (Germany, February 12th, 1920.)

2,081. "Electrical switches." Electrical Improvements, Ltd., and R. W. Gregory. January 14th.

2,084. "Device for recording telephone calls." H. A. Levens. January 14th.

2,094. "Means for registering telephone calls." G. C. & G. C. N. Beall. January 14th.

2,096. "Apparatus for controlling and regulating electric currents." A. W. Sharman. January 14th.

2,098. "Means for recording telephone calls." Sir C. C. Allom, S. Fisher, and O. V. Sigurdsson. January 14th.

2,110. "High-frequency telegraphy and telephony over wires." Ges. fur Drahtlose Telegraphie. January 14th. (Germany, January 16th, 1920.)

2,112/3/4. "Resistance switches for controlling intensity of electric currents" J. Watkinson. January 14th.

2,116. "Electric conductors." G. M. von Hassel. January 14th.

2,118. "Sparking plugs." P. Gueniffey. January 14th.

2,134. "Telemeters." J. H. L'A. Lund. January 15th. (Norway, January 16th, 1920.)

2,165. "Lighting gas fires by means of electricity." W. L. D. Gundry and Lord & Shand, Ltd. January 15th.

2,176. "Flywheel magneto and electric lighting generator." A. H. Dye and F. W. Lucas. January 15th.

2,204. "Holders for incandescent electric lamps." A. Armstrong. January 15th.

2,207. "Submarine sound transmitters." H. Simmacher. January 15th. (Germany, January 15th, 1920.)

2,245. "Suspension of train-lighting dynamos." British Lighting & Ignition Co., Ltd., and J. Etchells. January 17th.

2,269. "Carrying out electro-chemical gas reactions." Elektrosynthese Ges. January 17th. (Austria, July 19th, 1917.)

2,274. "Variable resistances." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 17th.

2,298. "Mercury vapour rectifiers combined with mechanical current interrupters." Akt.-Ges. Brown, Boveri et Cie. January 17th. (Switzerland, January 31st, 1920.)

2,299. "Insulators for electric lines." Soc. le Basalte. January 17th. (France, January 23rd, 1920.)

2,307. "Insulators for conductor rails, &c." W. H. Meyrick. January 17th.

2,337. "Time switches." E. J. Piper. January 17th.

2,365. "Electric junction boxes." F. Cox. January 18th.

2,379. "Balancing ocean cable systems." Western Union Telegraph Co. January 18th. (United States, January 28th, 1920).

2,385. "Electric cooking and heating devices." Falkirk Iron Co., Ltd., and A. R. Wood. January 18th.

2,392. "Subscribers' instruments for automatic telephone systems." C. R. Riber and Siemens Bros. & Co., Ltd. January 18th.

2,410. "Leading-in tubs for electric wires." G. E. Gurney. January 18th.

2,415. "Elastic fluid turbines." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 18th.

2,416. "Casings for electrical apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 18th.

2,417. "Electric furnaces." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 18th.

2,432. "Bonding blocks for metal-covered electric wiring." R. C. Milliken. January 18th.

2,483/4. "Ignition systems for internal combustion engines, &c." R. Bosch Akt.-Ges. January 19th. (Germany, January 19th, 1920.)

2,489. "Terminals for electric conductors." E. J. Bastock. January 19th.

2,497. "Telephone systems." H. H. Harrison. January 19th.

2,499/2,502. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. January 19th.

2,502. "Telephone systems." R. Mercer and W. O. Passmore. January 19th.

2,504. "Signalling apparatus for mine shafts." R. Blunt and H. F. Mitchell. January 19th.

2,509. "Fuse boxes for electric cables." R. A. Macaulay. January 19th.

2,519. "Spring device for suspending electric lamps, &c." R. P. Macfarlane. January 19th.

2,546. "Sparking plug testing appliances." W. Howlett. January 19th.

2,551. "Electric arc welding of studs, tubes, &c., to metal plates, bodies, &c." A. E. McCarthy, H. Martin, and L. J. Steele. January 19th.

2,557. "Apparatus for suppressing earthing currents in high-voltage nets." Siemens-Schuckertwerke. January 19th. (Germany, January 27th, 1920.)

2,560. "Electron discharge devices." British Thomson-Houston Co., Ltd. (General Electric Co.), and General Electric Co. January 19th.

2,562. "Electric relays." F. Bergmann and Igranic Electric Co., Ltd. January 19th.

2,565. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. January 19th. (United States, January 19th, 1920.)

2,576. "Electro magnetic wave transmitting systems." O. C. Roos. January 19th.

2,579. "Electric welding of chain links, &c." Columbus McKinnon Chain Co. January 19th. (United States, July 7th, 1919.)

2,591. "Non-luminous electric heaters." G. Wheeler. January 19th.

2,653. "Make-and-break devices for induction coils, &c." M. A. Codd. January 20th.

2,670. "Pendulum electrical indicators." R. Scruby. January 20th.

2,671. "Elevators and/or conveyors." E. W. Woolgar. January 20th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1914.

8,239. "Telephone system in which the lines are interconnected by the aid of electro-mechanically controlled switches." Aldendorff. April 1st, 1914 (Addition to 28,502, 1913.)

1917.

5,400. "Metals and their manufacture." British Thomson-Houston Co., Ltd. (General Electric Co.). April 17th, 1917. (155,851.)

1918.

6,515. "Application of thermionic valves to production of alternating currents and relaying." W. H. Eccles and F. W. Jordan. April 17th, 1918. (155,854.)

1919.

9,095. "Systems for supplying electric power for lighting purposes from low-frequency power circuits." Electrical Improvements, Ltd., and J. R. Beard. April 10th, 1919. (155,858.)

18,886. "Lighting system for power tables." W. Fairweather (Singer Manufacturing Co.). July 30th, 1919. (155,867.)

20,791. "Miners' electric safety lamps." Haslam & Stretton, Ltd., and J. W. Jones. April 22nd, 1920. (155,873.)

21,159 "Electric telegraph systems." Western Electric Co., Ltd. (Western Electric Co. (Inc.). August 28th, 1919 (155,877.)

22,184. "Air-cooling apparatus." K. Baumann and Metropolitan-Vickers Electrical Co., Ltd. September 9th, 1919. (155,881.)

23,292 "Electric welding machines." British Thomson-Houston Co., Ltd. (General Electric Co.). September 22nd, 1919. (155,899.)

23,349. "Sparking plugs for motor bicycles." R. T. Goodyear. September 23rd, 1919. (155,900.)

25,505 "Paste for electric storage battery plates." T. A Willard. October 17th, 1919 (155,944.)

25,598 "Magneto-electric machines." M. M. Cardellino. October 18th, 1919. (155,946.)

26,154 "Radiating or cooling apparatus." K. Baumann and Metropolitan-Vickers Electrical Co., Ltd. October 24th, 1919. (155,950.)

26,352. "Turbo-electric driving arrangements." Brush Electrical Engineering Co., Ltd., and C. C. Sutton. October 27th, 1919. (155,954.)

26,495. "Electric light fittings." H. A. J. H. Murrey and F. W. Standish. October 28th, 1919. (155,955.)

26,837. "Conductor arrangements of electric traction systems." C. E. Fairburn. October 31st, 1919. (155,959.)

28,944. "Telegraph printing systems." Automatic Telephone Manufacturing Co., Ltd., H. H. Harrison, and S. R. Smith. November 21st, 1919. (155,975.)

1920.

4,979. "Distributing terminals for ignition magnetos." Fabriques des Montres Zenith. June 11th, 1919. (144,609.)

5,437. "Controlling device for electrically-heated utensils." Landers, Frary & Clark. May 29th, 1919. (144,254.)

8,170. "Interrupters for use with high-tension magnetos." J. Guardiola. January 16th, 1919. (140,459.)

10,062. "Alternating current motors." F. Punga. March 26th, 1919. (141,383.)

11,519. "Conversion of electric currents." Siemens-Schuckertwerke. Ges. February 7th, 1917. (142,465.)

15,210. "Telephone exchange systems." Western Electric Co., Ltd. August 23rd, 1919. (150,300.)

17,760. "Process of electrolytically separating copper from nickel." P. Goldberg. July 9th, 1918. (145,600.)

18,718. "Electric steel-yard weighing machine." K. Schember and R. Joksch. July 8th, 1919. (146,843.)

24,472. "Ejectors for withdrawing condensate from condensers." Metropolitan-Vickers Electrical Co., Ltd. September 30th, 1919 (151,976.)

24,854 "Electrolytic tanks with diaphragm cells." G Haglund. September 17th, 1919. (151,260.)

25,438. "Repeaters for multiplex signalling systems.." Western Electric Co., Ltd. September 26th, 1919. (151,600.)

25,792. "Process and apparatus for starting polyphase asynchronous electric motors." Akt.-Ges. Brown, Boveri et Cie. September 8th, 1919. (150,746.)

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THE PASSING OF THE E.P.D.

ON Thursday last week, while we were going to press, Mr. Austen Chamberlain favoured his constituents at Birmingham with the momentous secret that the excess profits duty was dead, and that it was not to be replaced be any other tax on industry (though, of course, the profits thus set free will be subject to income tax at 6s. in the £).

He took the unusual course of anticipating the introduction of his Budget, in order that the country should benefit immediately, and, if possible, the tide of unemployment be checked. A great sigh of relief went up from commerce, finance, and even from labour. The first emotion is one of gratitude, such as we suppose a sheep would feel if a boa-constrictor decided at the last moment to uncoil.

The Chancellor himself dealt with the matter characteristically. He pointed out some of the grosser imbecilities of the tax, quite as though he had recently discovered them for himself, and very gravely sought the approval of his constituents for the step he was about to take. We recollect that some time before his last Budget he condemned the tax root and branch, and then proceeded to increase it from 40 per cent. to 60 per cent. He now speaks lightly of permitting it to run its normal course of seven years, and not renewing it, as it is no longer necessary. Not one word as to the vast claims for repayment of losses which it has to meet, and which we suspect to be the real reason for repeal!

A squeal is likely enough to be audible now from certain firms who are cheerfully carrying on at a loss, and intending to reclaim such loss from the Treasury under the provisions of the duty. Having done our best to suggest the attack upon this iniquitous and destructive impost, we naturally rejoice in its overthrow. But possibly our indignation that it should have been continued so long, and increased last year, is greater than our gratitude at its removal.

In the case of firms started since E.P.D. was imposed, it ceases to operate as from December 31st last. All other firms will pay (or reclaim, as the case may be) for a term of seven years from the first accounting period in which they fell under the operation of the Act. The Duty is due to expire on August 5th, and it is expected that very few firms will be subject to it after July 31st next.

There is a temptation to obey the maxim to speak only good of the dead, and to forget the colossal injuries inflicted by the duty. But with scores of engineering and other businesses in liquidation, and thousands of others in desperate straits; with over a million men registered as out of work; with enterprise of all kinds suspended, and credit stopped (under the influence of the Chancellor), we feel bound to put on record our view of the Excess Profits Duty.

It was hurriedly imposed upon the country under pressure from certain trade-union leaders, who seem to have had the Government on the leash almost since the beginning of the war. Their object was absolutely patriotic and sound. It was to prevent people from making fortunes out of others' misfortunes. Unfortunately the method was fundamentally wrong, and the Act failed of its object, and proved to be indirectly the cause of enormous injury to our trade during the war and since. What should have been done, as the economists and business men of the country pointed out, was to take the necessary steps to ensure that the Government and people should pay no more than a fair price for necessaries. The Government had, and used, the power to commandeer anything required for the war, and it might easily have bought the whole output of any article necessary for public consumption at a fair price, and passed it on to the public. Or as an alternative, it could, and did, regulate prices, and if properly organised this could have been much more effective. The Excess Profits Duty was not used to keep down prices, but from the first day was used to extract easy money for the Government to squander. It led to gross extravagance. It was a common saying in the mouths of Government buyers: "It does not matter about the price, as we get it back in excess profits." It led to extravagance on the part of manufacturers and traders, who looked about for ways to spend money rather than hand it over to the Treasury.

The Act was the joint product of lawyers and labour men, both being exempt. Government officials, though they might, owing to the war, be drawing three times their accustomed salaries, were exempt. But salaried foremen and managers in the employment of private firms were prevented by special ukase from getting any increase throughout the war, with the result that in many cases skilled foremen, working all hours, weekdays and Sundays, drew less money than raw lads under them doing an eight-hours' shift. This iniquity will not be soon forgotten by the victims. The avowed object of the Government was to prevent evasion of the Excess Profits Duty by giving away the profits in increased salaries. The result was that the men who, next after the soldiers, really won the war, were treated with harsh and wicked injustice.

Traders and manufacturers suffered unequally. Any firm which had made big profits during the two years before the war might continue its scale of dividends untouched. Businesses struggling before the war, which had chanced upon two years' bad trade, and nearly all new concerns started during the war, were penalised. Take the case, for instance, of a firm of gauge makers who, perhaps, had made 25 per cent. profits for two years before the war on a turnover of, say, £2,000. Under the Excess Profits Duty they could distribute 25 per cent., plus the statutory allowance, varying from 6 per cent. upwards, on any turnover—£20,000 or £200,000. Rival firms started during the war to do the necessary work were allowed the statutory profit only. This, of course, meant that the senior rival could under-quote, and put the new firm out of business without the slightest difficulty.

We said that *nearly* all new firms suffered. There were notable exceptions, some of which require further investigation, in the shape of favoured firms assisted by the Government to start, and *exempted* from the tax. Necessity was pleaded, as it is for every such Act; but what is to be thought of taxation imposed and administered in this fashion? No one outside Bedlam could justify it; and, to be fair to the Government, no member of it ever seriously tried to do so. The one cry was that it was a war measure.

The war having been over for a year, Mr. Austen Chamberlain raised the tax from 40 per cent., at which it then stood, to 60 per cent., thereby bringing about the biggest slump in industry experienced in this country in recent times. Now, two and a half years after the war, he yields at last to stern necessity (and to the pressure of claims for the repayment of losses), and ends it.

One of the last, and certainly one of the most effective, speeches made against the Act was delivered by Lord Leverhulme at the recent dinner of the Institute of Cost and Works Accountants. He had always opposed it, but the lawyer and labour politicians had no use for his wisdom and experience. In his speech he pointed out that the E.P.D. had swallowed up the reserves of manufacturers and traders, so that at the conclusion of the war they were absolutely dependent upon credit, which they were denied also by the action of the Treasury. Hence, too, the inability to carry stocks, and the crisis which followed, as an ordinary case of cause and effect. He also pointed out that every pound snatched by means of the E.P.D. cost the Government one pound or more which it could have had in a harmless way as income tax, if the business of the country had been rising instead of falling. Finally, he laid stress upon the inflation of the face value of prices and wages, which had been brought about largely through the Excess Profits Duty, without benefiting either labour or capital, the inflation which has now to be slowly and painfully deflated under the influence of imminent disaster when it is threatening to put us out of business in the markets of the world.

THE DISTRICT INQUIRIES.

The two inquiries which the Commissioners have opened and adjourned reveal conditions which are profoundly discouraging. It has long been the reproach of the electricity supply industry that it was incapable of co-operation or united action for any constructive purpose, and so far as these inquiries have gone that incapacity remains, in the districts concerned. This is disappointing. The authorised undertakers have been given a grand opportunity; apparently they cannot take it. It is an opportunity for which they asked with unanimity and fervour in 1919. The unanimity might have been taken as a symptom of improvement; it turns out, so far as can be judged at present, to have been only a unanimity for destruction, for constructive it is not.

If this judgment is thought too severe, let us cast our memories back to the story of the Electricity (Supply) Bill, 1919, which became the Electricity (Supply) Act in December of that year.

The original Bill authorised the appointment of Electricity Commissioners with certain duties of supervision and initiative, replacing the Board of Trade, with duties mainly of the police kind. The Commissioners were to have power to set up District Electricity Boards with powers of a somewhat sweeping nature, but which would certainly have enabled them to carry out the purpose of improving the supply of electricity throughout the country, and cheapening it if worked with reasonable skill and prudence. But the compulsory powers proposed were extremely distasteful to most of the authorised undertakers of both the company and the municipal type.

So the industry was for once unanimous—in criticism and condemnation. Its spokesmen said in effect:—"There is no need for these District Boards and their compulsory powers of interference with us. There is no excuse for putting upon the industry and the people the expense of this official organisation. The existing undertakers are both willing and able to do everything necessary if they are permitted to join together in suitable districts. They will do by co-operation, with the minimum of administrative cost and of new capital expense, all that the District Boards can achieve, and do it quicker. Give us the chance to combine and show you."

And the Government yielded to this appeal. It introduced into the Bill clauses permitting the establishment of Joint Electricity Authorities as an alternative to District Boards. At the last stage of the Bill the District Board clauses were dropped, and the Act became an Act to authorise the appointment of the Commissioners, enabling them to delimit districts, and to make schemes for the improvement of supply therein, which schemes may include the establishment of Joint Electricity Authorities. It is worth while to mention that the only necessary constituents of the Joint Authorities are representatives of the authorised undertakers.

It is true, then, to say that the authorised undertakers professed willingness and ability to do what was necessary by co-operation, if only they were permitted, and that the permission was given and legalised. So they have the opportunity they asked for.

What is the result, as shown by the inquiries at Bristol and Liverpool? The spirit of co-operation, of endeavour to pull together for the purpose of improving the supply of electrical energy, the capacity to sink local and personal differences and jealousies, the professional capacity to frame a sound technical scheme and support it with reasoned estimates? Nothing of the kind, unfortunately; let the reports of the inquiries speak for themselves. They are profoundly disappointing.

It might have been expected with a good deal of confidence that in each of these districts the engineers of the undertakings would at least have worked out a sound and practicable technical scheme. We are perfectly sure that they could have done this, and it is very difficult to understand why they have not. That section of the scheme could have been done without necessarily hurting anyone's feelings. Yet in the one case no technical scheme has even been considered. In the other a technical scheme was put forward, but of such a character in some essential features that it could not be characterised as well-thought-out or *prima facie* sound. As for co-operation between authorised undertakers, the inquiries show mainly an intense jealousy lest some one or other should possibly be in a superior position to somebody else.

So the goodwill and ability to co-operate vanish when put to the test. The old parochial feeling has triumphed.

This is a bad beginning. It must be intensely disappointing to the Commissioners, a body of men in whom the whole industry has the greatest confidence.

What is likely to happen if these bad beginnings are true samples of the bulk? This is a question which the responsible people ought to consider very seriously.

In the first place, the Commissioners are not obliged to adopt any scheme put before them. They may adopt such a scheme, with or without modifications, or they may formulate a scheme themselves, which may not bear much resemblance to any of those submitted.

But whilst they may formulate a scheme, they have little power to compel its adoption, none at all to oblige the undertakers to enter into it in the right spirit, without which the scheme cannot succeed. For the essence of Joint Electricity Authority schemes is that they be worked in a spirit of mutual helpfulness and co-operation.

What, then, remains? The Commissioners know the limit of their powers as well as anyone, perhaps better than anyone else. They are charged by Parliament with a duty which they can perform only if the supply industry manifests a general desire to carry out its promises and protestations of 1919. If it will not—if it cannot—the Commissioners have a clear course. They are not the men to say to their chiefs, and through them to Parliament: "We cannot do the duty you put on us, because these people will not do their part."

What they are much more likely to say is: "The opportunity for voluntary co-operation has been given, it has not been taken up; the necessity in the national interests of improving, cheapening, and generalising electricity supply is more urgent than it was in 1919, for two years have gone by and nothing has been done. The compulsory powers and the District Boards are necessary instruments for the execution of our duty, and we must have them."

And with what face can the supply industry again protest against this "big stick" being put into the Commissioners' hands? What amount of sympathy can it hope to gain from noble lords and honourable members in that case?

This is what is likely to happen; it will be a misfortune in some ways, but will it not be a smaller one in the common interest than allowing the present conditions to continue? The signs of the times are plain to read.

One word on the position of provisional-order companies. So far as can be seen their general attitude is somewhat apathetic. Most of them are due for compulsory purchase within a few years, and these seem to wish to be let alone for their short remainder of life.

We venture to suggest that this policy is a mistaken one. They could take a course which would make their latter years brighter than the former; nay, it is conceivable that they could lengthen their life and make it worth living. Is there no vision, no imagination among them?

Railway Electrification. In these days of trade depression, news of "a big job" which may come to this country for execution is more than ever welcome. Hence it is with much pleasure that we draw attention to the call for tenders for the electrification of certain railways of the Union of South Africa, which is advertised in this issue. It is true that the sections of line concerned are not of Continental dimensions; they are, however, not far short of 80 miles of route, and what is more important, they represent the first steps towards the carrying out of a general policy of electrification on a very extended scale by the Government of South Africa.

The tenders are to deal with the whole of the electrical rolling stock and the power stations and substations; steam plant is to be the prime mover, but doubtless other sections of the railways will be supplied with energy from water-power. We earnestly hope that British manufacturing firms, which have already proved their ability to cope with the electrification of railways in South America and Australia, and have secured important contracts in New Zealand, will be successful in obtaining the orders for this very important undertaking, which is likely to be the forerunner of vastly bigger schemes; if we make good on the first sections, there is every probability that we shall be entrusted with the later ones.

Fall in German Prices. The price regulation bureau of the German electrical industry has made a fresh reduction of up to 10 per cent. in the prices for electrical machines. In the case of products where high wages and salaries play a large part, and where the price of the requisite raw materials has not yet been reduced, the concessions which have been made are only on a limited scale. As bearing on this question Herr von Siemens, speaking at the recent general meeting of the Siemens & Halske Co., is reported to have stated that a beginning in lowering sale prices was made in July last, and had since been continued. The company had good orders on hand in most departments; the freedom from labour troubles in recent months was causing a renewal of confidence in other countries, and deliveries were again more reliable. If the production experienced a further increase it was possible that they might hope soon to revert to normal conditions of sale.

THE E.A.C. SWITCHGEAR WORKS.

A Tour of Four Works in and near London.

The Electrical Apparatus Co., Ltd., was established in 1906 with offices at Westminster, largely as sales agents, but also with the object of selling apparatus under its own patents, though manufactured by other firms; the incorporation of the present company dates from 1913. By 1908 the business had increased to such an extent that small works were established at Battersea for the manufacture of motor-control gear and electricity meters, but the premises soon became inadequate. In 1911 the company acquired freehold ground at Vauxhall, and the present Vauxhall works were built on the site of Percy Villa, which was occupied for many years by the late Lionel Brough. The apparatus manufactured at Vauxhall comprises a complete range of d.c. control gear, with the exception of tramway-type controllers, in addition to a.c. air-break and oil-immersed gear, a large amount of the latter apparatus being supplied for use underground in mines.

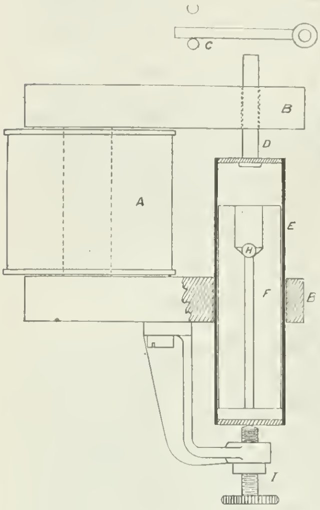

Fig. 1.—New Time-Lag Device.

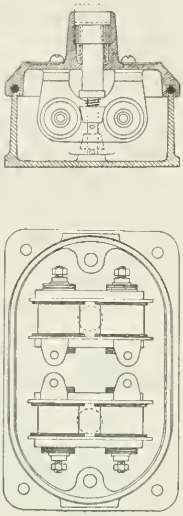

Fig. 2.—Push Button with Magnetic Blow-out.

During the war period the company was declared a controlled establishment, and a large amount of work was done in supplying the various services and munition works with motor-control gear, and by 1919 the premises were congested to such an extent that further extensions were inevitable. A plot of freehold ground upwards of 10 acres in extent was purchased at St. Albans, but as the building operations were likely to take some considerable time to complete, premises were acquired in Wandsworth Road to cope with the company's requirements for the time being. The Wandsworth works consist of what had once been the residence of Lord Eldon at the time when he was Lord Chancellor, and relics of ancient glory in the form of marble pillars and ornamental plaster work are still in evidence. These premises proved so useful that they are being retained for the production of small specialised articles for use at Vauxhall, and the automatic machine tools are installed in these premises.

The new St. Albans works were completed in the autumn of 1920, and are now in full operation. The principal item of the products of these works for the present is the oil-immersed switch of the draw-out pattern and its innumerable combinations with other control gear to form complete power units and distribution switchboards for industrial use. The meter department has also been transferred to St. Albans, and facilities have been provided for the manufacture of house-service meters of both the a.c. and d.c. types in large quantities.

The sales organisation is controlled from Vauxhall, and comprises the company's own offices with technical staffs at Manchester, Birmingham, Newcastle-on-Tyne, Glasgow, Cardiff, Nottingham, Leeds, and Bergen (Norway).

Fig. 1 illustrates the new E.A.C. time-lag device, in which A is the magnetising coil, B B are the magnets, C is the switch to be operated, and D the striker attached to the hermetically-sealed cylinder E which is filled with oil. Inside the cylinder, but unattached to it in any way, is the iron plunger F which, when current is switched on to A, begins to rise slowly until it reaches the point of maximum attraction. It then rises with a jerk and carries with it the cylinder E and the striker D. The ball valve H allows F to fall quickly through the oil after it has actuated, and the screw I is provided for adjusting the travel of E and F and thereby the time-lag required. The object of introducing the cylinder E is to ensure that once the plunger has been adjusted, and the cylinder sealed, it will remain constant in operation. The coil A is not usually placed round E, because if it were, the viscosity of the oil might be affected by the heating of the coil.

The above-described time-lag device has been incorporated in the firm's new current limiter, illustrated in fig. 3. The latter can be briefly described as a loose-handle circuit breaker which is tripped by means of the above-mentioned time-lag plunger when a previously determined current has been exceeded. It can be reset by simply turning the screw shown on the right-hand side of the illustration, and a number of advantages over the ordinary types of limiter is claimed for it, one being that the contacts will not weld up, no matter how it is operated. Devices to give warning before the circuit is broken can be incorporated if required. Fig. 5 illustrates a heavy-duty inching pillar for use with a 60-h.p. variable-speed motor, while fig. 6 shows a two-panel distribution board for mine service, consisting of a loose-handle automatic oil switch incorporating draw-out isolating features, an ammeter and integrating wattmeters for registering unbalanced load.

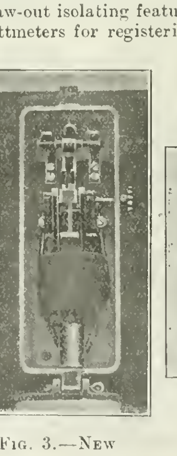

Fig. 3.—New Current Limiter.

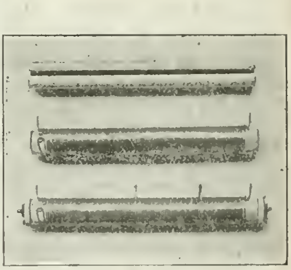

Fig. 4.—Resistance Units.

Early in 1920 an arrangement was made whereby the interests of the Electrical Apparatus Co., Ltd., and those of Messrs. Bray, Markham & Reiss, Ltd., were amalgamated, but with the exception of a common sales organisation and joint financial control, the two enterprises are being conducted separately, the B.M.R. works remaining under the able direction of Mr. E. N. Bray, who was one of the original founders, and is responsible for the many excellent types of motor-control gear manufactured at the Walthamstow works.

The B.M.R. firm was established in 1902 with offices and works in the buildings occupied by Messrs. Peter Hooker, Ltd., with the intention of making motor control gear. At that time nearly all starters with automatic releases were imported from America, and were of flimsy construction. The first point to which attention was given was that of resistances, and the particular unit was then designed and patented which has been in use without alteration ever since. It is quite different to any other type, and it is largely owing to its reliability that the success which has been achieved by the company is due.

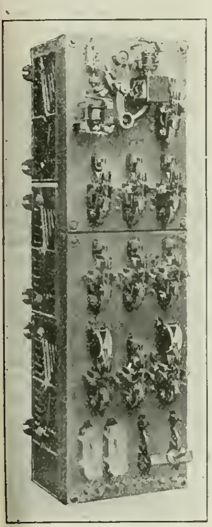
Fig. 5.—Heavy Duty Inching Pillar.

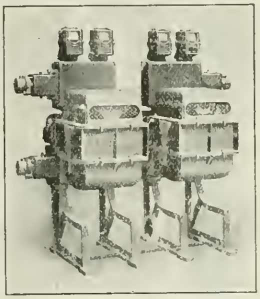
Fig. 6.—Two-panel Mining Distribution Board.

Fig. 4 shows a set of resistance units from the raw tube to the finished regulator. These units consist of non-corrodible wire wound on enamelled steel tubes; there is an inner coat of enamel melting at a high temperature and an outer one melting at a lower temperature. The tube is split along its axis, and is slightly compressed whilst winding, so that when removed the wire is held in position. A current is then passed through the wire, sufficient to bring it to red heat, when the outer surface of the enamel is softened, and the wire sinks in and forms a groove for itself, thus effectually preventing adjacent turns from "shorting."

In 1904 the company designed a series of starting panels which was accepted in connection with the electrification of dockyards, and shortly afterwards it also designed a starter which met with Mr. C. H. Wordingham's approval for use on battleships. From that time the orders for Admiralty switchgear steadily increased, and when war broke out this business formed 75 per cent. of the entire business of the company. During the war the company was nominated an Admiralty "A" firm, and almost the entire output was taken up with orders for the Royal Navy. It also developed a starter suitable for the mercantile marine which was adapted for use with ventilating and heating systems on liners to a very large extent.

In 1915 Messrs. Peter Hooker, Ltd., were making Gnome engines, and required the space occupied by the B.M.R. Co.; neighbouring works which had been burnt down were rebuilt for the company, and are now occupied by it. After the armistice Admiralty work dropped practically to zero, and still remains at about that point. Increased capital was required in order to carry on the business and the company, therefore, arranged to amalgamate its interests with those of the E.A.C. as above mentioned. Of the original members of the firm, Messrs. Markham and Reiss have now retired. The association of the two firms has been successful, and the output during the past 12 months has been larger than ever before. The company has concerned itself latterly largely with remote-control devices and automatic starters for d.c. work, and has developed its motor-operated type with considerable success, and also a type of starter of mica-iron construction which is in many respects a departure from the accepted types, it being a combination of the face-plate and drum types. This type was originally produced for use on H.M. submarines, where the drum type, which had hitherto been used, was found to be too bulky. A very large number of these starters was manufactured during the war, and the design was developed for use on land in the form of pillar-type panels, and considerable numbers have been manufactured.

The principal manufactures of the company are as follows: D.c. starters of the ordinary lever type, and the slow-motion ratchet type in every combination of pillar panel with fuses, breakers, shunt regulators, and so on; Navy type starters of the mica-iron construction; d.p. switches in cast-iron cases of the laminated-brush type, fitted with magnetic blow-outs; motor-operated remote-controlled starters, both of the face-plate type and of the motor-operated master switch and contactor pattern for larger powers; and all combinations of field regulators, both for shunt and main alternator field types. The firm also undertakes a great deal of special work, and contactors of all sizes have been standardised.

Fig. 7 shows one of the "Navy" pattern starters, comprising a starter with no-volt release and two contactors with an overload relay. The connections are such that when the starting arm is moved to the first contact the contactors close, and any further movement introduces an economy resistance so that the contactors cannot possibly be closed except when the starter is on the first contact, and consequently all the starting resistance is inserted. If the arm is moved too rapidly past the first contact, the contactors will not have time to close; if after the contactors are closed, the arm is moved too rapidly, the overload relay will break the circuit of the contactors, and the arm must be returned again to the first contact. The starters themselves are of the mica-iron type, and a coil which surrounds the hub or centre pin of the starting arm acts both as a blow-out and a no-volt coil, the base of the arm being made of iron. This forms a field between the face of the arm and the base, which effectually extinguishes any arc which may be formed on the contacts. The latter consist of copper tubes capable of revolving on heavy brass pins, except the final contact, where the tube is a fixture; all the tubes can, however, be easily removed and replaced, or turned round to present a fresh surface.

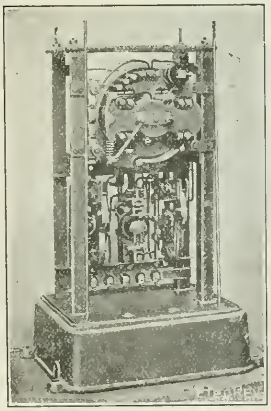
Fig. 7.—"Navy P.N.C." Type Starter Panel.

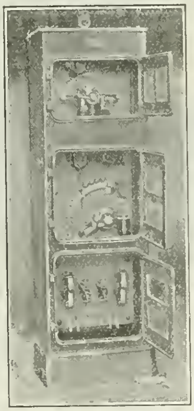
Fig. 8.—Type "A.A." Automatic Starter.

On the arm are mounted two controller type fingers with semi-circular copper tips, which are in duplicate, two bearing against the centre ring and two against the contacts; the arm itself is removed by undoing a single set of screws.

Fig. 8 shows a motor-operated starter and a motor-operated regulator built in panel form; these switches were supplied for push-button lathe control. The diagram, fig. 2, illustrates a push-button with magnetic blow-out. The contact is made by a cone-shaped copper contact being pressed against the periphery of two copper tubes; the blow-out coils are contained within the copper tubes, one end being connected to the core and the other to the inside of the tube, and the core also serves as the terminal. The lines of force are at right angles to the arc and blow it outwards efficiently, the switches being capable of interrupting 1.5 amp. at 600 volts.

In concluding this review of an instructive works inspection, we have to thank Major R. Amberton and Mr. E. N. Bray for the reception given us on the occasion of our visit, and for their personal assistance in the preparation of the above information and illustrations.

THE OPTOPHONE.

An Instrument to Enable the Blind to Read.

Hitherto the only means available for enabling the blind to read have been raised type systems, such as the Braille and the Moon, adapted to be read by the sense of touch. These methods are subject to disadvantages, such as the necessity for having specially printed, expensive, bulky books, with the consequence that the amount of literature available is limited, and the difficulty of acquiring the necessary sensitiveness of touch, especially by adult blind persons.

Such drawbacks are overcome by the optophone, an ingenious instrument invented by Dr. E. E. Fournier d'Albe which has been modified and developed by Messrs. Barr & Stroud, Ltd. Its purpose is to enable the blind to read ordinary printed matter, such as books, newspapers, and type-written matter, which object is accomplished by producing in a telephone receiver series of musical notes forming tunes, or musical motifs, representing the various letters as they are passed over by the instrument in traversing a line of print. It will thus be appreciated that the blind reader depends not upon the sense of touch, but upon hearing, which is usually quite sufficiently sensitive with the majority of blind persons, and reasonable facility in reading by its use can be attained after comparatively few lessons.

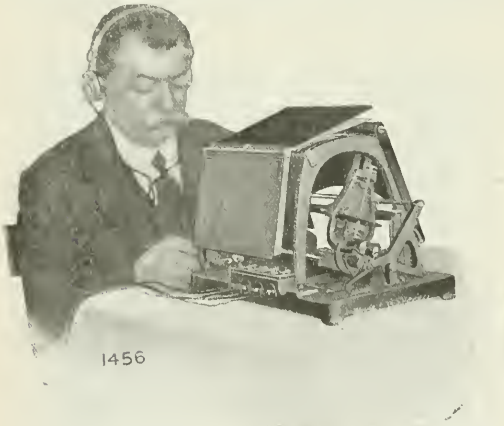

Fig. 1.—The Optophone.

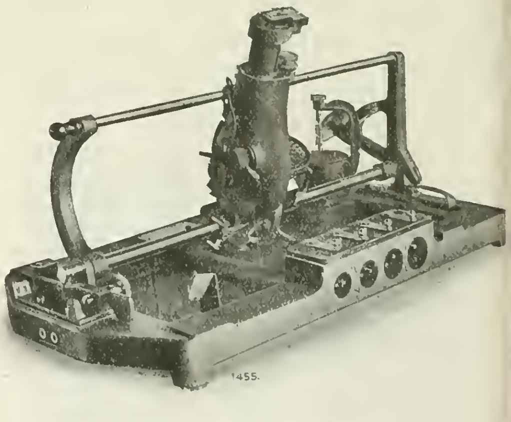

Fig. 2.—The Optophone with Book Rest Removed.

The instrument depends for its action upon the chemical element selenium, the electrical conductivity of which in one of its physical forms (grey crystalline) varies greatly in accordance with the amount of light to which it is exposed. If a telephone receiver is connected in series with an electric battery and a porcelain tablet having on its surface two separate conducting lines of graphite bridged over by light-sensitive selenium, a current will pass through the telephone which will vary as the lighting of the tablet is varied. When flashes of light are thrown on to the selenium bridge at a rate of 256 per second, the amount of current which will thereby be permitted to cross the bridge will rise and fall at that rate, and the telephone will sing out the note C (middle C of the piano). If the pulsations of the light are at half that frequency, that is, 128 per second, the telephone will sing out C an octave lower, and with 512 pulsations per second, the C one octave higher, and so on. The telephone can, therefore, be made to sound any tune by the proper succession of sets of pulsations of light applied to the selenium bridge.

In the optophone a selenium bridge is exposed to successions of sets of light pulsations, which vary according to the forms of letters as these are passed over in traversing a line of printed type, each letter being indicated in the telephone by a characteristic sound comprising successions of single notes and chords. Printed letters are thus translated by the optophone into a sound alphabet, which can be readily learned.

The arrangement of the device is illustrated in figs. 3 and 4. The printed page to be read is placed face downwards on a glass plate supported on a suitable stand, fig. 1; beneath the plate is a tablet of porcelain pierced with an aperture to permit the passage of light upwards and so through the glass on to the paper. The upper surface of the tablet (around the aperture) is prepared as a sensitive selenium bridge and connected with a battery and a telephone. The selenium bridge receives only light reflected from the page, and the light used is obtained from a small straight-filament electric lamp placed beneath a rotating disk, fig. 5, perforated with small holes arranged in five concentric circles near its edge. For simplicity in figs. 3 and 4 the lamp is shown immediately below the rotating disk, but in the instrument the lamp is so arranged, in conjunction with a reflecting prism and cylindrical lenses, that an image of the filament is produced in the plane of the disk, radially across the circles of holes, fig. 2.

The disk is kept in rapid rotation by means of a magneto-electric motor driven by energy derived from small secondary cells. Above the disk there is an optical system which throws on to the paper an image of the lamp filament as it would be seen through the perforations in the disk. By this means the light that falls on the printed matter forms five bright spots in line, forming what is called the "scala," and each spot pulsates at a rate corresponding to the number of holes in the circle of perforations to which it belongs, multiplied by the number of revolutions per second of the disk. There are 18 holes in the innermost circle, 24, 27, 30, and 36 in the other circles respectively, and if the disk makes 21⅓ revolutions per second, the second circle of holes will produce 512 pulsations of light per second—corresponding to the vibrations in the musical note C^1. The numbers of holes given above are in proportion to the vibrations in the notes G, C^1, D^1, E^1, G^1 (soh, doh, ray, me, soh), and a change in the speed of rotation of the disk, of course, alters the pitch of the notes, that is, the key in which the motifs are sounded, but the intervals remain unaltered.

The optical system used to produce the image of the holes has a variable minification, so that the length occupied by the scala of five spots may be adjusted to equal the height of the letters to be read, the range of adjustment covering the various sizes of type employed in ordinary printing. The optical system is so designed that the sharpness with which the five spots are focused upon the surface of the paper is little altered by a change in the minification, but more accurate focusing can be effected by movement of a small lens situated immediately below the selenium bridge. The spot of light corresponding to low G is caused to fall on the lowest points of such letters as j, p, y, &c., the high G^1 falling on the tops of capitals and of high letters, and the three intermediate spots cover the height of the short letters, as seen in fig. 6, which shows the path of the scala passing over the printed word "Type."

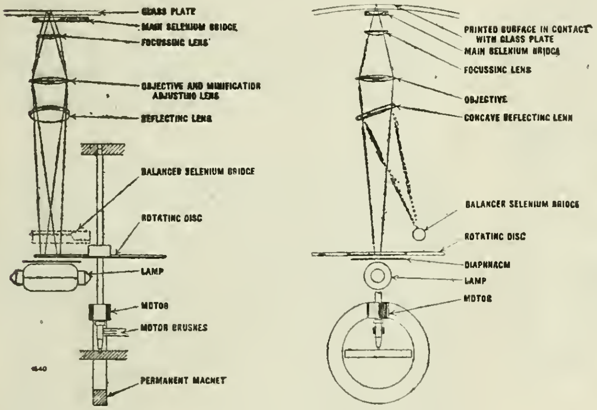

Fig. 3. Fig. 4.
Diagrammatic Arrangement of Optophone.

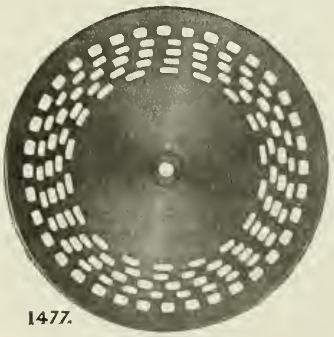

Fig. 5.—Rotating Disk.

With an optophone constructed in accordance with the above description, if all the spots of light fall on white paper—the space between two words, for example—all the notes will be sounded together in the telephone, producing a discord. If the scala passes over the letter V, the top note G^1 (high soh) will first be silenced, then E^1, D^1, C^1, D^1, E^1, G^1. Each letter will alter the succession of sounds in a different manner. This arrangement constitutes what is called the "white sounding" optophone.

The present improved type of instrument, however, is modified so as to make it "black sounding," in which form white paper is represented by silence, and notes are sounded as the scala passes over the black letters; with this optophone the letter V is represented by the motif G^1, E^1, D^1, C^1, D^1, E^1, G^1 (s m r d r m s).

The "black sounding" is obtained by providing a second selenium bridge, called the "balancer," which is illuminated by a small part of the intermitted light reflected aside before it reaches the paper—and connecting this bridge to the telephone and the battery in the manner shown in fig. 7, so that the current traversing the balancer bridge (Se. No. 2) acts in the reverse direction in the telephone to that of the current through the main selenium bridge (Se. No. 1). One battery is used and the two selenium bridges are connected one to each end of the battery and both through the telephone to a selected intermediate junction of the battery in the manner shown. The balancer thus tends to cause the telephone to sound all the notes continuously, and the main selenium bridge, that receives the light reflected from the paper, annuls the effect on the telephone in respect to any note when the spot of light corresponding to that note falls on white paper. The division of the total voltage of the battery can be varied so that when the whole scala falls on white paper the telephone is silent, and notes are sounded only as the scala moves over the black letters as previously described.

With regard to its mechanical construction, the base of the instrument consists of an aluminium casting carrying the book rest and the various parts of the mechanism. The book rest, fig. 1, consists of a metal frame standing on four feet and supporting a curved glass plate on which the page to be read is placed face downwards. Means are provided for clamping down the page so that it lies in close contact with the upper surface of the glass. Passing under the book rest, from the front to the back of the base, there is mounted a rocking shaft the axis of which is coincident with the axis of curvature of the book rest plate. The shaft is tubular and a slotted rod passes through it for effecting the line changing motion, and it carries an aluminium casting, called the "tracer," on which are mounted the electric lamp, the revolving disk and its motor, the optical system, and the selenium bridges, fig. 2; the tracer can swing from one side of the book rest to the other, and the lamp holder is carried at its lower end. Above it there is the rotating disk, through the perforations in which the light passes to the objective and through a small lens near the top of the tracer, above which again there is placed the main selenium bridge (Se. No. 1). Under the objective a concavo-convex lens is placed at an angle, which reflects a portion of the intermittent light on to the secondary selenium bridge (Se. No. 2), called the "balancer," situated in the tracer a little above the disk and to the right of its axis, fig. 3.

When the tracer is swung over to the right-hand side (by means of a handle seen in fig. 2) a spring situated on the base behind the book rest is bent down and tends to throw the tracer over to the left. A governor is provided which controls the swinging of the tracer to the left. On the top of the governor box (which is situated behind the left back corner of the book holder) there is a screw with a milled head for controlling the speed of swinging of the tracer, *i.e.*, the speed of passing along the line of printing. The farther this controlling screw is screwed down the slower the tracer swings and *vice versa*; when the controlling screw is sufficiently screwed down the swing of the tracer is stopped, but starts again when the screw is slackened.

An adjustable friction gear is provided for moving the tracer down or up the page one line space at a time if desired for re-reading a line. In the process of reading, when the tracer has passed to the end of one line, the line changer is operated and the tracer swung over, when it automatically traverses the next line. The line changing gear is operated by a lever seen at the front of the instrument in fig. 2. The lever is provided with a stop-screw which is adjustable and can be set to make the movement of the tracer exactly equal to the line spacing of the printing, when the lever is moved once backwards and forwards.

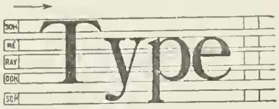

Fig. 6.—Scala Passing Over Printed Letters.

Switches are provided on the base of the instrument for the lamp, the motor, and the two selenium bridges. All the controlling parts and the necessary battery connections, &c., are designed with a view to ease of manipulation by blind persons, and after a few lessons little difficulty should be experienced in adjusting and using the instrument.

In the case of the letter V already referred to, the connection of the characteristic tune or motif with the actual form of the letter is readily recognised from the succession of notes. It must not be supposed, however, that optophone reading consists in analysing the sound motifs so as to identify the forms of the letters indicated. When the alphabet has been learned, the sound for each letter is recognised as a whole, and later in the reader's practice, the more extended sounds for syllables and even words will become familiar to his ear. A practised optophone reader will recognise words as readily as a telegraph operator interprets a succession of clicks on the Morse code. The great rapidity that has been attained by hundreds of readers of Morse sounds encourages the hope that equal or greater speed in optophone reading will be attained with practice.

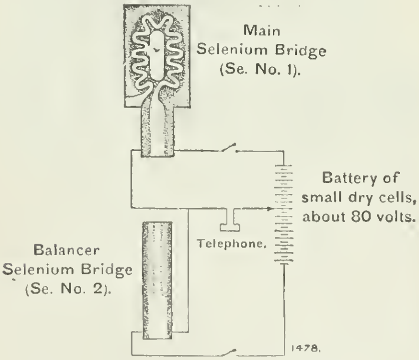

Fig. 7.—Selenium Bridge Connections.

Already it has been found that with the latest type of optophone a blind reader, after some practice, has attained a speed of reading of 25 words per minute. We have seen the optophone in use, and it is not difficult to imagine that it will be developed in the future to a perfection that at present cannot be foreseen, and there is no doubt that many who have had the misfortune to lose their sight will be profoundly grateful to the inventor and improvers of the device which places within their reach new sources of interest, instruction, and enjoyment, and which in many cases will greatly extend their opportunities and qualifications for useful and profitable employment.

JOINT ELECTRICITY AUTHORITIES.

Mersey and West Lancashire Inquiry.

(*Concluded from p.* 141.)

On Friday, January 28th, the inquiry was resumed, Mr. C. D. Taite continuing his evidence in support of the Liverpool Conference scheme. Cross-examined by Mr. Jeeves, K.C. (Wallasey Corporation), on the point that Mr. Dickinson's proposals would result in 50 per cent. of the plant being spare, the witness said that one would not provide so large a proportion in starting a new scheme; it arose out of the combination of existing systems. Answering Mr. Miller, K.C. (Birkenhead Corporation), he said that under the Conference scheme Wirral should be able to obtain a cheaper supply of electricity than if it had a separate area. In reply to Mr. E. T. Jones, K.C. (Mersey Power Co.), he said the whole of the proposed area was within the district covered by the Lancashire Power Co.'s powers, though the company gave no supply in that area. The chairman remarked that the Commissioners were well aware of the difference between the powers possessed by the Lancashire Power Co., and those which the Joint Authority would have. In further reply to Mr. Jones, Mr. Taite said that when the area was formed the company hoped to take a supply in bulk from the Joint Authority.

In re-examination, Mr. Taite expressed the opinion that it was of the utmost importance, in general interest, that Wirral should be included in the scheme. In reply to Mr. W. W. Lackie, he said that in addition to the Mersey Tunnel, the bridge at Widnes afforded a route for the mains to Birkenhead; and cables might be laid on the bed of the river, but the question of dredging would have to be considered. He was convinced that there would be an acceleration of electrical development in the future, and that it would be advantageous to Southport to come under the scheme when the railway companies took a supply in that direction.

The next witness was Mr. C. P. Sparks, who was called by Mr. Jeeves on behalf of the Wirral scheme put forward by Wallasey and Birkenhead. First criticising the Mersey and West Lancashire scheme, he said that assuming the capacity of the proposed capital station to be 75,000 kW, the cost worked out at about £60 per kW; allowing for loss in transmission, the total cost would be £64 per kW delivered, a figure which he considered too high. If the scheme were reconstructed, he thought that a much lower figure was possible. In view of the high rate of interest on borrowed capital, and the high cost of plant, he considered it very inadvisable to embark upon a large scheme at the present time. There was every indication of the cost of plant falling, and by adopting a smaller scheme they could take advantage of the falling market. He was not necessarily opposed to big generating stations—only to the method of procedure. He believed that within a few years the price of coal would fall.

With regard to the Wirral scheme, Mr. Sparks considered the estuary of the Mersey a serious obstacle to the supply from the north side of the river: it could only be crossed at the ends, by the Mersey Tunnel and the bridge at Runcorn, as he did not think they would ever lay cables across the intervening space. On his referring to Messrs. Lever Brothers' plant at Port Sunlight and their new power station at Bromborough, of 10,000 kW capacity, it was stated that the company's name had been inserted in the scheme without its consent. Mr. Sparks held that for a very long time, perhaps always, it would be better for Wirral to remain a separate area. The Wallasey generating station at Poulton, near the Great Float, was on an excellent site, and close to important industries; it had a present capacity of 7,000 kW, and the plans contemplated its extension to 16,000 kW. There was great industrial activity in the Wirral area, and the facilities afforded by the Ship Canal and the railways, if supplemented by an ample supply of electricity at a reasonable price, would ensure further development. The capital expenditure for two 5,000-kW sets would be £252,000, or £25.1 per kW installed and £30 per kW available output; two additional 10,000-kW sets installed when required would cost £410,000, or £22 per kW. Including a sum of £165,000 for mains, &c., the total cost would be £932,000, or £37.5 per kW supplied.

The inquiry was adjourned to Saturday morning, January 30th, when Sir John Snell asked for evidence as to the methods proposed for raising the money for the Mersey scheme. He admitted that in the absence of financial powers the promoters would have difficulty in complying with this request, but thought that the provisional arrangements that had been made between the members of the conference should be explained. Mr. Lloyd said he would submit the financial evidence at a later stage.

Proceeding with his evidence, Mr. Sparks explained the procedure contemplated in the Wirral scheme. It was intended to shut down the three stations at Birkenhead successively, and to extend the Wallasey plant to 16,000 kW, and later to 36,000 kW.

Cross-examined by Mr. Lloyd, he said that he thought electrical combination should proceed by the formation in the first instance of small joint districts, expanding later into large ones. The Act of 1919 was very different from the original Bill, and nothing could be done with it as it now stood. He was called in to advise Wallasey on January 13th, and did not devise the scheme for Wirral, but had considerably revised it. The Wallasey Council decided in December to oppose the Mersey scheme, and suggested that if it were adopted, the capital station should be built at the expense of Liverpool; he agreed that the suggestion that Liverpool should bear the whole cost was contrary to the spirit of the Act. So far as he knew, none of the urban district authorities in Wirral supported the Wallasey scheme. He agreed that if the best site for the proposed riverside generating station were found to be on the Cheshire side of the river, he could not justify his proposal to separate the two areas. In reply to Sir John Snell, he said that if, as he believed, it was not possible to proceed with a large scheme, the best thing was to go ahead with a smaller one, and link up later. The chairman expressed some doubt whether, if Wirral were once given a separate scheme, it would ever join the Lancashire side without compulsion.

Mr. Hamilton, addressing the Commissioners on behalf of Messrs. Lever Bros., declared that they had nothing to do with the scheme; they reserved the right to do what they chose with their private property. He did not say that they would never join up with anyone, but the Wallasey scheme in no way rested on their power station.

The inquiry was adjourned on Saturday afternoon to a date to be fixed later, but not to be before the end of February.

THE LONDON AND HOME COUNTIES SCHEME.

WHAT follows is a preliminary outline of a scheme proposed by the Conference of Local Authorities Owning Electricity Undertakings in Greater London for the constitution of a Joint Electricity Authority under the provisions of the Electricity (Supply) Act, 1919, for the provisionally delimited London and Home Counties Electricity District.

The district[*] has a total area of about 1,660 sq. miles; a population of about 8,000,000; a total assessable value of £68,663,477; and comprises 160 local authorities and eight county councils, including the London County Council. The Conference of Local Authorities Owning Electricity Undertakings in Greater London represents, with three exceptions, the local authorities owning electricity undertakings in the area, and is working in association with a Conference of Local Authorities *not* Owning Electricity Undertakings in the District. So far as the engineering side of the scheme is concerned, the advisers of the Conference are working in co-operation with the advisers of the London County Council, a group of nine of the principal London electricity supply companies, and representatives of certain railway interests.

The following is an outline of the provisions of the scheme so far as it has been settled. Part I, with Schedule II, provides for the establishment of a Joint Electricity Authority for the purpose of promoting, regulating, supervising, improving the supply of, and of supplying electrical energy within the area. The Authority shall consist of 27 members, appointed as follows: Sixteen by authorised undertakers, *i.e.*, eight by local authorities within and four by local authorities without the County of London; four by the companies in the area. Eight by the purchasing authorities, county councils, and local authorities who are not undertakers, *i.e.*, three by the London County Council; one by the City of London Corporation; two by the local authorities within and two by those without the county of London, including county councils. Finally, three by the Minister of Transport, representing railway companies, large consumers, and other interests, including labour.

Concerning the voting power of the members, the twelve appointed by the local authority undertakers are each to have one vote, plus one additional vote for each complete million units sold in excess of one million. The four appointed by local authorities not being undertakers are to each have one vote, plus one additional vote for each complete 10,000 of population: where the population of any local authority is less than 10,000 the voting power for that local authority shall be exercisable by the council of the county within the area of which it is situate, and the voting power of the county councils shall be limited by the amount of population included in those areas that have less than 10,000 population.

Part II confers upon the Joint Authority all powers, rights, privileges, and duties as are, or may be, conferred upon Joint Electricity Authorities under the Electricity (Supply) Acts, and enables the Joint Authority particularly to construct generating stations, main transmission lines, and other works necessary to give effect to the engineering proposals included in the scheme; to acquire undertakings or parts of undertakings of authorised undertakers and power companies within the area; and to supply electrical energy within or without the area of supply. Other clauses deal with other powers and duties incidental to the various powers enumerated.

Part III deals with provisions as to local undertakings, and enables the Joint Authority to fix standards of frequency, pressure and systems for the transmission, distribution, and supply of electrical energy within the area, and makes it necessary to obtain the consent of the Joint Authority for any extension beyond 10 per cent. of the existing capacity of the station, but such consent must not be unreasonably refused or withheld. It also enables the Joint Authority to require two or more undertakers to carry into effect arrangements for mutual assistance; to loan capital moneys to authorised undertakers; to give approval to authorised undertakers to enter into agreements with regard to the sale, lease, management, maintenance, or working of any local undertaking or part thereof; and to make representations to the Electricity Commissioners with a view to a revision of the prices or methods of charge by any authorised undertakers; together with other powers incidental to the above-mentioned powers and duties.

Part IV will, if necessary, deal in detail with land to be acquired, and works to be constructed, when the engineering scheme is complete.

Part V contains draft financial clauses in skeleton form only, and are dependent upon the report of the financial adviser to the Conference.

Part VI contains clauses conferring on the Joint Authority miscellaneous powers.

The schedules to the scheme indicate the area covered by the scheme, as provisionally delimited by the Electricity Commissioners, and provides for the constitution and proceedings of the Joint Authority. They also contain particulars of the engineering scheme (not yet issued) and regulate the issue of bills and bonds by the Joint Authority.

The outline of the scheme is signed by Messrs. Duncan Watson, chairman of the Conference; C. R. Attlee, chairman of General Purposes Sub-committee, and Leslie Gordon, town clerk, Hammersmith, hon. secretary.

THE NORTH WALES AND CHESTER SCHEME.

WE recently abstracted a scheme which has been submitted by the Chester Corporation[*] for the formation of a Joint Electricity Authority for the provisionally delimited above-named district,[†] and we are now able to outline a second scheme, which is signed by Mr. H. J. Jack, managing director of the Power Co., which has been put forward for the same district whereby application is made to the Electricity Commissioners for the extension of the area at present operated by the North Wales Power & Traction Co., Ltd., to enable it to supply the whole of the district as outlined by the Electricity Commissioners, and for the appointment of the Power Co. as an authorised undertaker for the district, subject to the provisions contained in the Electricity (Supply) Act, 1919. The Power Co. by its Act of Parliament (4 Edward VII) North Wales Electric Power Act, 1904 (Ch. cc XIII), is authorised to supply electrical energy within the area comprising the counties of Carnarvon, Denbigh (exclusive of the borough of Wrexham and the rural districts of Wrexham), Merioneth, and Anglesey.

The Power Co. has since the date of its Act considerably enlarged its plant and works, and in addition has become associated with the Aluminium Corporation, Ltd., which has also large hydraulic works in operation in North Wales for the generation of electricity, which places the North Wales Power Co. in a position to supply large quantities of electricity in bulk by means of e.h.p. transmission lines to the various sub-stations shown on the accompanying map, from these sub-stations the distributors would take their supplies and distribute in the usual way. The power system at present extends to some 80 route miles of e.h.p. transmission lines, with 12,000 kVA of transformer plant in sub-stations, mostly situated in the counties of Carnarvon and Merioneth.

With regard to the administration, it is proposed that the constitution of the Power Co. shall be as set out in the North Wales Electric Power Act, 1904, and in the memorandum and articles of association of the North Wales Power and Traction Co., Ltd. The Power Co. is at present supplying certain consumers at a price of 1½d. per unit, and it is at present believed that in no case will the price charged exceed 2d. per unit. It is proposed that the Power Co. shall distribute energy direct where it is found impracticable to arrange the supply through any local authority or private undertaking.

The technical portion of the scheme shows the present system of supply to be three-phase, 50 periods, transmitted entirely by overhead lines at 10,000 and 20,000 volts. It is proposed to increase the transmitting pressure when necessary to 34,600 volts ($\sqrt{3} \times 20{,}000$). All new main lines will be built for 34,600 volts with the exception of the special lines conveying blocks of power from Dolgarrog and Maentwrog to the eastern distributing centres, a distance of 45/50 miles, in which cases the transmitting pressure will be 66,000 volts or higher if necessary. In the western area it is proposed to continue to supply at 10,000 and 20,000 volts until such time as it is found necessary to change over to the higher pressures. It is proposed for future main transmission lines to use 0.1 and 0.15 sq. in. bare copper strand, and for the 66,000-volt lines it may be advisable to use steel-aluminium strand of equivalent sectional area to 0.15 sq. in. copper.

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[*] Elec. Rev. July 23rd, 1920, p. 106.

[*] Elec. Rev., Jan. 14th, 1921, p. 61.

[†] Elec. Rev., July 23rd, 1920, p. 107.

At present there are in operation in the district 21 generating stations with a total installed capacity of 19,783 kW, the total units sold in 1919-20 being 42,241,126. When a bulk supply is available it is suggested that 16 stations shall be discarded and the following hydroelectric stations retained: Cwm Dyli, Dolgarrog, Yale (all company), Chester (Corporation), Aberystwyth (oil), and Llangollen. The Cwm Dyli, Beddgelert, station has a capacity of 5,500 kW made up of four 1,000-kW, and one 1,500-kW sets, with an output of from 6 to 8 million units per annum. The Dolgarrog station, near Llanrwst (including the works nearing completion), has a capacity of 15,200 kW, the plant installed comprising four 1,000-kW d.c. and one 1,200-kW a.c. sets with auxiliary plant; the output is 54 million units per annum, and the proposed new plant would have a capacity of 10,000 kW a.c. Table I shows the new stations it is proposed to construct:—

TABLE I.

	Plant capacity.	Output in units per an.
Dolgarrog (low head)	— ...	7,000,000
Cwm Dyli (lower area)	— ...	3,000,000
Dolwyddelen	1,500 ...	7,000,000
Maentwrog—first development ...	12,000 ...	30,000,000
,, second ,, ...	12,000 ...	30,000,000
Totals ...	25,500 ...	77,000,000

The above schemes are estimated to give an output of 137 million units per annum, with a maximum demand of 35,000 kW under a load factor of about 45 per cent. In addition there are further hydro schemes within the district which can be developed, including low-head schemes where asynchronous generators could be used, floating on the system, but which can only be developed after the above schemes are completed. It is estimated that it will be possible to develop ultimately from the hydraulic power within the district up to 250 million units per annum. It is not proposed to ask the Ministry of Transport to construct any of the foregoing works.

The proposed transmission system extending along the route of the London and North-Western Railway main line, between Crewe, Bangor, and Holyhead, as well as the branch lines within the area, offer facilities for electrification of the railways should it be deemed advisable. It is assumed in all cases that where a supply in bulk is given, the existing steam, oil, or gas generating plant will be discarded within a reasonable time thereafter.

It is estimated that, excluding existing customers of the Power Co., an additional 15 million units per annum will cover the requirements for the western area. To take full advantage of the hydro-electric power available in the western area, it is essential to develop this power on a commercial basis, and it must be transmitted and sold at a reasonable price in some industrial zone which is within economic transmission distance from the source of power. This is found in the eastern part of the area at Crewe, Northwich, Wrexham, Chester, and along the Dee estuary, where the demand for power is already established and is increasing rapidly.

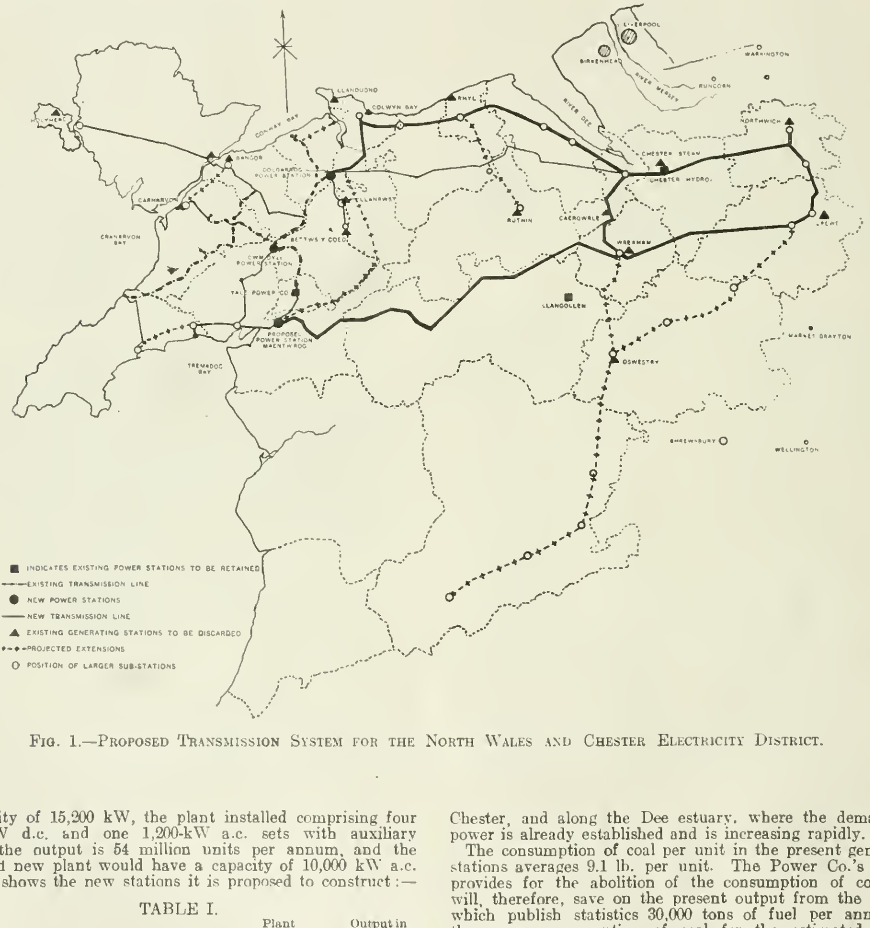


Fig. 1.—Proposed Transmission System for the North Wales and Chester Electricity District.

The consumption of coal per unit in the present generating stations averages 9.1 lb. per unit. The Power Co.'s scheme provides for the abolition of the consumption of coal, and will, therefore, save on the present output from the stations which publish statistics 30,000 tons of fuel per annum; if the average consumption of coal for the estimated demand of 134,550,000 units in 1920 is taken at 5 lb. per unit, the approximate saving in coal will amount to 300,000 tons per annum by the operation of this scheme.

The proposed new generating station at Dolgarrog will be built on a site adjoining the existing power station. It is designed to house five generating sets, two of which will operate at 428 r.p.m. on the head of 850 ft. available, and three sets will run at 500 r.p.m. at a head of 1,010 ft. Pelton wheels with single runners and oil-pressure governors, direct coupled to three-phase alternators, operating at 6,000 volts, 50 cycles per second, will supply current which will be stepped up to 34,600 and 66,000 volts as required for transmission by overhead lines within the area. The capacity of the smaller sets will be 1,250 kW and of the larger sets 2,500 or 3,000 kW. Each alternator will be tied electrically to its step-up transformer, forming one complete unit with switchgear on the e.h.p. side at 34,600 volts. The transformers will be 3-phase units, with separate forced-oil cooling system in duplicate; each alternator will have its own direct coupled exciter, and the voltage regulation will be controlled by automatic regulators of the Tirrill type.

The layout of the Maentwrog power station will in general be similar to that at Dolgarrog. The first development provides for 12,000 kW, consisting of 4 sets of 3,000 kW each, and the second development also provides for 12,000 kW and in this extension larger-sized units would be installed of 4,000 kW or even 5,000 kW capacity.

The total capital expenditure is estimated at £4,260,000, but for the requirements of the first five years £1,810,000 would suffice. The transmission lines it is estimated can be constructed at the following cost: For 66,000 volts, at £4,000 per mile; 33,000, at £2,500; and 20,000, at £1,500 per mile; the sub-stations will cost £5 per kW, and the hydraulic works at Dolgarrog and Cwm Dyli, £785,000.

TABLE II.

Present consumption, 49 million units at 1¼d. = £250,000.
Estimated consumption 1925, 94 million units at 1¼d. = £490,000.
Estimated consumption 1930, 134 million units at 1¼d. = £700,000.

Table II shows the estimates of revenue, and in order to carry out the works contemplated it is proposed that local authorities shall lend money to the Power Co. and the latter shall have authority to issue bills or stock. In the event of the revenue being insufficient in any one year to meet the interest charge and working expenses, the Power Co. shall assess the deficiency upon the users of the energy.

CORRESPONDENCE.

Letters received by us after 5 P.M. on TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Indicating Wattmeter in Remote Position.

In reply to "Inquirer's" question in your issue of January 28th, I developed a method of doing what he wants some three years ago, and an installation of the necessary apparatus to show kilowatts, amperes, volts, and synchronism has been at work ever since between Dunston and Carville power stations on Tyneside, with most satisfactory results, and the operating engineers find it a most valuable help. In the case in question the line resistance is 600 ohms, and the method can be used with considerably higher pilot resistances than that. The underlying principle is the transmission to the remote point, where indication is required, of a minute direct current obtained from thermo couples suitably connected, acted on by heaters energised by a definite fraction of the alternating current to be measured. For "current" the arrangement is simple, being a combination of current transformer and heater with ten small thermo-junctions in series at the transmitting end, giving at full output about 40 mV. At the receiving end is a "Pattern R" Paul unipivot galvanometer of ample sensitivity to give full-scale deflection with the above e.m.f. and line resistance, and yet a thoroughly robust instrument for commercial switchboard use. Embodied in the heater circuit is an automatic cut-out of specially quick-acting type to effectually protect the heater in case of overload or short-circuit on the power line.

For transmitting a true indication of kilowatts the current transformer at the transmitting end has two secondary windings of similar characteristics. One of these is connected to a heater as before, the other to a similar one, so that at any moment these currents traverse the heaters in opposite directions. The voltage required to give a true indication, in the correct phase relation, is applied to the same two heaters in series. The two relative banks of thermocouples are then connected in opposition, and the resultant e.m.f. is directly proportional to the a.c. power. This method is practicable and accurate right down to zero power factor.

Adaptations of this general method can be used to give remote indication of "wattless power," power factor, or synchronism; also, of course, voltage, though usually that can be done electrostatically. The general method is covered by patent No. 119,388, of which the Cambridge & Paul Instrument Co. are the sole licensees.

E. Fawssett.

Riding Mill,
Northumberland.
February 2nd, 1921.

On Statutory Earthing: Some Criticisms.

We have read the article under the above heading in your issue of January 28th with great interest, and in the main we agree with your contributor's remarks.

As originators of the steel conduit system of electrical wiring, it has constantly been our aim to make the system as perfect as is possible for the varying conditions met with in installations, and we have always recognised the absolute necessity of the screwed system being electrically continuous throughout, so that efficient earthing can be obtained.

Your correspondent's criticism of conduit fittings and tubes having threads choked with enamel is undoubtedly justified, and is applicable to a number of the cheaper makes of conduits and conduit fittings now on the market.

General condemnation of the screwed conduit system on this account is, however, unfair and misleading, and can only indicate Mr. Lee's experience with the inferior grades of material. The invariable practice in the manufacture of Simplex conduits and conduit fittings is to cut all threads *after* enamelling; consequently they are always clean and free from enamel, and electrical continuity is assured.

With regard to the non-screwed systems of conduit wiring, it is, of course, agreed that the use of these slip systems has a somewhat limited field, but very many satisfactory installations have been carried out in slip conduit with the use of Simplex grip continuity nipples and screwed fittings. When carefully installed, this system provides perfect electrical continuity, and the continual increase in its use would appear to be a sufficient reply to your contributor's opinion that "it would not be very surprising if in the near future the further use of conduit, the chief advantage of which is that of cheapness, were abandoned."

The statement repeated above relating to "cheapness" also calls for comment. We do not think a claim has ever been formulated to the effect that the conduit system—whether socket, grip, or screwed—is relatively cheaper than other systems of wiring, at any rate, not in first cost. The advantages claimed are that complete mechanical protection is afforded to insulated conductors, safety from fire, ease of erection, and in properly designed installations, facility of inspection for repairs or alterations. Furthermore, the conduit system is the only suitable one for installations where the conductors are liable to mechanical injury, and it cannot be disputed that it has a much longer life than any other system.

The remarks and criticisms relating to earthing clips are very interesting, but we will forgo any discussion on this subject until we have read the conclusion of the article in question.

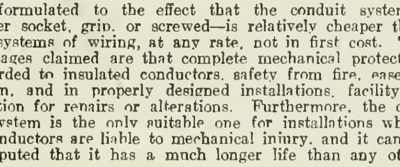
Simplex Conduits, Ltd.

Birmingham.
February 1st, 1921.

A Testing Coil for Short Circuits.

As one of your correspondents is asking for the design of a testing coil for locating short circuits in stator and rotor coils fixed in position, I wish to bring the following device to his notice.

In construction it really consists of a number of laminated plates bolted together. As shown, when it is completed it takes the shape of a pole piece of a d.c. generator. It is wound with a coil of wire having a suitable resistance for the supply voltage applied to the coil; the supply, of course, must be single-phase a.c. For exploring the stator coils, the pole pieces could be shaped as shown by the dotted lines.



A short circuit or an intermittent short circuit soon makes itself apparent by local heating.

T. D. Spark, M.I.M.E., A.M.I.E.E.

Whitehaven.
January 25th, 1921.

Pulverised Coal and Colloidal Fuel.

The short article written by "Imperial" which appears in your issue for December 24th has been forwarded to me in America.

I greatly appreciate the very fair criticism of my report and Iron and Steel Institute paper, and welcome the prominence your writer gives to this question of making full use of a system by which carbonaceous fuels can be conveniently applied and great economies effected thereby in a great many instances.

I do not refute the statement that I am an enthusiastic supporter of the general use of high- and low-grade solid fuel in pulverised form, for I have seen the success attained in this direction in America, and believe in the future of this system throughout the world, more especially in countries where coal prices have risen to such unprecedented figures, and where vast quantities of poor grade coals are available.

I must, however, take exception to the intimation that I am "biased" towards pulverised coal, *per se*, or that I favour any system or type of plant which is not the best and most efficient under the circumstances appertaining to any particular application.

In setting out upon my quest for information in 1918, I did so purely in response to a desire to find out whether there was anything in pulverised coal. I knew practically nothing of the subject at that time, and had it not been for my offer that my investigation would be carried out without expense to the country, I doubt whether I should have received facilities to visit America in March, 1918.

I hope that in the revised report, which will be available shortly, apparent inaccuracies and anomalies in the present report will be eliminated.

It was most difficult, and in cases impossible, to obtain accurate or connected data relating to actual costs of operation or running expenses, savings, &c., upon my first visit, but during the two years which have since elapsed further progress has been made, and my friends in America have supplied me with additional facts, figures, and opinions, so that in the revised edition of the Report the whole subject will be brought up-to-date.

I, myself, would like to see the information given in the Iron and Steel Institute paper incorporated in one cover with the Fuel Research Board Report, but this presumably cannot be accomplished.

In conclusion, I would thank "Imperial" for his open support of my object in giving as much authentic information as possible to the public on this most important national question, and trust that by putting on record the history and present-day practice regarding pulverised coal plant and applications, I shall have been, to some extent, instrumental in this future saving of valuable high-quality coal, considerable economy of labour and costs of metal losses, increased steam production per unit of fuel, and the utilisation of low-grade fuel deposits now unworked.

Leonard Harvey.

New York, U.S.A.
January 14th, 1921.

A Flashing Problem.

A series-interpole reversing motor flashes badly when running in one direction, but the flashing can be stopped by altering the brush position. When, however, the motor is run in the opposite direction, the flashing takes place as before.

The machine is correctly connected, and runs sparkless either on load or no load in one direction. If a motor of the above description flashed when running both clockwise and anti-clockwise, I could understand the trouble, but with the fault in question I am at present

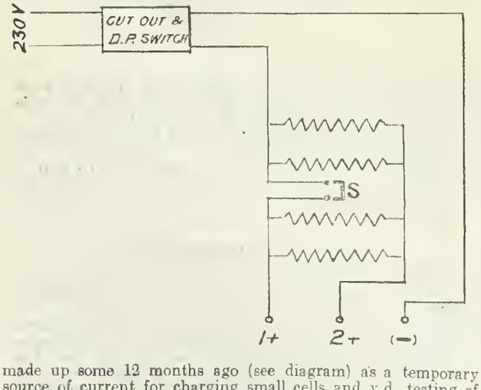
Dense.

February 5th, 1921.

Charging Batteries for Motor Cars.

Referring to Messrs. Rootes's letter of January 28th inst., I have always found it best to make up such boards myself.

Provided that energy is purchased at a low rate, the most adaptable method seems to be by independent resistances, allowing cells of the same charging rate to be charged in series, the number of separate resistances being determined by the number of charging rates required. Built up of radiator units, for instance, it could be constructed by the garage electrician in a very short time. A simple board I made up some 12 months ago (see diagram) as a temporary source of current for charging small cells and v.d. testing of armatures, &c., has proved so successful that it has not yet been replaced. Having enclosed one of the resistances in a sheet iron box, I can at the same time bake re-winds or dry out damp armatures. The resistance units in this case are 230-V Belling fire bars.



I look forward to suggestions from your readers about methods employing a motor-generator. The only one occurring to me as likely is by adapting the "C. M. B." booster, by using with auxiliary brushes on the generator half of the commutator for each voltage.

Cells in series with 1 (+) and (−) charge at 2 amperes.
,, ,, ,, ,, 2 (+) ,, (−) ,, ,, 4 ,,
,, ,, ,, ,, 2 (+) ,, (−)
with S closed ,, ,, 8 ,,

Car Lighting Electrician.

Maidstone.
January 31st, 1921.

We should be pleased to furnish Messrs. Rootes, Ltd., with particulars of our charging board for use on d.c. mains. With this board we are able to charge, say, six batteries at one time, having various charging rates, the current consumption amounting to the charging rate of the largest battery. The board is inexpensive and simple in operation.

E. & C. Gates, Ltd.,
Charles Gates,
Managing Director.

Norwich.
January 31st, 1921.

Shop Displays.

I have been much interested in reading the letters under the above heading appearing in your valuable journal during the last few weeks. The Electrical Contractors' Association is, as its name implies, an association formed for the protection of the electrical contractor. It may be of interest to some of your correspondents to know that we have as members the principal electrical contractors in every large town in this country, as for instance: Bradford (Yorkshire) 45 members, Manchester 120 members, Liverpool 60 members, Birmingham 30 members, Leicester 16 members, London 170 members, &c.

I suppose electrical shopkeepers generally are not electrical contractors, but principally shopkeepers selling electrical goods as a side line who really take the business which the electrical contractor who carries out the installation work should have.

The "Year Book" published by the Electrical Contractors' Association will give all who apply for a copy sufficient proof that the Electrical Contractors' Association is very much alive, and that but for the work it has done very many electrical contractors would not be able to carry on their businesses. We shall at all times be only too pleased to give information about membership, and what it means to the electrical contractor.

In conclusion, I may say that I have met personally hundreds of our members and have yet to find the dissatisfied ones. I can only think they exist in the imagination of one or two disappointed individuals.

W. A. Shaw,
Chairman, Propagandist Committee (E.C.A.I.).

London.
February 7th, 1921.

The Life of Metallic-filament Lamps.

We have read with interest the correspondence on the above, and while in the cases mentioned it is not stated under what conditions the lamps were burned, *i.e.*, whether bare or in fittings, it is well known that temperature, and therefore ventilation, has an enormous effect on their life.

We have found in a large number of cases that lamps are under-rated, and when used on a supply which is slightly above the normal voltage, last a very short time for this one reason only.

What appears, however, to be the general cause of lamp failure is vibration, which seems to be much more detrimental to the half-watt type lamps than to the ordinary metal filament ones, and in this connection it is now being universally recognised that the Ross patent anti-vibration disks which we are supplying in very large numbers, both for our own and other fittings, increase in many cases the life of the lamp by over 100 per cent. These disks enable even small-wattage half-watt type lamps to be used on cranes, in ships' engine rooms, for street lighting where raising and lowering gears are used, and in many cases where it is otherwise impossible for even metal filament lamps to be used.

Our experience proves very conclusively that there are few, if any, cases where it is necessary to consider carbon lamps.

For **Engineering & Lighting Equipment Co., Ltd.,**
W. Bird,
Director.

St. Albans.
February 3rd, 1921.

I have just read with interest the letter of your correspondent "J. W. H." of January 19th, and being deeply interested in lamp manufacture should appreciate a little further information of his experiences.

It is a strange thing that of the thousands of consumers of electric lamps on a large scale there should be so few who have had the unfortunate experience of "J. W. H." and "Dudlux." It is perfectly obvious that a manufacturer could not possibly keep in business if he turned out poor quality lamps, such as suggested by your correspondents; and I can only assume that by some misfortune poor lamps are being purchased.

Such adverse criticism of the performance of the modern metallic-filament lamp is an injustice to the trade, and cannot be left unchallenged. Lamps cannot be guaranteed for life individually—the reason for this should not require amplification—but average figures can be relied upon; and any consumer who has reason to believe he is not getting fair service can always, at trifling cost, call upon the National Physical Laboratory to corroborate his belief. The latter is a course which should be quite unnecessary, but one which is bound to give satisfaction one way or the other.

F. J. H.

February 7th, 1921.

A Slide-Rule Experience.

Having recently to carry out a number of volt drop calculations for cables of various sizes and capacities, I utilised the services of a Faber slide rule, pattern No. 378, fitted with dynamo and motor efficiency scales and loss of potential scales. It was with the latter that I carried out the calculations, and on completion I discovered that my results were in error to the extent of approximately 100 per cent.

To take a concrete instance, 100 yards of .06 sq. in. (nominal area) copper conductor has a resistance of .04002 ohm (C.M.A. standards), which, if carrying a direct current of 50 amperes, the volt drop $E = .04002 \times 50 = 2$ volts. Applying this to the Faber rule, taking 100 yards as 91 metres and .06 sq. in. as 38.75 sq. millimetres, the result obtained is 4.1 volts. Faber's formula in this case is:—

$$\text{Volt drop} = \frac{\text{Current in Amperes} \times \text{length in metres.}}{28.7\ \text{(copper constant)} \times \text{cross section in sq. mm.}}$$

It would seem that the result obtained under this operation is intended to give the total volt drop for lead and return, although it is distinctly stated in instructions supplied with the rule that the operation refers to a simple copper lead with direct current or alternating current free from induction.

It would be interesting to hear if any of your readers have noticed this error.

Leslie E. Toplis.

Glasgow.
February 4th, 1921.

A False Report.

Doubtless the attention of many electrical engineers will have been drawn to a case of a youth at Palmers Green found dead in his bath, and as reported in the papers, the general impression given by the head-lines and brief report is that the cause of death was, or probably was, electric shock from a portable heater.

The reports were so conflicting, and the matter is of such importance, that I have made inquiries, and although it is probably impossible to overtake the impression created in the mind of the public, I think electrical engineers should be put in possession of the facts so that they may answer anyone who raises this case in future.

At the first inquest, the medical evidence briefly was that as a small electric heater was found in the bath after the body had been removed, the presumption was electric shock, a presumption based on no technical evidence or investigation, and apparently put forward because at that time no other cause had been found. At the adjourned inquest Dr. Spilsbury, the Home Office expert, who had in the meantime been called in, stated that the cause of death was the existence of the condition known as "status lymphaticus," and he found no evidence of electric current having passed through the body. He added that this condition made sudden death possible from the slightest shock, such as fright or sudden immersion in hot or cold water. Unfortunately this use of the word "shock," which in medicine has a general meaning, was no doubt interpreted by the reporters to suggest electric shock.

No witness was able to say that the heater was in the bath before the body was lifted out, and the coroner, in summing up, pointed this out; and with reference to statements made at the first inquest about burns on the body, Dr. Spilsbury stated that these were made after death, in fact, in the effort to resuscitate by application of heat. Expert electrical evidence was given disproving the theory originally put forward.

It is evident, therefore, that Dr. Spilsbury was quite clear on the cause of death, and the fact that the predisposing cause was not equally clear does not affect the issue, which is that the suggestion of death from electric shock had no existence except as an hypothesis put forward to cover ignorance of the real cause.

Llewelyn B. Atkinson, M.I.E.E.

London.
January 31st, 1921.

The Reduction in Price of Lamps.

I should be glad if you would find space in your valued columns for a few remarks concerning the unfairness of the Electric Lamp Manufacturers' Association. Undoubtedly its members have for some time past had the intention of reducing the price of lamps to the public. This intention they no doubt kept a secret, giving no intimation to the trade, but helping retailers to pile up their stock at the old prices. And to-day, after announcing to the public the big reductions in lamps, they send out a circular letter that a $12\frac{1}{2}$ per cent. rebate will be allowed on lamps invoiced in January. This is, of course, very kind of them, but what about rebate on lamps purchased prior to January and still in stock? Not a word.

One can now understand why one of the E.L.M.A. members was offering prizes to his representatives for lamp sales up to December, 1920.

However, we must hear what the E.L.M.A., with which we have communicated, and other retailers have to say in the matter.

R. J. Scarborough,
Scarborough, Mitchell & Co.

North Finchley.
February 1st, 1921.

Electricity Supply from Surplus Sources.

The subject upon which Mr. Pain writes in your issue of the 4th inst. is one of immense importance from the point of view of coal conservation.

In spite of the great increase in the cost of coal, little effort seems to be made to further its more economical utilisation. The habit of "passing it on to the consumer" has become chronic, and all that most people can suggest is the super-station that is designed to perpetuate what Mr. Pain aptly calls the "ghastly waste involved in discarding 60 per cent. of the heat of the fuel with the cooling water." It is really about 50 per cent., but even if it is only 30 per cent. it is bad enough.

There are innumerable cases where waste heat from the power station can be used in industries, and the other way round, namely, industries requiring a large amount of heat and a small amount of power, could generate as much power as is represented by their heat requirements and feed the surplus power into the public mains.

A coal merchant was in my office yesterday chuckling over a factory recently changed from steam plant (with utilisation of exhaust steam for factory purposes) to electric power from the mains. They use live steam now, but buy from him as much coal as they did previously, and as he supplies the local power station as well, he gets the extra business represented by the power supplied to the factory—a splendid example of conservation of fuel aided and abetted by the electricity supply station!

An almost ideal example of conservation of fuel is to be found in a remote town in Essex, where a local timber works gasify their wood refuse and have installed a gas engine-driven electric plant. They generate nearly 1,000 h.p., three-fifths of which goes out of their works to light the town and supply power to other power users. Not a ton of coal is burnt, and over a period of ten years it is found that 3 lb. of this refuse produces a b.h.p.-hour, and the plant is extended nearly every year.

I know another town where the staple industry produces wood refuse in great quantities, and where, after great efforts, the local power users have been induced to install electric motors and practically give away their wood refuse. Some of the latter is burned under the boilers at the local power station. I would not quarrel with this arrangement provided the local electricity supply people had the intelligence to contract for the whole of the wood refuse and gasify it and make the best use of it, but instead of that they burn it, and use about 15 lb. per b.h.p.-hour instead of 3 lb., and use quantities of coal in addition.

In another case the local supply people use oil engines, and are, therefore, unable to burn any of the wood refuse.

I have on hand at the present time plans for what I imagine will show some rather remarkable results in thermal efficiency. The plant will consist of a steam electric power station for the manufacture of cyanamide for producing fertilisers for a group of sugar growers, whose refineries will adjoin the power station and absorb the waste steam heat, some of which will be supplied above atmospheric pressure.

Unless the steam electric station can work somewhat on these lines it is not justified, chiefly because it is a coal waster, and I maintain that a coal-wasting plant is bad engineering.

The other day a central-station engineer told me with pride that he had brought his coal consumption down to $2\frac{1}{4}$ lb. per kWh—"very near the super-station." As I had inspected a few days before a little 700-h.p. gas pumping plant working on a wretched load factor and doing a b.h.p.-hour on 0.9 lb. of coal, I could not work up much enthusiasm for his $2\frac{1}{4}$ lb. per kWh.

A. Hugh Seabrook.

London.
February 8th, 1921.

Trade with Brazil.—The new British Ambassador to Brazil, Sir John Tilley, K.C.M.G., C.B., attended the meeting of the Overseas Committee of the F.B.I., on January 27th. He solicited the views of the members of the Committee with regard to the difficulties experienced by British manufacturers trading in Brazil, and, according to the *Bulletin* of the Federation, he promised to do all in his power to encourage a closer trade relationship between that country and Great Britain, and to endeavour to secure the removal of several disabilities under which British manufacturers are at present labouring.

THE ELECTRICAL WHOLESALERS' FEDERATION.

On Wednesday, last week, at the Hotel Russell, the annual general meeting of the Federation took place, in private. At midday the proceedings were suspended for luncheon, to which the Press was invited. Mr. A. Albrecht, the chairman, presided, and in proposing the toast of "Kindred Associations," said it was the first occasion on which guests had been present. The Federation was formed in 1914 to safeguard the interests of the wholesalers' branch of the electrical industry; the factor was formerly looked upon as a parasite, but to-day it was recognised that he could give very important assistance to both manufacturer and contractor. They began by setting their house in order; their rules admitted only genuine wholesalers who carried stocks, and strict inquiries were made into the stability of new applicants for membership. All wiring interests were eliminated. They were a small body, but their numbers were increasing, and they rejected more applications for admission than they granted. They were now tackling the problems which affected other bodies also, and he offered a special welcome to Mr. Ll. B. Atkinson as representing the Cable Makers' Association; a year ago the two associations had formulated an agreement, which had worked so well that although the Federation had appointed a "Complaints Committee," it had never been called together. He also welcomed Mr. Edgcombe, of the Electric Lamp Manufacturers' Association, expressing the hope that the latter would recognise that the labourer was worthy of his hire, and that the differences between the Federation and the Association would soon be adjusted; he pointed out that recent amalgamations had been directed towards concentrating control and cheapening production, but none of them towards improving distribution—a very important consideration. To Mr. Collinson, president of the Electrical Contractors' Association, he also extended a welcome, remarking that their associations had many matters in common, and they would shortly meet to discuss them; the possibility that a consumer could buy electrical goods more cheaply than a contractor was a disgrace to the industry. In conclusion, he declared that the Federation worked in no selfish spirit, but aimed at co-operation and good fellowship and the welfare of the whole industry.

In responding, Mr. Atkinson claimed that the Institution of Electrical Engineers was now fulfilling the needs both of the industry and of electrical science. The Cable Makers' Association was equally fulfilling very useful functions to its own members and to the industry, and was a pattern of what a manufacturers' trade association should be; its relations with the Federation were most cordial, and both parties had benefited by the working of the agreement.

Mr. J. E. Edgecombe said the commercial side was the backbone of the industry, and referred to the recent reduction in price of lamps, which would greatly accelerate business. The interests of the manufacturers and the wholesalers were practically identical; the Lamp Manufacturers' Association had lately been in conference with the Federation, and was always pleased to discuss matters which concerned both sides.

Mr. Collinson emphasised the necessity of getting together and dissipating difficulties. A line should be drawn between the activities of the contractor and the wholesaler; it was largely a question of discounts, and he hoped their coming meeting would smooth away their differences. Approving of the reduction in price of lamps, he suggested that as rubber, copper, and cotton had fallen in price, the time was ripe for the cable makers to admit the buyer to a share in those reductions.

The Chairman, on behalf of the Federation, presented to Mr. A. G. Beaver, the hon. secretary, a cheque for 100 guineas as a token of their high appreciation of his indefatigable labours and ambitious schemes.

Mr. Beaver, in acknowledging the gift, said that his work for the Federation was a real pleasure, and he valued their goodwill above all else.

Mr. H. Boden, in proposing a vote of thanks to the chairman, described the Federation as a brotherhood, linking together the manufacturers and the contractors; and Mr. Albrecht, in responding, acknowledged the invaluable help afforded him by the Management Committee.

BUSINESS NOTES.

The "Trump" Electric Soldering Iron.—With reference to our description of the above new device in our last issue, it should be pointed out that the light-weight iron takes 1·5 A, or 150 W on a 100-V circuit, and not 2·7 A., or 270 W, which figures apply to the heavy-weight iron.

Company Liquidations.—Trafford Power and Light Supply (1902), Ltd.—Meeting of members will be held at 60 and 62, Spring Gardens, Manchester, on March 7th, to hear an account of the winding-up from the liquidator.

Grassington Electric Supply Co, Ltd.—Winding-up voluntarily. Liquidator, Mr. G. J. Harker, of Grassington, Shipton. A meeting of creditors is called for February 16th, at the Wilson Arms Hotel, Grassington.

Leyburn Electric Supply Co., Ltd.—A meeting of members is called for March 14th, at the registered offices of the company, Leyburn, to hear an account of the winding-up from the liquidator, Mr. F. Dobson.

Bankruptcy Proceedings.—George Wm. Lester, electrical engineer, formerly trading as Lester & Browne, at 44-6, Surbiton Road, Kingston.—A sitting of the London Bankruptcy Court was appointed to be held on February 4th, before Mr Registrar Francke, for the public examination. The receiving order was made on October 30th, upon the petition of Johnson and Phillips, Ltd., and accounts have been lodged showing total liabilities £1,903 18s. (unsecured, £1,823 18s.), and no available assets. Mr. Garton, Official Receiver, reported that the cash and goods accounts ordered on the last occasion had not yet been lodged, and the sitting was further adjourned till April 8th. Appended is a list of the principal creditors :—

Unsecured.

Johnson & Phillips	£417	Union Cable Co., Ltd.	£46
Stella Lamp Co., Ltd.	343	Wynne, G. E. L.	50
Siemens Bros., Ltd.	73	Studd & Millington, Ltd.	43
Western Electric Co.	60	"Electrical Review," Ltd.	37
Walker, E. J.	54	Northcott, W. H.	93
International Electric Co.	69	Shenton & Co., Ltd.	126
Oriental Tube Co.	73	Newman Electric Co.	38
Prior Watson & Co.	64	Belling & Co.	23
Pope's Electric Lamp Co.	53	Browne, W. F.	25
Treloar & Sons	52		

George Dolby, electrician, 39, East Marsh Street, and 129, Freeman Street, Great Grimsby.—The following are creditors in this case :—

Peadle & Co., Ltd.	£78	General Electric Co.	£49
Edison Swan Electric Co.	42	Geipel & Co., Ltd.	16
Dolby, Mrs.	750	Siemens Bros. & Co., Ltd.	33 & 154

James Sherred Denley, trading as Denley and Co., 69, Regent Street, Cheltenham, electrician and cycle dealer.—The first meeting of the creditors was held on February 3rd, at Cheltenham. The statement of affairs showed unsecured liabilities £111, while the gross amounted to £38, from which had to be deducted preferential assets claims, £20. Debtor attributed his position to want of capital, loss on contracts, bad trade, and not having a practical knowledge of the business. No resolution was passed, and the matter was left with the Official Receiver. The public examination of the debtor was held on February 3rd. The examination was closed.

J. W. Gladwin, electrical engineer, 81, Burcot Road, and 1a, Meersbrook Park Road, Sheffield.—First meeting, February 11th. Public examination, March 3rd. Both at Sheffield.

W. Drysdale, electrician, 24, Paxton Street, Barrow-in-Furness.—Trustee, Mr. H. Mossop, Ramsden Square, Barrow-in-Furness.

Dissolutions of Partnership.—Soho Electrical Works, electrical engineers, 125, Islington, Liverpool.—Mr. F. S. Ormonde and Mr. N. Silverstone have dissolved partnership. Mr. F. S. Ormonde will attend to debts.

Fennell & Forrester, electrical engineers, 48, Queen's Road, Nuneaton.—Messrs. W. W. Fennell and G. C. Forrester have dissolved partnership. Mr. Fennell will attend to debts and continue the business under the same style.

Trade Announcements.—Wright & Son, general engineers, of Edgware, Middlesex, who have been established since 1864, and are Government stampers and contractors, are now soliciting inquiries from electrical manufacturers, for pressings, components, press-tools, &c. Mr. G. G. Hazard, who is manager and secretary to the company, has been engaged in the London electrical industry since 1903, and for 10 years was London representative of Siemens Bros.

Messrs. Electrical Utilities, Ltd., have appointed the following firms to represent them :—Mr. H. H. Hopkins, of 16, John Dalton Street, Manchester (for Lancashire, Cheshire, and North Wales); Messrs. H. R. Herring & Co., of 10, Windsor Place, Cardiff (for South Wales, Monmouth, Hereford, and Gloucester).

Messrs. Johnson & Phillips, Ltd., have just opened a branch office in Bristol, at 1, Nelson Street (Telephone No. 2499), where they will carry stocks of cables, wires and accessories.

Mr. F. Husband informs us that his proposed representation of Messrs. Fillery Frères & Cie., of Paris, has fallen through, as the firm are shortly opening a department in London to give delivery from stock.

Messrs. Switchgear & Cowans, Ltd., have now removed to their new works at Elsinore Road, Old Trafford, Manchester. Telephone number: "Trafford Park 597." Telegrams: "Control, Manchester."

The Scientific Inventions Syndicate, Ltd., of 12, Tatham Road, Stonebridge Park, N.W. 10, has removed to 4, Dyer's Buildings, Holborn Bars, E.C.

Catalogues and Lists.—The Edison Swan Electric Co., Ltd., Ponders End, Middlesex.—A short circular letter notifying reductions in the prices of "Royal Ediswan" gasfilled and vacuum lamps.

List No. E.M. 206, "Massage and Radiant Heat" (28 pp.), a well-illustrated catalogue of electro-medical apparatus, including portable vibrators, Schnee baths, radiant heat baths, &c. List No. E.M. 207, "Diathermy and High Frequency" (16 pp.). This includes illustrations and descriptions of electrodes, condensation couches, and a diathermy and high-frequency attachment for use with coils of X-ray installations. Both catalogues are fully priced.

The Curtis Manufacturing Co., Conduit Place, Paddington, W. 2.—An illustrated folder giving details and prices of "Celec" "dimmers" for kinemas, &c.

Depôt Industriel Junod, Geneve-Carouge, Switzerland.—An illustrated leaflet in French, English, German, Italian, and Spanish dealing with a small table fan.

Harwol Specialties Co., 51, Oldhall Street, Liverpool.—An illustrated leaflet dealing with a very small and compact self-generating electric pocket lamp.

The Electrical Apparatus Co., Ltd., Vauxhall Works, South Lambeth Road, S.W. 8.—Leaflet H 55, illustrating and describing reversing starters for squirrel-cage motors—two and three-phase. Fully priced.

The Newman Electrical Co., 64, Newman Street, W. 1.—Four leaflets: (*a*) "Nuco" artistic opal bowl fittings; (*b*) net price-list of wood blocks; (*c*) "Nuco" alabaster bowl fittings; and (*d*) a price-list of lighting accessories, including holders, wall plugs, switches, &c.

The Stanton Ironworks Co., Ltd., Stanton-by-Dale, near Nottingham.—An illustrated folder giving details of cast-iron pipes of various sizes and types. A calendar for February is included.

The Midland Electric Manufacturing Co., Ltd., Barford Street, Birmingham.—"The M.E.M. Message"—an interesting booklet describing the methods of design, manufacture, and sale of ironclad switch and fuse gear by the firm. Views of the offices and factory appear, as well as illustrations of the switchgear manufactured.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C. 2.—List No. 323, giving details of reduced prices for various types of vacuum and gasfilled lamps. Also a leaflet (No. 322) illustrating "Sunco" British porcelain, one, two, and three-way connectors.

Messrs. Rayner & Heald, Ltd., Duke Street, Derby.—A fully-illustrated list (16 pp.) giving details of two- and three-phase induction motors with rotor starters and control gear.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Leaflets Nos. O S 2,370 and 2,385, also a small folder giving the revised prices for G.E.C. "Osram" vacuum and gasfilled lamps. Leaflet No. F I 2,462, dealing with "Benjamin R-L-M" standard dispersive reflectors; illustrated and priced. Leaflet No. F 2,480, containing a special offer (to the trade only) of electric light fittings and accessories at reduced prices during the month of February only. The list includes bowl fittings, electroliers, shades, table standards, and lanterns.

Section E (2), illustrating and describing small transformers and auto-transformers, single and three-phase, oil and air-cooled; prices are given. Section P (6), dealing with large single- and three-phase transformers, giving illustrations and dimensioned drawings.

Messrs. Sagar-Richards, Ltd., Woodbottom Works, Luddendenfoot, Yorks.—An illustrated booklet giving particulars of "Emcos" electrical mercurial cut-outs.

Messrs. Simpson, Baker & Co., 4, St. Augustine's Place, Tramway Centre, Bristol.—Stock list (24 pp.) and net price list (8 pp.) of electrical accessories, including switches, cut-outs, holders, wires, &c.

Messrs. Dieny & Lucas, 329, High Holborn, W.C. 1.—An illustrated pamphlet giving particulars of "Adhex" patent belting, and a reprint from *The Engineer* on the same subject.

Messrs. W. H. Pease & Co., 8, Southampton Row, W.C. 2 (agents for William Foster & Co, Ltd.).—An illustrated leaflet advertising Foster steam wagons.

Messrs. Jones & Pordes, 8, Crawford Passage, Farringdon Road, E.C. 1.—A letter announcing that a complete bell set has been placed on the market. The sets include bell, battery, leads, and fittings.

The British Aluminium Co., Ltd., 109, Queen Victoria Street, E.C. 4.—An interesting little booklet giving illustrations of a number of applications of aluminium to automobile construction, electric transmission systems, domestic utensils &c.

The Bell Electrical Co. (Northern), Ltd., Palatine Chambers, Market Street, Halifax,—A leaflet dealing with "Emcos" mercury cut-outs with hardwood cases. Priced.

Development of Trade with China.—*The Times* mentions the formation of a chartered corporation to develop British trade with China. It is not intended to call for subscriptions from the public at the present time. British manufacturers, however, are to be given the opportunity of subscribing for founders' shares, with which capital the business of the corporation will be commenced. Afterwards, when the affairs of the corporation have been placed on a sound footing as a going concern, the public, both in China and Great Britain, will be invited to subscribe for ordinary shares. One of the principal features of the corporation will be equal opportunities for all representative Chinese and British manufacturing and trading concerns either in the direction of obtaining from the corporation technical and financial assistance for setting up works and factories of all kinds in China or as to the best means for the disposal of British home-made products in the markets of China. The formation of the corporation has been largely due to the efforts of Major Nathan (of the Kailan Mining Administration) and Mr. H. E. Metcalf, of Messrs. Babcock & Wilcox.

Book Notices.—The Cambridge University Press hopes to publish by next October the first of a series of monographs on recent developments of physics, which shall serve as supplements to Dr. N. R. Campbell's "Modern Electrical Theory." It is difficult to keep such a book abreast of the times by means of new editions; accordingly, the plan is proposed of issuing monographs, each corresponding roughly to a chapter of the book, the collection of which will in due course replace the book. The monographs will be edited by Dr. Campbell, but he will not write all of them. The authors will not be, however, experts in the branches of physics concerned, for it is felt that a critical survey of a subject, such as is appropriate to a text-book, is more easily adopted by those who have not made important contributions towards it. The first three monographs of the series will deal with Spectra, the Quantum Theory of Energy, and the Constitution of Atoms and Molecules.

"The Electrical Power Engineer." Vol. II., Nos. 6, December, 1920, and 7, January, 1921. Price 4d. The December number includes, among many other interesting items, the "Colchester" award and reports of proceedings at the branches of the E.P.E.A. The January issue is particularly interesting, as it deals with the "crisis" which occurred in connection with the award of the National Joint Board. "Poeticus" contributes an amusing skit on the ways of local Councils in dealing with such matters.

Scientific Paper of the U.S. Bureau of Standards, No. 405, "A Simple Portable Instrument for the Absolute Measurement of Reflection and Transmission." (6 pp.) Washington: Government Printing Office. Price 5 cents.—In the instrument described, a small integrating sphere, with a small segment cut off, has been adapted for attachment to a portable photometer. The opening in the sphere is placed over the surface to be tested, so that the latter completes the surface of the sphere.

Technologic Papers of the U.S. Bureau of Standards. No. 173, "Tests of Bond Resistance between Concrete and Steel" (pp. 66, 85 figs.). Price 25 cents. No. 179, "Electric Arc Welding of Steel: I. Properties of the Arc-Fused Metal," (pp. 63, 28 figs.) Price 15 cents. Washington: Government Printing Office.—The latter paper is a record of experiments for determining the mechanical properties of the fused metal, and the structure has been microscopically examined and photographed.

"The Transactions of the South African Institute of Electrical Engineers," Vol. IX, Part 12, December, 1920. Price 2s.—This issue contains a paper on "Power Interference on Telephone Circuits," illustrated by diagrams, together with a discussion. Also a discussion on a paper on "Small Suction Gas Plants," which appeared in the August journal.

"Industrial Gases." Vol. I, No. 6. December, 1920. (32 pp.).—This issue contains a number of articles and notes on oxy-acetylene welding, production of helium in the U.S.A., synthetic manufacture of ammonia, &c.

"The Faraday House *Journal*." Vol. IX, No. 2.—This issue contains a portrait and obituary notice of the late Mr. Francis Ince, a Governor of Faraday House, and articles on "Insulation Resistance of House Wiring," "The Peebles-La Cour Motor Converter," &c.

"Elements of the Mathematical Theory of Electricity and Magnetism." By Sir J. J. Thomson, Fifth Edition. Pp. 410. Figs. 136. Price 25s. net.

"The Dynamical Theory of Gases." By J. H. Jeans. Third Edition. Pp. vii + 442. Price 30s. net. Cambridge: University Press.

"Engineering Abstracts." New Series. No. 6. January, 1921. London: The Institution of Civil Engineers.

"Foreign Trade Tables." By A. J. Lawson. London: Thos. Skinner & Co. Price 21s. net.

Norwegian Industry.—According to a Norwegian contemporary, a decided decline has taken place in the situation of Norwegian electrical manufacturing works, and many of them have been compelled to introduce restrictions in working. Foreign competition, particularly from Germany, is very perceptible, and it is submitted that steps must be taken to prevent it from getting the upper hand. Installation firms hope to have a good time this winter, but they regard the future with some concern.

Bristol Electrical Contractors' Dinner.—On January 31st the Bristol Branch of the National Federated Electrical Association held a dinner and social evening. The chair was taken by Mr. W. B. Williams, chairman of the branch. The chairman alluded to the powers possessed by the Bristol Corporation to carry on retail trade with regard to electrical work. He felt that the Corporation should not retain those powers. If the Bristol contractors were united into one body, he thought they would get the Corporation to relinquish such trading, not, of course, by force, but by agreement. Another matter they wished remedied, was wholesale houses supplying customers and allowing them discount; and some changes were also desirable in the matter of estimates, which often involved a contractor in considerable expense for nothing. The only way by which they could get matters improved was by organisation, and by getting every contractor interested in the Association. Mr. A. C. McWhirter (Cardiff) spoke of a number of difficulties concerning contractors which had been removed in Cardiff through organisation. Mr. W. A. Shaw (Stockport), chairman of the F.E.A. Propaganda Committee, followed with an address. Mr. L. G. Tate (London), general secretary, N.F.E.A., mentioned that a deputation of the Incorporated Municipal Electrical Association and a deputation of the Council of his Association were to meet shortly to see if some kind of agreement could be drawn up whereby the municipal engineers would not tread on the corns of the contractors, and the latter would do all they could to assist the sale of the "juice." The question of registration was being put before the Electricity Commissioners.

British and German Magnetos.—Lecturing at the Motor Show in Glasgow on "Magnetos for Internal Combustion Engines," Mr. A. P. Young, M.I.E.E., pointed out that British designers had improved on the design of the German Bosch Co, both electrically and mechanically. Unless the promised Government protection of the magneto industry as a "key" industry was forthcoming, the lecturer stated that in his opinion the British industry would perish. At the present moment German magnetos were coming freely into this country, and on account of the favourable rate of exchange, the Bosch Co. was able to sell at prices less than the cost of materials used in a corresponding British resign.

Calendar.—The City Electrical Co., 1, Emerald Street, London, W.C. 1, has sent us one of its large art calendars, which will quite worthily adorn our walls during the remainder of 1921, and possibly thereafter, by reason of what is described to us as the "guileless innocence" of "Our Lady Artist" (by M. Hervé), the subject of the picture.

Continental Competitive Prices.—The following letter from an importer at Madeira appeared in *The Times*, under the title "Prices and Unemployment":—

"In the ordinary course of business I had to buy 50 tons of quicklime and 10 tons of hoop iron. I received the following prices from England and Belgium:—Hoop iron, f.o.b. Antwerp, £19 10s. per ton; Liverpool, £28 5s. per ton; lime, f.o.b. Antwerp, £4 per ton; Liverpool, £6 17s. 6d. per ton. The difference in price against the British manufacturer was 47 per cent. and 70 per cent. respectively. Naturally, orders went to Belgium. Should such vast differences continue, exports from Great Britain must decrease and unemployment increase. Harry Hinton."

United States Exports.—Attention is drawn by a special correspondent of *The Times Trade Supplement* in New York to the Foreign Trade Financing Corporation, which is being organised by a Committee under the auspices of the American Bankers' Association, U.S. Chamber of Commerce, and the National Foreign Trade Council. Its purpose is to enable foreigners to buy American products by financing exportation. The corporation is to have a capital stock of $100,000,000 and powers to issue debentures up to $1,000,000,000. Producers cannot sell on a long-term payment basis, and Europe, the principal market, cannot buy on a short-term basis. The Corporation will, therefore, provide for the extension of credit, but only "to countries where there is a stable Government and where there is an assurance of intelligent purpose." A campaign of education on the value and responsibilities of foreign trade will be inaugurated through every possible channel.

For Sale.—By direction of the Disposal Board, Ministry of Munitions, Messrs. Edwards, Son & Bigwood will sell by auction on February 24th and 25th at H.M. Cartridge Factory No. 3, Blackpole, near Worcester, a quantity of machine tools, electrical and other plant; Assets Auctions Co., Ltd., will sell by auction at Shepherd's Bush, on February 15th, a quantity of electrical goods and stores. For particulars, see our advertisement pages to-day.

Foreign Trade.—January Figures.—The following are the values of imports and exports of electrical goods and machinery in January:—

	January, 1921. £.	*Inc. or dec.* £
Imports.		
Electrical goods, &c.	242.643	+ 164,774
Machinery	1,559,615	+ 45.939
Electrical machinery	111,001	+ 2,000
Exports.		
Electrical goods, &c.	1.294,898	+ 604,504
Machinery	8,060,264	+ 4,326.890
Electrical machinery	445,132	+ 271,206
Re-exports.		
Electrical goods, &c.	30.498	+ 18,896
Machinery	133.432	+ 52,410
Electrical machinery	8,600	+ 6,680

Ediswan Girl Footballers.—The Girls' Football Team of the Ediswan Electric Co., Ltd., played their first away match on February 3rd, their opponents being a team of girls from J. Lyons and Co., Ltd. Although defeated by 5—0, the Ediswan girls were not disgraced, the general run of the play being in their favour. Future fixtures include matches with girls' teams from Eley's, the G.E.C., &c.

Industrial Efficiency.—A number of conferences, in some of which the Industrial League and Council has co-operated with the Higher Production Council. are to be held in connection with the *Daily Mail* Efficiency Exhibition at Olympia. The subjects include:—February 12th, "Commercial Education"; February 14th, "Fatigue Elimination"; February 21st, "Scientific Management"; February 22nd. "Industrial Co-operation"; February 23rd, "Production and Unemployment."

Franco-American Enterprise in Spain.—It is announced that the French Thomson-Houston Co., in conjunction with the United States General Electric Co., is forming the Société Iberique de Constructions Electriques of Bilbao, with a share capital of 20,000,000 pesetas, for the construction of electrical apparatus. One-third of the capital is to be subscribed by the two founder companies.

Low-Voltage Appliances.—The Electric Heating Co., of George Street, Croydon, points out that the greater use which is now being made of small lighting sets for country houses. farms, &c., has created a demand for apparatus suitable for low voltages—30 to 60 V—common with that class of lighting. A considerable volume of business has therefore fallen to the company, owing to its having immediately set itself to cater for this business, and its "Elect" irons are eminently suited for this low-voltage work, by reason of the construction lending itself to low loading, which is important when the margin of surplus load is small. These irons are of the type which has just successfully borne the ordeal of a very severe test, and are made in mass production, 40,000 always being in stock and progress.

The Manufacture of X-Ray Apparatus.—In order to reduce costs and to increase the efficiency of their X-ray and electro-medical apparatus, Messrs. X-Rays, Ltd., have made arrangements with the Cox-Cavendish Electrical Co., Ltd., whereby all the X-ray apparatus required by the latter firm in future will be manufactured throughout at the first-mentioned firm's works at Queen's Park, W., and on the other hand, the accessory appliances and electro-medical apparatus will be made at the Cox-Cavendish Co.'s factory at Willesden. This combination of interests is expected to result in the design of X-ray outfits being considerably improved. Messrs. X-Rays, Ltd., possess a well-equipped research laboratory, and are in a position to supply transformers and coils of unique design.

Foreign Trade Catalogues.—The Exhibition Division of the Department of Overseas Trade has issued an index of foreign trade catalogues available in the Department. The collection contains 15,000 trade catalogues of German, Austrian, United States of America. Italian, Belgium, Canadian, Swiss, Danish, French, Japanese, Dutch. Polish, Swedish, Norwegian, Portuguese, Spanish, and Finnish firms. The catalogues may be examined by United Kingdom manufacturers in the library of the Foreign Samples Section at 7-11, Old Bailey, E.C. 4, or copies will be sent out on loan to manufacturers in the provinces who may desire to inspect them. During the year 1920, 6,482 catalogues were borrowed by 506 firms, the total number borrowed since the inauguration of the library being 28,000. It is hoped that the facilities provided by this library will be fully utilised by manufacturing firms in the United Kingdom.

E.D.A. Activities.—The Electrical Development Association has just published a booklet (E.D.A., 9s. 3d.), entitled "The Power Behind the Home." This illustrates and describes very fully the houses erected and equipped by the Newcastle-on-Tyne Electric Supply Co., at Billingham, Stockton-on-Tees. The photographs of the house interiors seem to radiate cleanliness in every detail, and are an admirable testimony to the health-preserving qualities of electricity in the home. The booklet also gives views of some houses erected by the Hammersmith Borough Council, where the wiring has been carried out in a very effective manner.

The Cost of Living.—"The most prevalent evil of the day is exaggeration," writes Mr. H. G. Williams, M.Sc., M.Eng., A.M.I.C.E., in the January issue of the Industrial League and Council *Journal*, in his article on the industrial situation, "and," he proceeds, "at the moment it is devoting itself to the unemployment problem. If care is not exercised by the more thoughtful members of all parties, quack remedies will be applied, which will do more harm than good." Commenting on the variation in the index figures on the cost of living, he says:—"These figures bear out the prediction I have been making during the last six months, ever since wholesale prices started to drop. Retail prices always follow (both up and down) about six months after wholesale prices. The latter have fallen one-third in the last six or seven months, but as wages have not fallen, but, on the contrary, risen, the same fall cannot be expected in the retail prices of finished goods. By May, 1921, however, retail prices should be about a fifth lower than they were on November 1st last, *i.e.*, the index number of the cost of living should then be about 220, implying a cost of living 120 per cent. above pre-war level. I venture to predict that by the end of this summer the level will have fallen to about double pre-war, and that thereafter world prices will fall slowly and steadily over probably a quarter of a century, when they may again reach pre-war levels."

With a 10d. increase in gas over a large metropolitan district, with rates increasing, and with talk of a rise in certain coal prices following de-control, one feels inclined to wait until May to see whether even the above prediction is not an exaggeration.

A B.T.H. Dinner.—On Saturday last the Switchboard Assembly Department of the British Thomson-Houston Co., Ltd., Willesden, held their first dinner and concert in the works canteen, which was transformed for the occasion. Mr. P. E. Leggett, foreman of the department, presided. Messrs. F. A. Sumpter, J. W. Pepper, and W. Ried acted as entertainment committee. The artistes were all members of the department. The toasts were as follows:—"The King," by the chairman; "The Chairman," by Mr. F. A. Sumpter; "The Visitors," by Mr. R. D. Crisp, responded to by Mr. A. W. Viney, assistant works superintendent.

German Electrical Activity in Chile.—According to *Commerce Reports* a Chilian branch of Siemens-Schuckert has received from Germany 72 tons of electrical goods. The consignment is said to be composed of appliances for household use, or for light manufacturing.

Socials.—Mr. Robson (of Robson & Coleman, electrical engineers, Newcastle-upon-Tyne) entertained his employés and their wives at the Banqueting Hall, Jesmond Dene, on Friday evening last. Guests numbering about 150 were received by Mr. and Mrs. and Miss Robson. The proceedings began with a whist drive, after which supper was served, and a concert and dance lasted until 1 a.m. Mrs. Robson presented prizes to successful whist players, after which Mr. E. L. Wilson was presented with a gold watch by Mr. Robson, on having completed 21 years with the firm; he is the third employé on the present staff to receive this token of appreciation. The M.C.'s were Messrs. A. S. Lowrey, C. McCulloch, J. Graham, and A. S. Hobson, the last-named acting as secretary.

The annual concert of the Bradford Corporation Tramwaymen's Club took place on February 2nd, at St. George's Hall.

The first social in connection with Dick, Kerr's Boys' Club was held in the Canteen Theatre, Preston, on February 3rd. The visitors included Mr. Livingstone (works manager) and Mr. Player (superintendent of the commercial staffs). Captain Faulkner (welfare master) and Captain Warburton acted as M.C.'s.

British Engineering Industry.—The January number of the *Bulletin* of the British Engineers' Association contains "Some New Year Thoughts on the Engineering Industry" from the pen of Mr. D. A. Bremner, the Director of the Association. He says that British engineering industry is bearing its share of the universal burden of trouble and anxiety, but it would be absurd to indulge doubts as to its ability to survive the ordeal. If the engineering industry cannot readjust itself to the new conditions and triumph over the difficulties left in the wake of the war, then our other industries are long past praying for. He remarks that the preservation of our great engineering industry is a vital necessity, not only for Britain's own survival as a civilised Power, but for the recovery of the world at large. The resources of the industry are essential to our national defence. "The situation may be bad, but where is it better? Relatively our position is good, and holds the promise of future favourable development beyond the hopes of most other countries." The times call for strong sanguine men with large hearts, clear brains, and big ideas. "There are many such born captains in the engineering industry, and it is high time that their trumpet call drowned the vapourings of the crazy and the croakings of the poor in spirit." It is again pointed out that the future prosperity of the engineering industry, and the welfare of all engaged in it, will depend on its ability to enter into firm contracts, to deliver the goods within a reasonable time at a price which the consumer is able and willing to pay. Recent demonstrations of his power have given us a wholesome reminder that the consumer is the final arbiter of industrial fate. "Failure to satisfy his requirements spells ruin." The same issue of the *Bulletin* contains a contribution on "Engineering Industry and Export Trade," in which there are given comparative statistics for the years 1913-1920, on the basis of equivalent values in those years.

German Machinery Prices Reduced.—A Berlin Exchange dispatch, dated February 1st, in the *Financier*, says:—"The Price Bureau of the German Electrotechnical Industry has reduced the prices of all electrical machines by 10 per cent. This is the third price cut since maximum prices were reached last year. Prices are now 30 per cent. lower than then."

The British Empire Exhibition.—The site for the British Empire Exhibition, to be held in London in 1923, with the King as patron, may be decided within the next four or five weeks. Five or six alternative centres are under consideration. The exhibition will probably cover an area of between 100 and 300 acres, and will be near one or two tube railways. The scheme initiated by Lord Strathcona in 1913 was revised shortly after the armistice, and the Government was approached by two independent organisations, the British Dominions Exhibition, Ltd., and the London Great Exhibition, which agreed in July, 1919, to amalgamate. The Government has agreed to guarantee £100,000 if other guarantees totalling not less than £500,000 are obtained.—*Evening News.*

An Electric Iron Smelter.—An electric iron smelting plant is being built in Ribeiro Preto, Province of Sao Paulo, Brazil, by the Companhia Electrica Metallurgica Brazileira. The construction will start as soon as the American contractors get their engineers on the ground. The plant will be 75 miles from the mines of iron ore in the Province of Minas Geraes.—*Iron and Steel Trades' Journal.*

Swedish Import Duties.—As a counterstroke to the recent application made to the Swedish Government by the Association of Electrical Industry for the import duties on electrical machinery to be trebled, the Economic Association of Electricity Supply Works has asked the Government not to grant the request. It is suggested that the question of the need of protection should be examined for each group of products separately, but that any increase in the duties would not be adapted to reduce the costs of production of electricity.

German Dumping in Denmark.—In spite of extensive dumping of German goods in Denmark, as the result of the low value of the mark, the Danish Government has declined to prohibit imports or take measures likely to impede a fall in prices, but has undertaken to alleviate the position by reducing railway tariffs, &c.—*The Times.*

Correction. — In the advertisement of the DIESEL ERECTION AND REPAIRS CO., LTD., appearing on p. 64 of our Advertisement Supplement in this issue, by a printer's error the word *Hand* appears instead of *Land*, in the second line.

LIGHTING AND POWER NOTES.

Ballymoney (Co. Antrim).—ELECTRICITY SCHEME COMPLETED.—An electric lighting and power scheme has just been successfully completed for the town by the Ballymoney Gas Co., a private concern, which formed another company with a capital of £10,000, the greater part of which was subscribed by inhabitants.

Belfast.—POSITION OF UNDERTAKING.—At the monthly meeting of the Corporation, Sir James Johnston, in moving the adoption of the minutes of the Electricity Committee, said that the council in committee had decided to approach Messrs. Harland and Wolff, Ltd., with a view to obtaining facilities for extending the temporary power house and the installation of additional plant to meet the requirements of the winter of 1921-22. Matters of grave importance would have to be faced. The installation of a 6,000-kW machine at the temporary station was necessary. That would cause a dead loss of between £12,000 and £15,000, but on the other hand, they would not have a breakdown in the supply. They were already committed to an expenditure of £640,000, and it was said that the increased cost of production would mean another £200,000, and there was a possibility of an additional £350,000 being needed for the requirements of 1921-22. A resolution was passed asking the Electricity Commissioners to sanction an immediate loan of £24,000.

Birkenhead. — NEW SUB-STATIONS.— The Electricity Committee has decided to proceed with the erection of electrical sub-stations at Beaufort Road and Marshall Street.

Birmingham. — FINANCIAL POSITION. — At a recent meeting of the Birmingham Chamber of Commerce, the chairman of the Corporation Electric Supply Committee (Councillor Beale) attended to explain the position of the Corporation with regard to the lack of funds for electricity works extensions. Councillor Beale stated that the whole of the lighting, small power supplies and tramways only represented 25 per cent. of the output of the electricity works, the rest was taken by manufacturers. The waiting lists of the department contained applications for supplies amounting in the aggregate to 45,000 h.p. It had been suggested by Mr. George Cadbury that as the Corporation had difficulties in raising funds, the manufacturers who required additional power should join in subscribing the necessary amount at the usual rate of interest. Mr. Beale said that if a million pounds was forthcoming, the department would be able to satisfy all demands. Some doubts were expressed by the meeting as to the probability of traders being willing to lend money to the Corporation at 6 per cent. when they could not borrow it on such low terms and they would also require a much stricter control over the funds subscribed than the Corporation was prepared to give them.

MODIFIED SCHEME SANCTIONED.—The modified scheme of extensions at the Nechells station, involving an expenditure of £170,000, has been sanctioned by the City Council.

Blackburn.—EXTENSIONS.—At a recent meeting of the Town Council, it was reported that the Electricity Committee had decided, in accordance with Sec. 2 of the Electricity Supply Act, 1919, to apply to the Electricity Commissioners for sanction to extend the new electricity generating station at Whitebirk by the provision of a second generator and auxiliary plant and buildings, as authorised by the Council.

Colchester.—PREPAYMENT METERS ABANDONED.—The Electricity Committee recommends that the use of prepayment meters on consumers' premises be abolished. It is estimated that the change can be effected in six weeks.

Cork.—WAGES DISPUTE.—Owing to a wages dispute between the Cork Electric Tramways and Lighting Co. and its employés, supplies have been seriously curtailed, and the tramways have ceased running. The Corporation has appointed a Committee to approach both sides with a view to settlement.

Darwen.—LOAN SANCTIONED.—The Electricity Commissioners have sanctioned a loan of £11,674 for the purpose of extending the electricity undertaking.

Derby.—ADDITIONAL LOAN.—A proposal of the Electricity Committee to apply for powers to borrow an additional £10,000 for extensions, was objected to on the ground that if the work was to be carried out by direct labour, this amount would not be necessary. The application was approved by a small majority.

Dover.—SUPPLY SCHEME ABANDONED.—Owing to the high cost of cables and transformers, the Town Council has decided that it cannot give a supply of electricity in bulk to the Deal Gas and Electricity Co., which had offered to accept a supply of single-phase current. A scheme of free wiring for houses on the hire-purchase system is to be drawn up for consideration.

Dublin.—ADDITIONAL LOAN.—The Electricity Supply Committee has asked the Corporation to apply for sanction to borrow £75,766 to cover over-expenditure in connection with plant extensions, which have been carried out in stages since 1918. The excess is composed of the following items:—Boilers and accessories, £7,944; 5,000-kW turbo-alternator, £25,024; North Wall tunnel, £35,000; North Wall sub-station and cables, £7,798. The main cause of the over expenditure has been the continued rise in the cost of labour and materials.

Dundalk.—Price of Energy.—Mr. Spalding, the electrical engineer, in replying to adverse criticisms on the management of the electricity undertaking, states that never since 1912 has the undertaking imposed a charge upon the rates. Although the price of gas in the town had been doubled, electricity charges had been increased only by 66 per cent.

Faversham.—Loan.—The Town Council has applied for a loan of £17,000 for additional plant, and for extensions to the electricity works.

Hereford.—Loan Sanctioned.—The Town Council has received sanction to borrow £19,857 for the purpose of extending the supply of electricity in the Leominster, Weobley, and Kington areas.

Horbury (Yorks.).—Proposed Electricity Supply.—At the District Council meeting, last week, a letter was received from the Electrical Distribution of Yorkshire, Ltd., stating that application had been made to the Electricity Commissioners for immediate consent to the company's proceeding with works for the supply of electricity under the Horbury Electric Lighting Order of 1915. The Council decided to support the application.

Ilkley.—Bulk Supply.—At a meeting of the Council, correspondence was submitted from Keighley Corporation embodying terms under which Keighley is prepared to give a bulk supply to Ilkley. The Clerk was instructed to communicate with the Electricity Commissioners upon the subject, and a deputation was appointed to meet the Commissioners.

Leeds.—Loan Sanctioned.—The Electricity Committee has received sanction to borrow a further sum of £110,000 for electricity extensions.

Lincoln.—Loan.—The Corporation is applying for sanction to an additional loan of £62,475 for electricity purposes, and at the same time the Commissioners are being asked to consider an extension of the time for repayment.

Liverpool.—Year's Working.—The accounts of the Corporation Electricity Supply Department for the year ended December 31st last, show a total revenue from all sources of £885,263, and working expenses amounting to £642,795, leaving a gross profit of £242,468. This was allocated as follows:—Interest, £82,082; sinking fund, £70,782; renewal fund, £39,604; and contribution to general rate, £50,000. The sinking fund now stands at £558,608, and the renewal fund at £2,434.

Ludlow.—Proposed Price Increase.—In connection with the Electric Light Co.'s application for permission to make increased charges, the Town Council has decided to forward a resolution to the Ministry of Transport objecting to the proposal, and lodging a complaint as to the service and lighting in the town.

Manchester. — Mains Extensions.—The Electricity Committee has approved a large number of mains extensions, at an estimated cost of £100,000.

Marsden.—Proposed Supply from Huddersfield.—At a special meeting, last week, the District Council, after hearing a deputation from Huddersfield Corporation, agreed to support the Corporation's application to the Commissioners for power to supply electricity for lighting and power to Marsden.

Newton Abbot.—Option of Purchase.—At a conference between representatives of the Torquay and Newton Abbot Councils, the question of erecting a large generating station upon a site near the Teign was again discussed. It was stated that the proposed station would cost about £200,000, and the difficulty of raising funds was emphasised. The Newton Abbot representatives stated that they were in a peculiar position. Under the agreement by which permission was given to the Urban Electric Supply Co. to serve the town, the Council had the option of purchasing the undertaking at the end of each period of seven years. The second period was now almost due. It is understood that the company requires approximately £70,000 for its undertaking.

Otley.—Electricity District.—The District Council recently complained to the Leeds Corporation against the apparent fact that the town was not included in the first extensions under the new West Riding electricity scheme prepared by the Leeds Corporation. A reply was received last week from Leeds, pointing out that the Leeds scheme dealt with generation and main transmission only, and not with distribution, and that any special facilities which Otley might have in the latter matter would not be interfered with by the scheme. The Electrical Distribution of Yorkshire, Ltd., has a provisional order for the Otley district, and the Leeds Town Clerk stated that not only will that company have a representative on the proposed electrical authority, but that there is nothing in the scheme to interfere with the Otley Council's arrangements with the company.

Palestine.—Jordan Hydro-Electric Scheme.—One of the first schemes to be taken in hand after the Palestine mandate has been registered, will be a Jordan hydro-electric enterprise which will require two millions sterling; Dr. Weizmann is proceeding to America to carry on a campaign for this object.—*Reuter.*

Rochdale. — Distribution of Bulk Supply. — The Town Council has approved of the proposed borrowing of £106,000 for the necessary plant, mains, &c connected with the distribution of the bulk supply of electricity being obtained from the Lancashire Electric Power Co. The amount is made up as follows:—Power station (plant, switchgear, and buildings), £35,458; mains extensions (conduits and feeders), £51,379; service extensions (services, transformers, and sub-station equipment), £19,307.

Tain. — Proposed Electricity Supply. — The Town Council has referred to a Committee a proposal to establish electricity works in the town.

The Grampian Scheme. — Objections. — Thirty-eight objections to the proposals of the promoters of the Grampian Electricity Supply Scheme have been lodged; the time allowed elapsed on Jan. 28th. Among the objectors are a number of local authorities, chief among which are the Glasgow, Dundee, and Perth Corporations. The list also includes the Highland and Caledonian Railway Companies, as well as a number of trustees and private individuals.

At a meeting of the Dundee Town Council, on February 3rd, a letter was read from the Hydro-Electric Development Co., the promoter of the Grampian Electricity Supply Order, to which the Council objects, suggesting an interview with its chairman, Sir Henry Babbington Smith, and it was decided, after opposition, that the whole Council should see him.

Todmorden.—Bulk Supply.—Cabling was completed last week at Mytholmroyd for the supply of electricity in bulk to the Todmorden Corporation from the Thornhill works of the Yorkshire Electric Power Co. During the week-end the installation was tested, with a view to the operation of the new supply, and the closing of the Corporation's generating plant practically immediately.

Torquay.—Arbitrator's Award.—The arbitrator's award in the dispute between the Town Council and the Tramway Co. regarding the price of power has been received. The cost at present is 1⅝d. per unit, and in consequence of the greatly increased price of coal, &c., the local authority asked for 3½d. per unit. The award allows 1d. increase per unit, or 2⅝d. up to half a million units, and after that 2½d. per unit. The award is retrospective to April last. It is based on the price of coal at 55s. per ton, and in the event of a fall in price, there is to be a revision of the charge.

United States. — Water-Power Concessions.—The *Electrical World* states that up to December 30th last, the Federal Power Commission had received applications for 137 water-power concessions, representing in the aggregate 12,901,131 h.p. net. The largest scheme is that of the Southern California Edison Co. which aims at developing 5,072,500 h.p. The Louisville Power Corporation, New York, is applying for power to develop 600,000 h.p., and there are 17 other applications for schemes above 100,000 h.p.

Walton-on-the-Naze.—Purchase of Undertaking.—The Urban District Council has entered into a provisional contract for the purchase of the electric lighting undertaking at a cost of £5,500.

West Bromwich.—Extensions.—The Electricity Committee recently submitted to the Town Council a scheme of extensions to cope with the enormously increased demand for electricity. The scheme was approved, and sanction is to be sought to a loan of £67,000.

West Ham.—Electricity for Houses.—At a recent meeting of the Town Council, the Works Committee announced that it had decided to recommend the installation of gas for lighting and heating. Councillor Thompson mentioned the recent increase in the price of gas, and moved an amendment asking the borough electrical engineer to install electricity. The amendment was carried.

Woodstock.—Supply Company Formed.—An electric light and power company has been formed for the purpose of supplying electricity to the borough, and the Corporation has leased premises to the company for an electricity works.

Worksop.—Loan.—The Town Clerk's request for the passage of a formal resolution to ask sanction to a loan of £42 214 for the carrying out of a number of electricity extensions, including the taking of a bulk supply from the Wigan Coal and Iron Co., has been granted.

TRAMWAY AND RAILWAY NOTES.

Bath.—Electric Vehicles.—A Committee appointed to report upon the question of electric vehicles for refuse collection and other purposes, states that it has visited various works, and has seen the vehicles in operation. It is thought that the substitution of these for the present horse-haulage system will result in an annual saving of about £245. The Committee, therefore, recommends that four 2-ton vehicles be purchased for the collection of refuse, and one of a similar capacity for general haulage. The amount required for the purchase of these and the provision of a garage and charging plant, &c., is estimated at £7,945, for which a loan will have to be raised with the sanction of the Ministry of Health. The matter is to receive further consideration.

Bingley.—Call for Extensions.—Bradford Tramways Committee has received a letter from the Bingley District Council, stating that the requisite widening of the main road from the present Crossflatts tramway terminus to the Bingley boundary, near Morton, has been completed, and calling upon the Bradford Corporation, which runs tramcars to Bingley, to proceed with the promised tramway extension. The letter mentions that the period allowed by the Ministry of Transport for the completion of the tramway has been extended to February 7th, 1922. The Bradford Committee has decided that "in the light of present economic conditions," the Bingley Council be asked to defer the call for the extension until conditions are more favourable.

Bradford.—Accidents.—On February 3rd two tramway accidents occurred on the Bradford Corporation system, both in dense fog. The one, in the morning, was a collision in Manningham Lane, between a car and a brewer's dray which was drawn across the track. The tramcar driver applied his brakes, but the impact was unavoidable. The driver, although seriously injured in the leg, which necessitated treatment later at the Infirmary, made use of the electric brake, which resulted in the car commencing to run backwards, but, though dazed and in pain, he had sufficient presence of mind to cut off the power, thus avoiding another probable collision with a car following behind.

The other accident, late at night, was much more serious. A car proceeding to Thackley, well laden with passengers, left the metals at the points at Five Lane Ends, and, careering from side to side of the road, it finally ran into a wall and overturned. About 30 passengers were hurt, and 10 were removed to the Infirmary. It was found necessary to detain only three. The driver of the car, though badly shaken, was not actually injured. In a subsequent interview, the motorman said he was unable to explain what threw the car off the lines, but the fog made him lose his exact bearings, and he thought he was at the top of the hill instead of being down beyond the points. The car was moving at from 8 to 10 miles an hour. Mr. T. Stirk, tramway traffic manager, declared that at the moment the accident was inexplicable, neither the fog nor the points being, apparently, sufficient to account for the happening.

Cheadle and Gatley.—Tramway Repairs.—The Council has decided to give one month's notice to the Stockport Corporation respecting repairs to the tramways in its area, in default of which the matter is to be immediately reported to the Ministry of Transport.

Doncaster.—Loan.—The Corporation is applying for sanction to borrow £12,000 for the doubling of the existing tramway track on the Balby route from Cleveland Street to beyond Balby Bridge.

Dudley.—Fare Increase.—Increased fares came into operation on the system of the Dudley, Stourbridge and District Electric Traction Co. on February 5th. Except on the lines where the 1d. minimum prevails the minimum fare for the first stage is raised from 1½d. to 2d., and the charges for some other distances are slightly increased.

Glasgow. — New Generating Plant. — The question whether the tramway department should generate its own electricity or receive it from the electricity department was recently raised at a meeting of the Corporation. The Tramway Committee submitted a proposal to purchase a new 10,000-kW turbo-generator set for the Pinkston power station, which has supplied the tramway system for 17 years in addition to selling its surplus to the electricity department. The cost of the new plant is estimated at £100,000, but the general manager of the tramways states that a supply from the electricity department would be more expensive in the long run. The installation has been sanctioned by the Electricity Commissioners, but the electricity department has suggested a five years' supply agreement as an alternative.

Huddersfield. — Uniform Tramway Time. — The new electrical clock system—by which the master clock on the tramway offices governs the whole of the clocks on the tramway system, receiving its own time daily by wireless from the Eiffel Tower—was formally inaugurated on February 3rd by the Mayor. It is expected that all the public clocks in the town will be timed by this master clock. Mr. Sellars (chairman of the Tramway Committee) said that he understood that Huddersfield was the first municipality to adopt this system of standard time.

Llandudno.—Proposed Sale of Company.—At the annual general meeting of the Great Orme Tramway Co., the chairman said that early in the year under review the Llandudno Council was approached by letter regarding the exercise of its option to purchase the system. The offer was described as a "tempting" one, but beyond a formal acknowledgment of the letter, no action was taken. The next opportunity of acquiring the undertaking would occur in 1926, but in the interval the directors of the company would not refuse to open negotiations regarding the matter.

Middleton.—Purchase of Undertaking.—The Town Council has decided to inform the Rochdale Corporation that it is not at present prepared to accede to the latter's suggestion for a meeting to discuss the purchase of the undertaking of the Middleton Electric Traction Co.

Nelson.— Purchase of Points, &c.— At a recent meeting of the Town Council, Councillor Blakey failed to secure a seconder to a reference back of the proposal to purchase new points and crossings for the tramways. He said the undertaking was already losing £15 a week, and if the wage application was granted, this would be increased to £40 a week. As prices were falling, he suggested postponing the purchase.

Newcastle-upon-Tyne.—Electric Vehicles.—A company has been formed in Newcastle under the name of Northern Electric Vehicle Services, Ltd., with a capital of £100,000, for the purpose of selling, hiring, and arranging hire-purchases of electric vehicles. Manufacture is not to be undertaken. The concern is to be run in conjunction with the Newcastle-upon-Tyne Electric Supply Co., and the charging of the batteries of the vehicles will form a useful load during slack periods. Garages and charging stations are to be established in various parts of the North-East Coast area, at which arrangements for boosting the battery charges will be made. The vehicles will be returned to a central station for charging.

North Kent.—Proposed Amalgamation.—Owing to the losses in working incurred by the municipal tramway undertakings of Erith, Dartford, and Bexley, the Ministry of Transport has proposed amalgamation of the three systems. Since a fire at the depôt in 1916 the Dartford Council has been without rolling stock, and has asked for a loan of £80,000 to reinstate the system. The three Councils concerned are being asked to send representatives to a conference on the subject.

Southport.—Electric Vehicle.—The Corporation has decided to acquire a new electrical vehicle, at a cost of £478, complete, including batteries capable of drawing a load of 9 tons at the rate of four miles an hour, for use in connection with the removal of refuse from the Marine Lake, the Lagoon site, and the development of the foreshore generally.

TELEGRAPH AND TELEPHONE NOTES.

Cable Delays.—Cable Users' Committee.—The Postmaster-General has decided to establish a permanent committee of users of the cable and wireless services to places abroad. The committee will be under the chairmanship of the Secretary of the Post Office, and will include two representatives of the Press, and one each of the London Chamber of Commerce, the Association of British Chambers of Commerce, the Stock Exchange, the Baltic Exchange, and Lloyds. The cable and wireless companies will be invited to send representatives when it may be necessary to consult them. The committee will discuss improvements in the cable and wireless services.—*Daily Mail.*

The Antwerp Chamber of Commerce has protested strongly against the seven to ten days' delay on Antwerp cables to Brazil or the Argentine, says the *Evening News*. It is plainly suggested that such cables are delayed in London, with consequent prejudice to Belgian trade interests.

Cuba.—Cable Dispute.—A Cuban Presidential Decree has been issued suspending the concession to the Western Union Cable Co. for connecting the Barbados cable with the Cuban coast. The reason given is that the Western Union Co. is alleged to have failed to fulfil a provision in the concession that the laying of the cable should be carried out under the inspection of, and in agreement with, the competent Cuban authorities.—*Reuter's Trade Service* (Havana).

Last September the Western Union Cable Co. had completed the laying of a cable from Barbados to within three miles of Miami, Florida, but the company was forbidden to land the cable there. It was announced in December that the cable would be tapped and a short length would be laid to a Cuban village near Havana, which would connect with the line to Key West, Florida.

Italy.—Wireless Telegraphy.—Direct wireless telegraphic communication between Italy and Switzerland was inaugurated on December 20th for State, private, and Press messages. A similar service was established on December 25th between Rome and Sophia (Constantinople) and Bulgaria. The service which commenced on October 15th between Triest and Subiana, in Jugo-Slavia, has been interrupted, but steps are being taken by the Jugoslavian administration to restore it. Two 1·5-kW Marconi sets have been ordered in connection with the establishment of an auxiliary telegraph service between the Italian mainland and the island of Sardinia. The equipment, we are informed, "will transmit voice messages, which are written in shorthand on reception, at an average speed of 100 words per minute."

Netherlands. — Telephonic Communication with England.—In reply to the request of the Rotterdam Chamber of Commerce that arrangements might be made for direct telephonic communication between the Netherlands and England, for the mutual commercial benefit of both parties, the Netherlands Minister of Commerce replied that the delay was caused by the action of the British Government, which was using the telephone cable for other purposes. Nor was there any immediate hope of the cable becoming available.—*The Times.*

Post Office Workers.—Strike Policy Abandoned.—The Metropolitan Districts Branch of the Union of Post Office Workers, consisting of counter, telegraph, and telephone employés, on January 2nd rescinded the strike policy decision of the last conference. The resolution stated that "the conference, realising that the Union had to choose between the abandonment of the strike policy and the loss of 40,000 or more workers, decides that it could not afford the latter alternative"

Wireless Telegraph Services.—In view of the institution of several wireless telegraph services with the Continent, auxiliary to and at the same rates as those for the ordinary cable services, the Postmaster-General notifies that he reserves the right to use these services for urgent, ordinary, or Press telegrams, except in cases where the senders mark the original forms "by wire."

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aberdare.—March 4th. Urban District Council Electricity and Tramways Department. Stores for one year, including cable, meters, lamps, &c. (See this issue.)

Aberdeen.—February 21st. Corporation Waterworks Department. Electrically-driven pumping machinery. Specifications, £5 (returnable), from Water Engineer's Office, 41½, Union Street, Aberdeen.

Australia.—MELBOURNE.—March 2nd and 9th. Victorian Railways. Reactances and condensers (for power signalling), electric crabs and equipment for cranes.*

SYDNEY.—March 21st. P.M.G.'s Department. Telephone and telegraph apparatus, testing instruments and switchboard parts, Schedule 814. (January 28th.)

PERTH, W.A.—April 5th. P.M.G.'s Department. Accumulators, &c., for Eucla, W.A. (January 28th.)

BRISBANE.—March 30th. P.M.G.'s Department. Switchboard apparatus and parts.*

Belfast. — February 26th. Tramways Committee. —Tramway stores, including electrical accessories, cable, lamps, carbon brushes, &c. (January 28th.)

Belgium. — February 17th. Municipal authorities of Schaerbeek-lez Bruxelles. Supply of three static three-phase transformers. Particulars may be obtained from, and tenders are to be sent to, the Hotel Communal, Schaerbeek, Brussels.

Buenos Aires.—March 21st. Department of Sanitary Works. Two groups of water turbines and generators with accessories, including switchboard and transformers.*

Doncaster.—February 14th. Wiring for electric lighting of 100 houses for Town Council. R. E. Ford, Housing Surveyor, 3, Priory Place, Doncaster.

Greece.—March 7th.—Municipal authorities of Rethymo. Construction of an electricity generating station in the town.

Leicester. — February 19th. Electricity Department. Two 10,000-kW, 3-phase turbo-generators, with condensing plant; also screens for straining condensing water. (February 4th.)

London.—H.M. Office of Works. February 21st. Supply of electric bell fittings for six months. (See this issue.)

Manchester.—February 15th. Tramways Committee. Tramway stores, including meters, cable, lamps, bells, insulators, &c. (January 28th.)

New Zealand. — WELLINGTON. — March 1st. Public Works Tender Board. Seven 4,000-kVA single-phase transformers, with accessories, for Lake Coleridge electric power scheme.*

March 5th. Government Railway Department. Two overhead travelling cranes.*

February 18th. Southland Electric Power Board. Bare copper, galvanised iron wire and jointing sleeves. Mr. A. W. Rodger, chairman of the Board, 51, Tavistock Square, W.C.1.

Portsmouth.—Electricity Supply Department. Three 1 500 kVA Scott connected transformer groups, 3-phase, 6,600-V switchgear. (See this issue.)

Salford. — February 14th. Tramways Committee. Twelve months' supply of miscellaneous stores. Particulars from General Manager, 32, Blackfriars Street.

South Africa. — PRETORIA.—March 10th. Municipal Council. One 20-ton overhead crane, six boilers (350-lb. working pressure), three 3,000-kW steam turbo-generators with condensing plant, five 750-kW converters. Further particulars can be obtained from Mr. T. C. Wolley-Dod, general manager, electric lighting department. Specifications (five guineas) from the town clerk.

February 16th. One 1,000-kW rotary converter with transformers and switchgear.*

May 3rd. S.A. Railways and Harbours. Plant for the electrification of the Cape Town-Simonstown and Durban and Pietermaritzburg Railways. (See this issue.)

Spain.—Tenders have lately been invited by the municipal authorities of Arroyo del Puerco (Province of Caceres) for the concession for the electric lighting of the town.

March 17th. Spanish Ministry of Public Works. For the concession for the construction and working of an electric tramway between Oviedo and Posada de Llanera. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Obras Publicas, Madrid.

April 1st. Junta de Obras del Puerto de Alicante. Electric crane of 30 tons capacity.—*Reuter's Trade Service* (Madrid).

Uruguay.—MONTE VIDEO.—March 29th. State Power House. Single and three-phase meters.*

February 21st. State Power House. Electrical accessories, including plug fuses, branching blocks, cut-outs, keys and switches.*

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Birkenhead.—Electricity Committee. Accepted :—

Supply of main cables, £3,018.—McIntosh Cable Co., Ltd.

Bradford.—Electricity Committee :—

One 800-kVA transformer.—Brush Electrical Engineering Co., Ltd.
L.p. and e.h.p. cable.—British Insulated and Helsby Cables, Ltd.
Steel staircase at Valley Road Works.—W. Walker & Co., Ltd.

London.—The English Electric and Siemens Supplies, Ltd., has received a contract from the London County Council for 100,000 metal filament electric lamps.

The tender of the same company has also been accepted by the Director of Army Contracts for metal filament lamps (vacuum and gasfilled types), covering approximately 100,000 lamps.

Manchester.—Electricity Committee recommended :—

1,000-kW motor converter for Knott Mill sub-station.—Bruce Peebles and Co., Ltd.
Steelwork for boiler house.—Sir Wm. Arrol & Co., Ltd.

New Zealand.—WELLINGTON. — Public Works Tender Board, in connection with the Waikaremoana power scheme :—

Exciter set, £12,093.—Vickers (New Zealand), Ltd.
Switchboard, £3,414.—Tolley & Son. —*Tenders.*

Warrington.—The Electricity and Tramways Committee has accepted the tender of the Anglo-Belgian Improvement Corporation for the supply of steel rails. The tender was £400 below any other. The proposal evoked sharp criticism, one councillor stating that it was known that Belgium was producing very little steel, and that much of it came from Germany through Belgium. Sir Peter Peacock, the chairman of the Committee, stated, in reply, that they were compelled to accept this tender, not only because it was cheaper, but because they could obtain delivery almost immediately, whereas other firms could give no guarantee. The sooner the rails could be delivered, the sooner could local men be set to work in laying them. On a vote being taken that the matter should be referred back for further consideration, the motion for the acceptance of the tender of the Anglo-Belgian company was accepted.

British Oil.—The production of oil at Hardstoft, Derbyshire, last year, was 2,909 barrels, or 375 tons, according to a report issued by the Government Petroleum Department on February 3rd. The total production from the well up to December 31st last was 4,575 barrels, or 590 tons. The oil was purchased by the Anglo-American Oil Co. at £22 10s. per ton. Oil in commercial quantity has been proved to exist at a depth of 3,077 ft.

Report on Railway Collision.—On November 23rd last a collision occurred between two steam locomotives, one of which was drawing a passenger train, at Fairfield Station (G.C.R.). Col. T. W. Pringle, in his report on the accident to the Ministry of Transport, states that the cause was wilful disobedience of rules and irregular conduct on the part of a signalman and a lineman's labourer. A system of track circuiting was in use, and to release a certain signal which was track-locked, the signalman asked the lineman's labourer to help him. The labourer therefore loosened the set screw, which held the cap at the bottom of the frame containing the replacer magnet, and then screwed up the cap by hand. This raised the armature and the attached rod in the same way as if it had been lifted by the magnet. The valve admitting air from the main pipe was thereby closed and the lever freed. In censuring the men responsible for the accident, Col. Pringle says: "Where a device, such as track-circuiting with electrical locking, has been installed, in order to detect vehicles which may be standing out of sight or forgotten, and to make it impossible for signalmen in such conditions to give wrong signals, there can be no justification for evasion of the rules for obtaining a release of the electrical locking . . . . It is clear that the precaution, in the way of seals, taken by the company to prevent tampering with the replacer cocks, must now be taken to prevent interference with the caps of the electro pneumatic valves."

FORTHCOMING EVENTS.

Electro-Harmonic Society.—Friday, February 11th. At the Great Hall, Cannon Street Hotel, E.C. At 8 p.m. Concert. Ladies' night.

Institute of Industrial Administration.—Friday, February 11th. At the Central Hall, Westminster. At 8 p.m. Address on "Present Day Industrial Psychology," by Sir Lynden Macassey, K.B.E., K.C.

Faraday Society and the Manchester Literary and Philosophical Society.—Friday, February 11th. At 36, George Street, Manchester. At 6.30 p.m. Lecture on "Studies in Capillarity," by Drs. A. Ferguson and P. E. Dowson.

Manchester Association of Engineers.—Friday, February 11th. Anniversary dinner.

Physical Society of London.—Friday, February 11th. At the Imperial College of Science, South Kensington, S.W. At 5.15 p.m. Discussion on "Absolute Measurements of Electrical Resistance and Instruments based on the Temperature Variation of Resistance."

Birmingham and District Electric Club.—Saturday, February 12th. At the Grand Hotel, Colmore Row. At 7 p.m. Paper on "Reminiscences of the Test Bed," by Mr. J. A. McDonald.

Institution of Post Office Electrical Engineers (London Centre).—Monday, February 14th. At 5.30 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Paper on "History of the Development of Thermionic Valves for Wireless Purposes," by Mr. F. W. Davey.

Institute of Cost and Works Accountants.—Wednesday, February 16th. At the Institute of Chartered Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Lecture on "Costing as an Aid to Management," by Mr. V. H. Minton.

Royal Society of Arts.—Wednesday, February 16th. At John Street, Adelphi, W.C. At 8 p.m. Paper on "Pneumatic Elevators in Theory and Practice," by Dr. W. Cramp.

Institution of Electrical Engineers.—Thursday, February 17th. At the Institution of Civil Engineers, Great George Street, S.W. At 6.30 p.m. Lecture on "Magnetic Susceptibility of Low Order: Instrumentation," by Prof. E. Wilson. (Lecture 1.)

Informal meeting.—Monday, February 14th, at the Institute of Patent Agents, Staple Inn Buildings, E.C. At 7 p.m. Discussion on "Some Notes on the Design of a large Power Station." To be opened by Mr. J. R. Cowie.

North-Eastern Centre.—Monday, February 14th. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Paper on "Temperature Limits of large Alternators," by Mr. G. A. Juhlin.

Association of Engineering and Shipbuilding Draughtsmen.—Thursday, February 17th. At Priory Street Higher Grade School, York. At 7.15 p.m. Paper on "Modern Boiler House Operation," by Mr. M. Cohen.

Belfast Association of Engineers.—Thursday, February 17th. At the Municipal Technical Institute. At 6 45 p.m. Paper on "The Generation and Distribution of Electrical Energy," by Mr. W. J. Girvan.

Chemical Society.—Thursday, February 17th. At Burlington House, W. At 8 p.m. Ordinary scientific meeting.

Roentgen Society.—Thursday, February 17th. At University College, Gower Street, W.C. At 8.15 p.m. General meeting.

Institution of Mechanical Engineers.—Friday, February 18th. At the Institution, Storey's Gate, S.W. At 6 p.m. Annual general meeting. Paper on "Desirability of Standardisation in the Testing of Welds," by Mr. F. M. Farmer.

Junior Institution of Engineers.—Friday, February 18th. At 89, Victoria Street, S.W. Social evening.

NOTES.

Gift to Hospital.—Messrs. Leyland Motors, Ltd., have presented Chorley Hospital with a complete electric lighting and power set, value £350, to be used in connection with X-ray work.

Recent Progress of the Metric System.—Since the war the metric system has made notable progress in many countries which have not yet officially rendered its use exclusive in trade, and a short summary of the movement has been issued by the Decimal Association in order that the trend of national executives in this matter may be noted. In view of the urgent need to expand our export trade, and of the fact that the majority of foreign countries prefer the metric units, this subject deserves careful consideration on the part of the Government, which should now abandon its attitude of passive permission of the metric units, and embark on a campaign of active encouragement.

In Greece the weights and measures laws have been re-cast, and provision has been made for the administration of the new enactment passed last November. Attempts have been made in the past to introduce the metric system, but, as in Turkey, they have not completely succeeded owing to the neglect of the administrative measures necessary to ensure uniformity.

The Chinese Government has shown its intention very clearly, and, as soon as it becomes possible, will standardise on the metric units; meanwhile, the metric system has come into exclusive use on the railways as from January 1st last.

It is reported that a Bill has been introduced in the Japanese Diet having as its object the exclusive use of the metric units, and in Siam legislation to the same effect has been passed, and is awaiting the necessary administrative measures.

A Bill has been introduced into both legislative Houses of the United States of America, with the object of making the metric units exclusively legal in commerce after a period of 10 years; this Bill has very strong support, and the prospects of its passage in the near future are very hopeful. Should it become law, it will be increasingly difficult for us to regain our position in the South American and other metric markets.

In the United Kingdom the Ordnance Survey Office announces that on all small-scale maps an alternative scale of kilometres and tenths will be printed, in addition to the scale of inches, and on all small-scale layer maps the metric heights will be added to the nearest metre.

It appears inevitable that the metric units will ultimately become the world standards of weights and measures; it is only a question of time, and the longer we delay, the more difficult and costly will be the transition.

The E.P.E.A. Award.—Several undertakings are still negotiating with the E.P.E.A. for modification of the award of the National Joint Board.

A conference between Gloucester and the Association was to be held yesterday under the auspices of the Ministry of Labour.

Burnley, Darwen, Wallasey and other North-West Midlands undertakings are also conferring in the course of a few days.

The principal objections to the award arise out of the conditions of employment. In the case of Wallasey it is proposed to defer payment until the report of a committee of inquiry into recent breakdowns is received.

Educational.—The annual examinations for a Faraday Scholarship of 50 guineas per annum, tenable for two years in college and one year in manufacturing works, and for a Maxwell Scholarship of 50 guineas per annum, tenable for one year in college and one year in works, will be held at Faraday House on April 12th, 13th and 14th. Exhibitions may also be awarded to candidates who acquit themselves creditably in the above examinations. Particulars can be obtained from the Secretary, Faraday House, 62-70, Southampton Row, London, W.C. 1.

Sir Robert Ho Tung has, according to the *Daily Mail*, given £10,000 to the Hong-Kong University for the endowment of workshops under the Faculty of Engineering.

Fatality.—A verdict of "Accidental Death" was returned at an inquest held on January 31st at Bury (Lancs.) on the body of Harold Mort (26), an electrician, of Ainsworth, near Bury, who died from injuries received while erecting an overhead wire near Bury. It was stated in the evidence that deceased probably took hold of two live wires, and the shock caused him to fall to the roadway, a distance of about 30 ft. A witness said that Mort had previously gone to switch off the current, and probably had operated the wrong switch.

The Electrical Engineers' Ball.—On Friday last, after a lapse of seven years, the Electrical Engineers' Ball was held at the Hotel Cecil. We are pleased to say that the occasion established a new record; the number present was over 480, and everyone appeared to be thoroughly satisfied with the arrangements which had been made by the Executive Committee—at any rate, not a single remark to the contrary was recorded. The music was good, the supper excellent, E.P.D. was dead—or, rather, it stood for the End of a Perfect Dance—and the only regrettable feature of the function was the fact that it would not be repeated until 12 months had elapsed. Hearty congratulations are due to all who took part in organising a "greater success than ever."

Patent Fees in Denmark.—The Minister of Commerce has introduced a Bill in the Folketing for the purpose of increasing the fees for patents. It is proposed to raise the application fees from kr. 20 to kr. 50, and the charge made when a patent is granted from kr. 10 to kr. 35.—*Reuter's Trade Service* (Copenhagen).

Helium Production.—The American Air Service has submitted estimates for the coming financial year, amounting to no less than 60 million dollars (£12,000,000 nominal), and it is proposed to spend over £370,000 on research into the production of helium. The proposed experiments are expected to result in the gas becoming a commercial product.

Appointments Vacant.—Stores and wages clerk (£180 + 25 per cent.), for the Bexley Heath tramway and electricity undertaking; assistant electrical engineer (Rs. 632 per month), for the Great Indian Peninsular Railway; assistant telegraph engineer (Rs. 600 per month), for the Bombay, Baroda and Central India Railway.—See our advertisement pages to-day.

INSTITUTION NOTES.

Institution of Electrical Engineers (Students' Section).—Arrangements for 1921: February 4th, paper on "The Selection of Prime Movers for Small and Medium Power," by Mr. R. Tait. February 18th, Presidential Address by Mr. Ll. B. Atkinson, M.I.E.E. March 4th, paper on "Telephonic Transmission through Submarine Cables," by Mr. A. Rosen. March 11th, paper on "Some Recent Developments in Machinery for Small Sub-stations," by Mr. J. A. Broughall. February 26th, Annual Dinner at Gatti's Restaurant.

Scottish Centre.—Under the auspices of this Centre, a conversazione and dance were held in the M'Lellan Galleries, Glasgow, on February 3rd. Mr. James E. Sayers, the President, received the members and their friends.

Society of Technical Engineers.—The second annual dinner of the Birmingham Branch was held at the Imperial Hotel on January 28th, when Mr. J. F. Parke, A.M.I.M.E., took the chair. Mr. T. H. Hunter, in proposing the toast of the Society, said that if the ideals and objects for which the Society was formed were carried out, it was bound to be of great benefit to its members, also to the engineering industry, and necessarily to the nation in general. He deprecated, however, most emphatically the policy of the Executive Council in the past in keeping from the public view the high principles for which they stood. Mr. William

Cranston, A.M.I.E.E., in his response, said that members should realise and keep in view the aims and ideals of the Society, as no society could become influential if these were lost sight of. Mr. Gill, Secretary of the Local Branch of the Industrial League, proposed the "Health of the Engineering Profession," and Prof. Cramp, of the Birmingham University, replied. Mr. James Anderson, A.M.I.E.E., of the Birmingham Branch Council, proposed the "Health of Kindred Societies," and alluded to the growth of protective Associations for nearly every class of what were termed "black-coated" workers, some of which had attained a very large membership. Mr. James, of the Foremen's Association, replied, and said that his Association fully recognised the necessity of close relations with the S.T.E. An enjoyable musical programme followed.

Nottingham Society of Engineers.—On Wednesday last a paper on "The Utilisation of Exhaust Steam," was read by Mr. E. G. Phillips, M.I.E.E., A.M.I.Mech.E., who gave the power engineer's point of view, and Mr. H. B. Clarke, A.M.I.E.E., who dealt with the user's point of view.

Royal Sanitary Institute—A prize of 50 guineas and the medal of the Institute has been offered for an essay on "Central Hot Water Supply and Heating, adapted to Housing Schemes." Particulars may be obtained from the Secretary, The Royal Sanitary Institute, 90, Buckingham Palace Road, London, S.W. 1.

Röntgen Society.—The joint meeting of the Society with the Institution of Electrical Engineers and the Electro-Therapeutic Section of the Royal Society of Medicine has been postponed until next autumn, when it is proposed to have a number of fresh papers for discussion.

It is hoped that a special meeting of the Society will be held at Manchester at the end of March or the beginning of April. Full particulars will be announced later.

Chelmsford Engineering Society.—On February 2nd Mr. H. S. Primrose delivered a lecture on "Testing Machines," in which methods of testing steel were fully dealt with. Mr. C. H. Ford will lecture on "Thermionic Valves" on February 17th.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the **Electrical Review** *posted as to their movements.*

An echo of the recent dispute in the Halifax Town Council as to appointments in the tramway department, as a result of which the chairman and deputy-chairman of the Tramways Committee, and the chairman of the Sub-Committee resigned, was heard in the Town Council last week, when the Council agreed to make a grant of £250 to Mr. J. D. Caird, the retiring traffic manager, who has been too ill to attend to duty for some time past, but declined to say that this matter should be reviewed again 12 months hence. In accordance with the demand of the Council, at a previous meeting, the Tramways Committee recommended that the position of general manager of the tramways should be advertised at £900 a year (although the Tramways Committee had had Mr. Galloway in mind). After some opposition, the recommendation was approved.

Swindon Town Council has increased the salary of the general manager of the electricity and tramway department (Mr. T. Metcalf) from £460 to £520 a year as from October 1st; and that of the electrical engineer (Mr. F. Newey) from £450 to £520 from the same date.

Gillingham (Kent) Town Council has increased the salary of the electrical engineer (Mr. C. D. Chalmers) to £600 from January 1st, and that of the assistant engineer to £400 from the same date.

Dover Town Council has increased the salary of the electrical engineer (Mr. Harpur) from £520 to £550 a year.

After a lengthy discussion, Halifax Town Council has decided to advance the salary of the electrical engineer from £900 per annum to £1,100.

Mr. F. H. Page, lately with the Crypto Electrical Co., Ltd., has joined Messrs. H. W. Smith & Co. (1920), Ltd., as representative in London.

The Times states that Mr. John H. B. Noble has been elected vice-chairman of Sir W. G. Armstrong, Whitworth & Co., Ltd., and Mr. Alfred H. J. Cochrane, a director of the company.

Mr. E. G. Lind, A.M.I.E.E., who for 14 years held the position of engineer and manager of the Tudor Accumulator Co., Ltd., export department, has been appointed sole agent for the Accumulatoren-Fabrik A.G., of Hagen, and has opened an office at 48a Buckingham Palace Road, Westminster, S.W.

Messrs. Dolby & Williamson, consulting engineers of Westminster, S.W. 1, have taken into partnership Mr. H. McK. Kirkby, A.M.I.E.E., who was intimately associated with the firm as principal assistant for many years prior to the war. At the outbreak of war he was manager of the installation testing department of Messrs. Drake & Gorham, Ltd., and was overseas on active service from September, 1914, until February, 1920.

Obituary.—Mr. T. E. Lindley.—The death has taken place of Mr. Thomas Edwin Lindley, electric installation foreman at the Ipswich Corporation electricity works for the past 12 years, and formerly on the Doncaster Corporation tramway staff.

Will.—Mr. Edward Dewhirst, electrical engineer, of Fulwood, Preston, left £20,945 gross, £7,963 net personalty.

CITY NOTES.

Melbourne Electric Supply Co., Ltd.

Mr. Joseph Bevan Braithwaite, M.I.E.E., the chairman of the company, presided on Monday last at the twenty-first annual general meeting of the shareholders of the Melbourne Electric Supply Co., Ltd., held at Winchester House, Old Broad Street, E.C., and in moving the adoption of the report and accounts said the year under review had been one of the most difficult ones the directors had ever had to deal with in connection with the company. That was due to a variety of causes, not the least of which were the strikes with which the directors had had to contend. The principal strike was that of the marine engineers in January last year. That affected the coal supply, and the Australian Coal Board introduced restrictions which operated, as far as certain factors were concerned, for about one month. Then, for the first time in the history of the company for twenty years, their own engine drivers and firemen were forced to come out in support of a general strike of engine drivers throughout the Commonwealth. With regard to the drought, that was luckily not very severe in the southern portion of Victoria, and the latest reports told them that it was expected that the wheat crop this year would be a record one, bringing into Australia many millions of pounds beyond the record of anything previously done. The shortage of plant had been due to the delay in delivery, delay in shipping, and various things of that kind, and they had had rather a job to deal with their rapidly increasing demands for their supplies, but he was glad to tell them that the directors had recently concluded arrangements with the Victorian Railway Commissioners to take a supply of 10,000 kW for their power house. That was a good thing with regard to the cost of the generating plant, and cemented their relations with the State authorities. The first 5,000 kW of the supply would be available very shortly, and the remaining 5,000 kW would be available later on. He proceeded to deal with the figures in the accounts, and with regard to the profit and loss account, said he thought that these accounts showed very satisfactory results under adverse circumstances. Their profit had risen in Melbourne from £167,072 to £205,357, an increase of £38,000 in round figures, or equal to 22¾ per cent. In view of all the circumstances, he thought that was extremely satisfactory. At Geelong the profits had increased from £13,087 to £16,030, which was about the proportional increase, and they were expecting a bigger increase at Geelong when the additional plant they were now putting down for the purpose of supplying industrial power in that neighbourhood was in operation. The Geelong tramways especially had justified themselves, and had carried 1,700,000 passengers, which, for a small town like Geelong, was a very remarkable thing. That showed an increase of 37½ per cent. on the previous year. The growth of the business was perhaps more easily reflected to the minds of shareholders by a comparison of the number of consumers the company had and the number put on during the year. Last year he told them that they had 5,560 new consumers, which constituted a record, but during the past year the company had 9,245 additional consumers, an advance of 66 per cent. on the previous year. Cable advices from Melbourne gave the information that from September to December the new services had averaged over 10,000 a year, which was a phenomenal rate of increase, and that that rate was being fully maintained. These increases had taken place not only in providing ordinary light, but in providing industrial power. During the year they had had to increase the industrial power by 361 h.p., and the total amount of the industrial h.p. was now 30,600. There was an increase of 27 per cent. in the amount of coal used, and the efficiency of the coal was slightly improved, during the year, so that if it had not been for coal strikes, the results would have been considerably better. They had got a very live undertaking, and in spite of difficulties the results of the past financial year were extremely satisfactory, and fully justified the increased capital which the directors had put into the business. As a matter of fact, he considered that the results fully justified the increased capital which it was proposed to raise, and put into the business in the coming year. If they would look at the Melbourne accounts they would see how the revenue was arrived at. By private supply they obtained £204,689, as against £165,688 last year, so that there was an increase there of £39,000 in round figures. In power, heating, &c., the figure stood at £114,485, as against £84,376, so that they would see that there was a very substantial increase there. On the public supply the amount stood at £12,475 for lighting, against £12,408, and in the supply to municipal tramways they had £56,436, against £50,971. The supply to municipal tramways was £56,436, against £50,971. The bulk supply amounted to £13,059, instead of £9,848, a very important increase on that item. The meter rents amounted to £17,773, and, of course, reflected the increase in the number of customers. The total revenue was £420,645, against £339,120, and the increase was, in round figures, about £80,000, half of which was derived from private trading.

At extraordinary meetings which were subsequently held, the proposals of the directors with regard to the increase in capital, &c., were unanimously adopted.

London Underground Railways.

Metropolitan District Railway Co.—Final dividend on the 5 per cent. second preference stock of 1¾ per cent., making a total of 3 per cent. for 1920. £20,537 carried forward.

London Electric Railway Co.—Final dividend on the 4 per cent. preference stock of 2 per cent., making a total of 4 per cent. for the year 1920. Final dividend of 1 per cent. on the ordinary, making 1⅛ per cent. for the year. Carried forward £22,350.

City & South London Railway Co.—Final dividend on the consolidated ordinary stock of 1¼ per cent., making a total of 1½ per cent. for 1920. £13,820 carried forward.

Central London Railway Co.—Final dividend on the undivided ordinary stock of 2 per cent., making 2¼ per cent. for 1920. Final of 3½ per cent. on the preferred ordinary stock. making 4 per cent. for 1920. A dividend for the year 1920 of ½ per cent. on the deferred ordinary stock. £15,160 carried forward.

Underground Electric Railways Co., of London, Ltd.—Subject to final audit, the revenue will enable the company to pay the full interest to December, 1920, on the 6 per cent. first cumulative income debenture stock, and to pay interest at the rate of 2 per cent., free of tax, on the 6 per cent. income bonds of 1948, for the half-year ended December, 1920. Carried forward £20,236.

Metropolitan Railway Co.—Total net income for 1920 £674,504, plus £19,864 brought forward. Interest rentals and other fixed charges and appropriation to renewals require £328,245; preference dividend £239,107; final dividend at the rate of £2 per cent. per annum on the ordinary stock, making 30s. per cent. for the year. To general renewals £50,000 is put, against £40,000 for 1919. Carried forward £15,416. The future position of the railway in its relation to the London group, suggested in the scheme of the Ministry of Transport, is receiving the consideration of the board. The increase in revenue which has so far resulted from the revisions in fares is considered satisfactory. The large additions to the rolling stock have relieved the congestion of traffic during the rush hours. Four steam locomotives of a powerful type and seven new trains of six coaches each have been placed in service. Of the new cars ordered for the electric service, twelve have been delivered, and others will be available shortly. The re-equipment of the existing electric locomotives with higher-powered motors is being gradually effected. Arrangements for augmenting and improving the generating plant at Neasden are proceeding favourably, and when completed, these and other works in hand will amply provide for a substantial development of the company's business.

Sunderland District Electric Tramways, Ltd.

In presenting the directors' report at the annual general meeting held in London on February 1st, Mr. H. B. Hogg, the chairman, said that permission to raise charges had not been received until August last, when the cost of material had increased many times, and successive arbitrations were steadily increasing employés' wages. Wages of motormen and conductors alone had cost the company £4,800 more than in the last period. The work of enlarging and improving rolling stock, sheds, and workshops had been proceeded with, and many improvements had been effected. The track had been considerably improved although renewals of a permanent nature had been found impossible of execution. Work was to be commenced on the cables at the earliest possible moment. Owing to the arrears of repairs caused by the war period it would be necessary to spread the carrying out of the work over several years. The outlook as regarded steel and copper was more cheerful as prices were gradually tending towards normal levels. There was a slight reduction in the number of passengers carried during the year—7,611,000, although the gross receipts had increased owing to the increased fares. The investment securities of the company had decreased in value during the year, and it had been necessary to write off £1,800 to bring them to a realisable value. The speaker, referring to the tramway employés' claim for an additional 12s. per week, considered that the limit had already been reached with regard to the amount of wage payments the industry was able to bear. If further demands were conceded tramways would cease to exist, and another form of transport would have to be substituted. The report and balance sheet were adopted, and the retiring directors and auditors were re-elected.

Denmark.—A message from Aarhus says that the board of directors of Aktieselskabet Jydsk Electro has decided to propose a dividend of 16 per cent. for the year 1920, after writing off about kr. 100,000 on buildings and machinery.—*Reuter's Trade Service* (Copenhagen).

Sweden.—*Elektriska Pannrenening Aktiebolaget* (Electric Boiler-cleaning Company) realised during the past financial year a net profit of Kr. 62,150 on a capital of Kr. 100,000, compared with Kr. 93,300 for the previous twelve months. The directors propose a dividend of 20 per cent. as before.—*Reuter's Trade Service*, Stockholm.

Aktiebolaget Membra, the electric apparatus manufacturing company at Stockholm, has decided to increase its share capital from Kr. 150,000 to Kr. 450,000 by the issue of 3,000 new shares.

Hong-Kong Tramway Co., Ltd.—The profits for 1920, subject to audit, amounted to £86,295, which, added to amount brought forward, makes £93,411. The directors have transferred £50,000 to contingent liability account, and recommend a final dividend of 1s. 3d. per share, making 2s. for the year, carrying forward £10,911. Income tax will be deducted from the dividend paid to shareholders on the London register.—*Financial Times.*

Reduction of Capital.—Sevenoaks & District Electricity Co., Ltd.—A petition for confirming a resolution reducing the capital of the company from £40,000 to £29,948 has been presented to the High Court, and will be heard on February 22nd.

Central Electric Supply Co.—For 1920 there is a profit of £8 after putting £29,513 to depreciation.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets have been a little lightened by the announcement with regard to the forthcoming abandonment of Excess Profits Duty, and the fact that a definite term is set to its duration. There was at first a general rise in most of the industrial markets. As, however, this was not backed up by any great amount of increased business, a halt was called to the improvement. Nevertheless, the fears which anticipated the Budget are to a large extent dissipated by the Chancellor's declaration that he intends to substitute no other tax in place of the Excess Profits Duty. In the prices with which we deal in this column there is not much change as a result of the Excess Profits Duty announcement, but the relief felt in business circles is reflected in a more cheerful tone that touches electricity issues as well as others connected with trade undertakings.

Particulars are published of an ambitious scheme which seeks to incorporate a company for the purpose of constructing works for generating electricity by means of power afforded by water from lochs, rivers, streams and gathering grounds in the neighbourhood of the Grampian Hills. The capital of the company is proposed to be a million pounds, which may be increased to four million pounds with the sanction of the Board of Trade. We seem to have heard of the scheme before, and are under the impression that it was war conditions which held up its prosecution. There will be a good deal of interest attaching to its inception and progress.

Home Railway dividends in the Underground group did not make a particularly good showing. London Electric ordinary shares receive 1⅛ per cent., for the full year and City and South London 1½ per cent., both showing declines of ½ per cent. as compared with 1919. London General Omnibus Company pays 5 per cent. free of tax, as against 7 per cent. for 1919, and the Underground Electric Income Bonds get 2 per cent. free of tax as against 4 per cent. for the previous twelve months. The dividend on District 5 per cent. second preference stock comes down from 4 per cent. to 3 per cent. The carry-forward is reduced in every case, with the exception of the Central London Company, where, however, the dividend of ½ per cent. on the deferred is 2½ per cent. less than that paid for 1919. The London Electric Railway Company increases its carry-forward by £1,400. As the market was going for no more than 1 per cent. on Underground Electric Income Bonds, the announcement of 2 per cent. caused a rise of 2 points in the bonds, and had the effect of stiffening the price of the £10 shares; the "A" shares are sixpence easier at 5s. 6d. Districts put on 10s. to 16. Metropolitan ordinary is lower at 21½. The Home Railway market is flat on the statement of earnings published this week by the Ministry of Transport.

Amongst electricity supply shares, City of London at 24s. 3d. are again a little better, following upon their improvement of last week, and Metropolitan regained the 2s. 6d. which was then lost. South Londons rose ⅛ to 2⅝, and business has been marked in the shares at 55s. It gives a pretty clear indication of the narrowness of the market in electric lighting shares to remark that this improvement of 2s. 6d. came about as a result of three deals, which involved the bagatelle of 25 shares altogether. Edison-Swans have gone back to 12s., and manufacturing shares as a whole have received no quotable benefit up to the present from the E.P.D. announcement by the Chancellor of the Exchequer. The Central Electric Supply Company's accounts show a profit of eight pounds for last year. This is added to the amount brought forward, doubling the latter, and £16 goes forward to the new year. The company transfers £29,500 to depreciation.

Melbourne preference rose to 4¾, evidently with the intention of making a better setting for the proposed issue of new shares at this price. More attention is being paid to Mexicans, on account of the expectation that a loan will be arranged immediately, through the medium of Messrs. J. P. Morgan & Co., from the United States to Mexico. This has brought about big rises in the prices of Mexican Government bonds, though the improvement has hardly got round to the utility issues. Mexican Light and Power first mortgage at 63½, showing a rise of a point, are the only bonds that have advanced up to the present. Amongst Argentines, Buenos Aires Lacroze debentures improved to 54½, and Anglo-Argentine Tramways 5 per cent. debenture stock is again a point to the good at 59½.

As usual, the telegraph and telephone list makes the best showing in our lists. Eastern ordinary we quote at 159½, but buyers would probably have to pay more than 160. The new shares are 31s. Eastern Extensions and Globes are nominally ¼ down at 15½, although actually there is very little stock in the market. Eastern Extension new shares are quoted 15⅜ and Western new shares are 15⅜, the old in the latter concern having risen to £16. Henley's are scarcely so good at 28s. 6d., but the new have hardened to 1s. premium bid, and it is evident that holders of the former have been exchanging into the latter, there being a small turn to be made by so doing. Babcock & Wilcox advanced to 2¼, in company with the shares of most of the engineering, coal, iron and steel companies, these being expected to obtain substantial advantage from removal of E.P.D. The armament group is quiet, and people in the North who are in a position to know what is going on, speak none too hopefully of the prospects of the armament companies. Rubber shares are heavy and dull. There is no particular rally in the price of the produce. Stocks of rubber on hand continue to pile up at a rate which alarms those who observe how retail is the demand for raw rubber from America and other big customers.

Marconis have been up to £2, but subsided to 1 15/16. Canadian Marconis eased off to 7s. 9d., and there is nothing doing in Radios. Inquiries arise as to when the first dividend may be expected on Radio preferred, and, although some look for a distribution next month, nothing official has been announced on the point.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1918.	Dividend 1919.	Price Feb. 8, 1921.	Rise or fall.	Yield p.c.
Brompton Ordinary..	8	12	5⅞	—	£10 4 4
Charing Cross Ordinary	4	7	4	—	8 15 0
do. do. do. 4½ Pref. ..	4½	4½	2¾	—	8 8 8
Chelsea..	8	4	8⅛	—	8 6 0
City of London	8	10	24/3	+ 6d.	8 5 4
do. do. 6 per cent. Pref. ..	6	8	17/6	—	8 17 2
County of London	7	8	7½	—	10 18 4
do. do. 6 per cent. Pref.	6	8	7¾	—	7 16 0
Kensington Ordinary	6	7	8¼	—	9 0 6
London Electric	Nil	2½	¼	—	10 0 0
do. do. 6 per cent. Pref...	8	5	2¾	—	10 18 2
Metropolitan..	5	6	2⅞	+ ⅛	10 8 8
do. 4½ per cent. Pref. ..	4½	4½	2 9/16	—	8 16 8
St. James' and Pall Mall	10	12	8¼	—	8 12 0
South London	5	8	2⅝	+ ⅛	9 9 10
South Metropolitan Pref.	7	7	18/9	—	10 8 8
Westminster Ordinary	8	10	6½	—	9 10 6

Telegraphs and Telephones.

	Dividend 1918.	Dividend 1919.	Price Feb. 8, 1921.	Rise or fall.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	81½	+2	7 7 8
do. Def.	88/6	1½	16⅜	+ ½	9 6 6
Chile Telephone	8	6	5¾	—	*5 4 4
Cuba Sub. Ord.	7	7	6¼	—	*10 16 4
Eastern Extension		10	15⅝	— ¼	*6 9 0
Eastern Tel. Ord.	8	10	159½	+2	*6 5 5
Globe Tel. and T. Ord.	8	10	15⅝	— ¼	*6 9 0
do. do. Pref.	6	6	8¾	—	6 17 2
Great Northern Tel.	22	22	22	—	10 0 0
Indo-European	13	10	80	—	8 6 8
Marconi	25	25	1 15/16	—	—
Oriental Telephone Ord.	10	12	2 5/16	—	*5 4 0
United R. Plate Tel.	8	8	6¼	—	*6 8 0
West India and Panama	1/8	Nil	3/16	—	Nil
Western Telegraph..	8	10	16	+ ⅛	*6 5 0

Home Rails.

	Dividend 1918.	Dividend 1919.	Price Feb. 8, 1921.	Rise or fall.	Yield p.c.
Central London Ord. Assented ..	4	4	43¼	—	8 4 6
Metropolitan	1	1¼	21½	— ½	6 19 6
do. District	Nil	Nil	16	+ ¼	Nil
Underground Electric Ordinary	Nil	Nil	2	+ ¼	Nil
do. do. "A" ..	Nil	Nil	5/6	— 6d.	Nil
do. do. Income ..	5	4	67½	+2	2 19 3

Foreign Trams, &c.

	Dividend 1918.	Dividend 1919.	Price Feb. 8, 1921.	Rise or fall.	Yield p.c.
Anglo-Arg. Trams, First Pref. ..	Nil	5½	2¾	—	10 0 0
do. do. 2nd Pref. ..	Nil	Nil	8½	—	Nil
do. do. 5 % Deb. ..	5	5	69¼	+1	8 8 0
Brazil Tractions	Nil	Nil	37	—1½	Nil
British Columbia Elec. Rly. Pfce.	5	5	56	+1	8 18 6
do. do. Preferred	2½	6	63½	—	*8 16 0
do. do. Deferred	Nil	8	61½	—	*12 2 8
do. do. Deb. ..	4½	4½	54½	—	7 16 0
Mexico Trams 5 per cent. Bonds..	Nil	Nil	40½	—	Nil
do. 6 per cent. Bonds..	Nil	Nil	26½	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	21½	—	Nil
do. 1st Bonds	Nil	Nil	63½	+1	Nil

Manufacturing Companies.

	Dividend 1918.	Dividend 1919.	Price Feb. 8, 1921.	Rise or fall.	Yield p.c.
Babcock & Wilcox	15	15	2¼	+ ⅛	*6 13 8
British Aluminium Ord.	10	10	18/3	—	10 19 2
British Insulated Ord.	12½	15	1⅝	—	9 5 10
Callenders	25	15	1⅜	—	10 16 2
„ 6½ Pref.	6½	6½	17/6	—	7 6 7
Castner-Kellner	20	17	2⅞	—	7 12 9
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	10	12/-	—6d.	—
do. do. 5 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	⅞	—	11 8 8
Gen. Elec. Pref.	6½	6½	18/6	—	7 2 6
do. Ord.	10	10	1 3/16	—1/32	*8 8 5
Henley	25	15	1 7/16	—	10 6 0
do. 4½ Pref..	4½	4½	8½	—	6 18 6
India-Rubber..	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	1 13/16	—	8 16 4
Siemens Ord...	10	10	1 1/32	— 1/32	*9 18 8
Telegraph Con.	20	20	21½	—	*5 11 8

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, February 8th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/4	...
a Ammoniac Sal	per ton	£110	...
a Ammonia, Muriate (large crystal)	„	£76	£16 dec.
a Bisulphide of Carbon	„	...	...
a Borax	„	£88	...
a Copper Sulphate	„	£38	£2 dec.
a Potash, Chlorate	per lb.	7½d.	½d. dec.
a „ Perchlorate	„	1/0	...
a Shellac	per cwt	£18 10s.	£3 10s. dec.
a Sulphate of Magnesia	per ton	£18	...
a Sulphur, Sublimed Flowers ...	„	£16	£5 inc.
a „ Lump	„	£18	...
a Soda, Chlorate	per lb.	5d.	1d. dec.
a „ Crystals	per ton	£7	...
a Sodium Bichromate, casks ...	per lb.	1/-	...
METALS, &c.			
p Babbitt's Metal Ingots	per ton	£95 to £300	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/0½	1d. dec.
c „ Tubes (solid drawn)... ...	„	1/2¾ to 1/3	...
c „ Wire, basis	„	1/0¾	...
c Copper Tubes (solid drawn) ...	„	1/5	...
c „ Bars (best selected) ...	per ton	£124	...
c „ Sheet	„	£124	..
c „ Rod	„	£124	...
d „ (Electrolytic) Bars ...	„	£77	£3 dec.
d „ „ Sheets ...	„	£143	...
d „ „ Wire Rods..	„	£93	£3 dec.
d „ „ H.C. Wire ..	per lb.	1/0⅛	...
f Ebonite Rod	„	8/6	...
f „ Sheet	„	8/-	...
n German Silver Wire	„	2/9	...
h Gutta-percha, fine	„	14/- to 18/-	...
h India-rubber, Para fine	„	11¾d.	¾d. dec.
i Iron Pig (Cleveland Warrants) ...	per ton	Nom.	...
l „ Wire, galv. No. 8, P.O. qual.	„	£50	...
g Lead, English Pig	„	£24	£1 dec.
g Mercury	per bot.	£12 10 to £12 15	...
e Mica (in original cases) small ...	per lb.	6d. to 4/6	...
e „ „ „ medium..	„	6/- to 10/-	...
e „ „ „ large ...	„	12/6 to 25/- & up	...
p Phosphor Bronze, plain castings	„	1/6 to 1/11	...
p „ „ rolled bars and rods	„	2/5 to 2/8	...
p „ „ rolled strip & sheet	„	2/5 to 2/9	...
d Silicium Bronze Wire	per lb.	1/4	4d. dec
r Steel, Magnet, in bars	„	1/6	...
n Tin, Block (English)	per ton	£157 to £158	£7 dec.
n „ Wire, Nos. 1 to 16	per lb.	4/8	...
p White Anti-friction Metals ...	per ton	£78 to £300	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd
n P. Ormiston & Sons.
p ———
r W. F. Dennis & Co.

Kinema Eye Strain.—With reference to the complaints that have been made by the Actors' Association concerning the harmful effects of the strong lights used in kinematograph studios, the Ministry of Health's Departmental Committee on Blindness was to visit the Stoll Film Co.'s studios at Cricklewood, this week, to investigate the complaints of injury to artists' eyes by the heat and other rays of the lamps. When the Palace Theatre, W., is converted into a kinema theatre, a new method of projection is to be tried, says the *Evening News*. Instead of being thrown on the screen from the front, the pictures are to be projected from behind. It is claimed that this method will considerably lessen the eye-strain of the audience; and the experiment should be specially interesting by reason of the proposal of the London County Council to regulate the distance between the front seats and the screen in picture theatres. It is intended to bring the pictures and the eyes of the audience on to the same level.

The Proposed Engineers' Club for London.—The following names have been added to the list of the Provisional Committee, given in our last issue (p. 138):—Mr. Harry Allcock, M.I.Mech.E., M.I.E.E. (Vice-President, British Engineers' Association); Mr. D. A. Bremner; Mr. A. W. Dennis; Mr. D. N. Dunlop (Director, British Electrical and Allied Manufacturers' Association); Sir E. H. T. d'Eyncourt; Mr. H. Ll. T. Foster, M.Inst.C.E., M.I.E.E.; Mr. A. E. Gelder; Major K. G. Stacy Hatfield; Mr. J. S. Harding, A.I.E.E.; Mr. J. Snow Huddleston; Mr. A. H. Hopkinson, M.I.Mech.E.; Mr. C. P. Martin, M.I.E.E.; Rt. Hon. Lord Moulton, P.C., F.R.S.; Dr. W. R. Ormandy, F.I.C., F.C.S. The first meeting of the provisional committee was to be held yesterday (February 10th). Prospective members are invited to send their names to the hon. secretary, Mr. E. L. Hill, 39, St. James's Street, S.W. 1.

A New Electrically-worked Mine.—The Udston Coal Co. is sinking a new pit at Macmerry Station, Haddingtonshire, and as it is proposed to use several coal-cutting machines, a 250-kW electric plant has been installed, the generator being driven by a Belliss & Morcom vertical compound engine of 365 h.p. There is a Sirocco single-inlet fan, 6 ft. in diameter, capable of producing an air current of 61,000 cb. ft. per minute against a water-gauge of 3 in.

THE TEMPERATURE LIMITS OF LARGE ALTERNATORS.

By G. A. JUHLIN, M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers.)

(*Concluded from page 156.*)

To determine the effect of temperature on insulation, a number of samples were tested. Each complete bar consisted of three conductors insulated from each other by half-lap layers of mica tape. Bending tests were made on a number of bars in the condition they were in after having been insulated in the wrapping machine in the usual way. Other bars were tested after being heated. As the breaking load was approached, the deflection increased rapidly even with the load constant. For this reason it was not possible to determine the deflection at the breaking point with any degree of accuracy. The results of the tests are shown in figs. 7 and 8; the upper parts of the curves are dotted for the reason just given. In all cases mechanical failure of the wrap preceded electrical failure. The effect of the prolonged heating was only to reduce slightly the load required to produce a given deflection, and also to reduce the load at which the insulation cracked.

The tests show clearly that no diminution in the elasticity of the insulation is caused by temperatures up to 150 deg. C. This result may seem doubtful, but when it is considered that the insulation is heated to approximately 150 deg. C. during its application on the conductors, and that this temperature is high enough to evaporate most of the volatile constituents in the bond, but not to destroy either the backing or the bond, there seems no reason why any loss in elasticity should occur with prolonged heating. It may, on the contrary, be expected that the deflection which the bars would stand without breaking should increase after heating to a temperature high enough to destroy the bond, as the individual mica pieces would then have a certain amount of freedom to move. It is probable, however, that in such a case electrical failure would precede mechanical failure. The reduction in mechanical strength is due to the backing used having lost its strength.

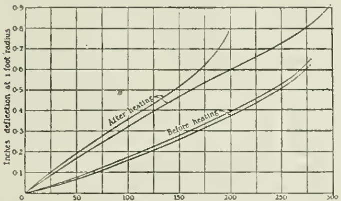


Fig. 7.—Relation between Load and Deflection of Copper Bars, Paper-mica Wrap.

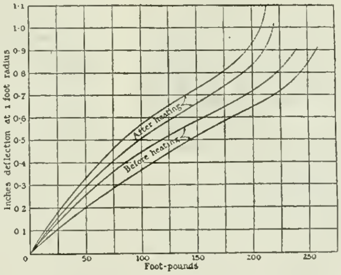


Fig. 8.—Relation between Load and Deflection of Copper Bars, Cambric-mica Wrap.

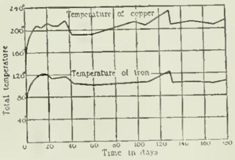


Fig. 9.—Temperature During Heating Test.

Dielectric tests were carried out on all samples after the bending tests. There was no difference in breakdown strength of the insulation between the bars before and after heating. On account of the excellent condition of the insulation after having been subjected to a temperature of 150 deg. C., further tests were arranged to determined the effect of still higher temperatures. In order to approximate to actual service conditions, new samples were placed in semi-enclosed slots of a sector of laminations taken from a standard machine and assembled for the purpose of the tests. A typical temperature chart of one bar is shown in fig. 9; no insulation troubles were, however, experienced. Dielectric tests were made on the bars after the heat run, and the test showed that no appreciable deterioration of this insulation had taken place.

The bars were removed from the slots and were found to be in a satisfactory condition. It is of special interest to know that the bars were tighter in the slot after the run than before; a certain amount of shrinkage does take place, but the shrinking is more than compensated for by the elasticity of the mica. The mica splittings act in the manner of a multilayer spring which presses against the slot sides and so keeps the coil in position. This is borne out by ordinary experience, because it is usually exceedingly difficult to withdraw bars from machines which have been in operation for some time. The paper and cambric used for building the mica upon was found to be carbonised, but remained intact on the inside layers. The fibre wedges employed at the top of the slots for holding the bars in position were very brittle and loose due to shrinkage. This was caused partly by the iron temperature, which was considerably higher than that met with in actual practice owing to the lack of ventilation of the surface of the lamination, and partly by the absence of the mica strip which is normally used between the bars and the wedges.

The surface temperature of the iron is shown in fig. 9.

It has been recognised for a long time that the solidity of the wrap is of great importance as far as its heat-resisting qualities are concerned. Of still greater importance is the percentage of mica employed. In order to determine the influence of these factors several sets of bars were made and insulated with wraps containing mica varying from 20 per cent., in the old hand-wrapped type, up to practically pure mica in some special wraps. It was found possible to apply mica wraps containing no paper by means of the Haefly wrapping machine.

The bars used for this test were taken from some coils of a standard water-wheel alternator in process of manufacture. The insulation between individual turns consisted of the cotton covering of the conductors and mica strips between each conductor. The thickness of the insulation was that normally employed for an 11,000-volt machine. All these bars were subjected to a temperature of 190 deg. C. continuously for 10 months. In Table I the samples are given in the order of the percentage of mica contained in the wraps and the breakdown value of the insulation follows the same order.

TABLE I.

Wraps on samples.	Breakdown voltage. Minimum.	Maximum
(1) Empire cloth and mica, hand-wrapped	15,000	26,000
(2) Cambric and mica, machine-wrapped...	31,000	35,000
(3) Paper and mica, machine-wrapped ...	32,000	45,000
(4) Paper and mica, machine-wrapped ...	47,000	48,000
(5) Mica and shellac only, machine-wrapped	50,000	52,000

The insulations (3) and (4) differ in the percentage of mica due to a different thickness of paper being employed. In applying the insulation it was found that the bars wrapped with No. 3 insulation were not as solid as those wrapped with No. 4. These high-pressure tests are highly satisfactory with the exception of those on the Empire cloth samples, and these were expected to show low breakdown values.

At the end of the test the bars were still a good fit in the slot, but the cotton covering on the individual conductors was entirely destroyed, all the conductors being quite bare. The mica strips between the conductors were, however, in perfect condition. The general condition of the wraps was the same as in the previous tests, *i.e.*, the fibrous materials used for building the mica on were carbonised, but the wraps were in all cases quite intact. The solidity varied with the amount of mica embodied in the wraps. The hand-wrapped Empire cloth and mica insulation was spongy, but the paper mica wraps were quite solid, the pure mica wraps being practically as hard as when the test began.

The above tests confirm the results obtained from a series of similar tests carried out by the Westinghouse Electric and Manufacturing Co., Ltd., at Pittsburg, U.S.A. In these tests mica insulation was subjected to temperatures as high as 300 deg. or 400 deg. C. without any serious loss in dielectric strength. Tests carried out by the same company on one of the original Niagara Falls machines gave valuable data on the maximum safe temperature of mica insulation. Table II summarises the operating record of the machine in question.

TABLE II.

Length of service in hours.	Operating temp. in ° C. (based on 35° C. air).
40,000	120 to 145
13,800	145 to 175
8,200	175 to 210
2,600	210 to 245
100	245 to 285

No insulation failures which could in any way be attributed to the deterioration of the insulation were experienced during the whole of the time the machine was in service. The author believes that this machine is not unique, but that there are other machines operating at temperatures almost as high as those given in the table.

As regards rotor insulation the temperature distribution is generally more even than in the case of the stator. Tests indicate that the temperature of the end windings is greater than that of the slot portion, because the rotor body is at a low temperature and rapidly carries away the heat from the copper in the slots, whereas the ventilation of the ends is, at the best, somewhat inefficient.

The problem of insulating the rotor winding is not as difficult as that of the stator winding, as practically pure mica can be employed, both for the insulation between turns and for the slot insulation. The insulation of the retaining ring for the end windings can also be pure mica moulded into the rings. There is, therefore, practically no destructible material in the insulation, and it may be classed under heading (5) in Table I.

Moreover, the danger of breakdowns caused by deterioration of the insulation due to high temperatures is considerably less in the rotor than in the stator, and higher temperatures may, therefore, be adopted for this part of the machine than for the stator. There is no difficulty with regard to other materials than mica being used in turbo-rotor construction, as machines are now constructed in which nothing but asbestos tape is used for protecting the coils from dirt, and "Bakelite" is used for any packing blocks and distance pieces required. These materials are absolutely unaffected by temperatures considerably higher than those which it is suggested mica insulation may be subjected to.

It is not possible to come to a conclusion with regard to the maximum temperature to which mica, as used at present in the insulating of electrical machines, may be subjected. However, there is no foundation whatever for the doubt that the temperature limits laid down by the British Engineering Standards Association are too high, on the contrary, they may with safety be increased. The tests show that mica insulation of the type employed in the construction of up-to-date alternators is capable of withstanding temperatures up to 200 deg. C. without losing its electrical or mechanical properties.

In order to take full advantage of this, the maximum temperatures should be increased to 160 deg. C., based on embedded temperature-detector measurements for the stator winding, and on the increase-of-resistance method for the rotor winding. Allowing a correction of 10 deg. C. for the difference between the maximum temperature and the observable temperature, the latter would then be 150 deg. C. This correction should refer to double-layer coils, with the temperature detectors placed between layers. In cases where the detectors are placed between the winding and the laminations, a greater correction factor would be necessary.

The values of these correction factors should be based on the voltage, as the difference in temperature between the inside of the insulation and the lamination will depend on the voltage, the thickness of the insulation varying with the latter. This has been recognised in connection with temperatures measured by thermometer on the surface of stator end windings, and there seems to be no reason why it should not be applied to the slot portion also.

Admitting that no reduction in safety will result, which the tests have demonstrated, there is no argument against the change. There are considerable advantages to be obtained: (*a*) In the case of machines running at the same speed, those with high temperature rating are cheaper. (*b*) Higher efficiencies are obtainable. (*c*) Larger units can be built, or (*d*) higher speeds can be adopted for machines of certain sizes. (*e*) Less space is required.

Advantage (*d*) is of great importance because an increase in speed reduces the cost of both the alternator and the turbine. Better steam consumption is also obtained under certain conditions for the high-speed turbines. The increase in the temperature limits is, therefore, in some cases very far-reaching.

There is a distinct tendency among American engineers to accept higher temperatures, and the two largest manufacturing companies have adopted a guarantee of 150 deg. C. for the ultimate temperature of their turbo-alternator rotors, and one of the companies gives this guarantee for the stator windings.

The Westinghouse Co., of America, has installed 160 and has on order 90 machines [a total of 250 with a total of 3,481,600 kVA] based on a guarantee of a maximum temperature of 150 deg. C. The sizes of these machines vary up to 35,300 kVa, and they operate at pressures up to 13,200 volts. Makers who have to compete for orders for machinery of this class are placed at a disadvantage if they are unable to offer standard machines with the higher temperature limits.

It is encouraging to note that some engineers in this country are disposed to accept higher temperature limits than existing standards, but it is of great importance from the point of view of standardisation that it should be generally accepted that higher temperatures may be adopted without reducing the margin of safety.

Discussion in London.

The President (Mr. Ll. B. Atkinson), in calling upon Mr. C. H. Merz to open the discussion, explained that he had assisted cable makers by adopting higher pressures notwithstanding the indisposition of others to do so, and the speaker, therefore, appealed for closer consideration to be given to the subject before them. The subject was of importance inasmuch as it tended to reduce capital expenditure, and at the same time, more precise methods of temperature measurement would result in greater safety.

Mr. C. H. Merz pointed out that the adoption of the suggestions outlined by the author would both cheapen the cost of large machines and allow of their being run at their maximum efficiency under all conditions. He agreed with the president's remarks, and thought the paper was a step in the right direction; it should remove any hesitation to install temperature detectors wherever possible, but one or two points would require attention. Would the adoption of higher temperatures cause other parts of the machine to suffer? For instance, what would be the effect on the insulation used between the laminations and also with regard to the distortion of mechanical parts? Practice supported the author's request for higher temperatures, and the speaker saw no reason why the manufacturer should not specify the temperature at which his machine should be run, in the same way that he fixed the steam consumption guarantees.

Mr. R. Orsettich agreed that the specified temperatures could not be accurately recorded by thermometers, but emphatically disagreed that the higher temperatures which were actually attained would be adopted as standard. The tests outlined by the author were not representative of the actual conditions obtaining in a machine. There were three different rates of expansion in a slot, copper, insulation, and iron, and no test could take all their effects into account. Coil expansion was an important feature, but was not dealt with in the paper; for every 100 deg. rise of temperature a certain coil would expand 3 mm.; the core of the machine would expand at a different rate, and there would be rubbing and perishing going on all the time. Moisture played such an important part that in some machines heating elements had been placed in the ducts in an attempt to maintain an even temperature under all conditions. The insulation of a coil would absorb as much as 10 per cent. of its weight in moisture when immersed in a saturated atmosphere, and dirt also contributed towards increasing the temperature of the whole machine. None of the above-mentioned serious factors had been dealt with by the author, and it seemed to the speaker that it would be rash to adopt higher temperatures before having obtained more data on the subject. Regarding temperature limits in America, his information was entirely different from the author's.

Mr. F. H. Clough agreed that in the past machines had operated at much higher temperatures than had been suspected, but he thought they should not be too eager to adopt higher temperatures, especially for stator windings. A stator should always be cooler than its rotor, which condition could be obtained if the stator winding was properly designed. Most manufacturers were taking steps to incorporate temperature detectors in their machines, and they relied on the assistance of operating engineers to furnish them with data on the results of their experience with such devices.

Mr. J. Shepherd was of the opinion that thermo-couples were not always reliable, and doubt had been cast upon their readings when they were placed at the top of the slots or between the windings and the wedge. Ultimate temperatures would have to be considered sooner or later, and whilst higher temperatures might cheapen machines, they could not afford to sacrifice operating safety by being in too much of a hurry to adopt them, notwithstanding that the temperature under present conditions might reach 200 deg. C. when the ducts were choked. The author had given no indication of the conditions obtaining inside the insulation, and it was the speaker's opinion that by the use of continuous slots, or their equivalent, so as to bind the insulation tightly against the metal (as in commutator segments), and thus eliminate mechanical stress, temperatures as high as 200 deg. C. could be safely adopted.

Dr. S. P. Smith, referring to the author's remarks concerning the B.E.S.A. report No. 72, thought it was desirable to arrive at some rules which could be universally applied. In the absence of a superior method at the moment, he favoured internally-fitted temperature detectors; most turbo-alternator troubles were the result of ignorance, and the thermometer was of little use. He agreed with the importance that Mr. Orsettich attached to the problem of expansion, and said that the formula:—

$$t_2 = R_2/R_1\ (2{,}345 + t_1) - 2{,}345,\ \text{in deg. C.},$$

was simpler, and did not necessitate the use of the tables in the B.E.S.A. report No. 72 when calculating the temperature increase by the increase in resistance method.

Mr. A. R. Everest pointed out that since the International Electrotechnical Commission dealt with the subject some years ago, thermo-couples had been developed, and they must, therefore, associate higher temperatures with standard machines; it was, however, commercially impossible to fit embedded detectors in rotors, and he warned his hearers not to draw too many conclusions. Experience had shown that a high-temperature mica-insulated machine at Niagara had given considerable trouble, whilst mica-insulated machines which had operated at low temperature had not done so.

Mr. A. B. Field strongly supported the author's contentions. Reliability and efficiency were the two most important qualities of a machine, but purchasers often overlooked the fact that by limiting the manufacturers with regard to temperatures they actually obtained a less reliable and often less efficient machine than could otherwise be supplied. If they allowed a reasonable temperature rise they would discourage freak ventilation schemes; simplicity and mechanical strength should be their aim rather than pretty results on paper.

Mr. H. W. Taylor, as a manufacturer, supported the author's point of view. Internal temperatures were undoubtedly high, and some operators knew what they actually were. Some years ago they had had to choose between allowing the higher temperatures and refining details of design so as to reduce the temperature, and the latter course had been successfully adopted.

Mr. G. A. Juhlin read a communication from Prof. Miles Walker, and a lantern slide was projected on to the screen, showing how the temperature piled up in a machine having a long core.

In reply to the discussion, Mr. Juhlin expressed his gratification at the general agreement on the subject of higher temperatures, and explained that the point he wished to emphasise was that the adoption of his suggestions would not, in fact, increase the temperatures because in consequence of their inability to accurately test them they were being worked to at present. He did not advocate any rash adoption of higher temperatures, but as mica was capable of withstanding the temperatures mentioned it was time advantage was taken of the fact. He agreed that the bending tests mentioned in the paper were not the only ones, but they showed the conditions as well as any other method would do. He had not found any effect due to expansion because the mica acted as a sort of spring. Embedded detectors would indicate the true temperature only to within one or two degrees, but that was near enough for practical purposes.

LEGAL.

Lee & Berlin v. Levy.

In the Shoreditch County Court, on February 3rd, before Judge Cluer, Messrs. Lee & Berlin, of St. Peter's Square, Hackney Road, electrical engineers, sued Mr. E. Levy, of Hackney Road, N.E., mantle manufacturer, to recover £19 for electrical fitting work done.

Mr. Lee stated that they got an order for eleven electric lights to be fixed at £2 each, which they did, and they supposed the work had been passed by the borough council. Cross-examined, he said the work was done in June, and then they got a notice from a borough council as to the work, which they put right, and they had heard nothing since. It was not within the witness's knowledge that only half the lights could be used. In re-examination he said he was quite willing to put anything right now if it was proved to be wrong.

The Defendant said that on the completion of the work in June the inspector from the Shoreditch Borough Council came in and saw it and refused to connect. The plaintiffs were supposed to see to the work, and the inspector called again in September, but it was not right then. He tried to arrange for the plaintiffs to meet the inspector at his place, but plaintiffs did not turn up. All that could be used were six lights.

Mr. Fordham, consumer's engineer, and inspector in the Electricity Department, Shoreditch Borough Council, said that when he saw the work in June he gave no order for connecting, as the testing was below the standard and the tubing was unsatisfactory. He went again in September in response to an appeal from the defendant, but the work was then too bad for him to provisionally connect, but he understood it was to be put right as soon as possible. He had never met the plaintiffs there. He had not certified the installation fit for use as the work was still unsatisfactory.

Judge Cluer decided that as the plaintiffs had to put the work right, there would be a non-suit, the action being premature.

Bristol Tramways, &c., Co., v. The Corporation.

In the King's Bench Division, on February 4th, Mr. Justice Sankey had before him a special case stated on an arbitrator's award in a dispute between the Bristol Tramways & Carriage Co. and the Bristol Corporation. The question was what amount of compensation should be paid by the Corporation to the company for certain tramway buildings on land in the parish of St. Michael's, Bristol, lately taken over by the Corporation.

Mr. Jeeves, K.C., for the Tramway Co., said the question was what was the basis of value of certain buildings erected on land leased to the company by the Corporation, to be paid by the Corporation to the company under the provisions of the lease. The lease was dated July, 1875, and was for 21 years. The period expired in 1896, and the tenancy was continued till 1918, when the Corporation gave notice to terminate it. The notice expired in May, 1919, and the question of the amount of compensation for the buildings erected on the land was referred to arbitration. The question was what was the meaning of the covenant in the lease of the land by the Corporation that at the expiration of the term of occupation the Corporation should pay to the lessees "the then value for all buildings which should have been erected on the land by the lessees with the approval of the lessors. Before the arbitrator the tramway company contended that the proper value of the buildings was the cost of their construction less depreciation. The Corporation contended that the value should be what anyone would pay for them in the open market. The arbitrator found that if the company's contention was right the amount should be £6,499, and if the Corporation were right £4,000. Counsel contended that the "then value" must be the cost of construction of the buildings less depreciation, and therefore the company was entitled to £6,499.

Mr. Inskip, K.C., for the Corporation, said the land on which the buildings stood was a plot entirely separate from the tramway undertaking, and it was a mere accident that the lease was included in the tramway agreement. When the company purchased the tramways the plot and the buildings had no connection with them. To adopt the company's contention would be to give an entirely fictitious value to the buildings. The arbitrator had to find the value of the buildings divided from the land, and that was what he had done.

Mr. Justice Sankey remarked that an intending buyer of the buildings would have to consider the question of the rental of the land. The buildings without the land would have no value.

Mr. Inskip said the arbitrator would first consider the prairie value of the land, and he would then proceed to value the buildings. Valuers found no difficulty in doing this. He contended that the market value of the buildings was their true value.

Mr. Justice Sankey, in giving judgment, said he did not agree with Mr. Jeeves that the matter came under Section 43 of the Tramways Act, and he did not take the view that the lease was a lease of a tramway authority. Mr. Jeeves was wrong, he thought, in the way he assessed the value. The way to assess the value was that contended for by the Corporation. Therefore he must answer the question entered in the award in the sense that the Corporation must pay £4,000.

Semco, Ltd., v. Russell.

In the Shoreditch County Court, on Monday, before Judge Cluer, Messrs. Semco, Ltd., of Shoreditch, electrical engineers and contractors, sued Mr. E. Russell, of Commercial Street, E., to recover £11 18s. 6d. for electrical work done and materials supplied. A sum of 50s. had been paid into court in full settlement.

Mr. Clark, the foreman, said he went to do the job, which was very urgent, and had to be finished that night, so that it could be connected up the next day. This meant overtime work for the electricians, and their rate of pay was 5s. an hour for overtime, which was established by the trade union rules. The defendant must have known what the cost would be when he ordered the night work. There were two men on the job till 10.30 at night, and they tested it and found it correct before they left. He understood that the trouble was that the electrical power supply authority had been round previously but refused to connect up as there was an earth. Counsel explained at this point that the charge was arrived at by taking the cost of wages and material and adding on 25 per cent. for establishment charges, and then a further 25 per cent. for profit.

Judge Cluer: Well, that is one way of charging certainly, but being a limited company it must make a profit for its shareholders I suppose.

Mr. Hornby: Our contention is that a price of 50s. for the job was fixed.

The defendant was called, and said he had a good deal of work to do on the job, which he took at £6. He asked the plaintiffs to do the electrical work, and they agreed to do it for 50s.; it was absurd to suggest he would leave them free to charge what they liked when he was only receiving £6 for all the work.

Judge Cluer eventually found for the plaintiffs for £9, saying the plaintiffs had charged a little too much in making out their profit.

Tramway Wages Inquiry.—The Court of Inquiry appointed by the Minister of Labour, under the chairmanship of Sir David Harrel, G.C.B., commenced its duties on January 26th, and many witnesses have been examined during its proceedings. Mr. E. Bevin, the leader of the Trade Union side, called a number of tramway employés and their wives to testify to the cost of living and the impossibility of living at a proper standard under present rates of wages. The employers' side, on the other hand, produced evidence to show that the burdens already placed upon the industry had reached the utmost limit. At the session of February 4th it was decided to send out a *questionnaire* to all undertakings to elicit the following information:—Number of route miles and of car-miles, 1914 and 1920; number of persons employed giving grades 1914 and 1920; excess of expenditure over revenue in respect of each undertaking, and source from which excess was met, 1914 and 1920; excess of revenue over expenditure, and how excess was disposed of; the amount granted by each undertaking on the base rates subsequent to the Industrial Council's agreement of March 31st, 1920; variations between the wage rates in 1905 and 1914 ?

THE CALLENDER KAY POLE.

The question of overhead transmission is rapidly increasing in importance with the development of stations serving wide areas or distant localities, and one of the most important considerations in the study of this branch of engineering is the choice of a suitable standard or pole for supporting the heavy load of copper required for the work.

The standardisation of transmission poles is a difficult question as far as size is concerned, as so many factors enter into the calculations. As regards proportions, however, standardisation is not so difficult as has been proved by Messrs. Callender's Cable & Construction Co., Ltd., in the production of their Kay poles. These poles consist of a vertical member supported by four legs and the same number of stays, as seen in fig. 1. The distance from the ground to the point at which the stays are fixed to the vertical member is taken as a unit of proportion, and all other parts are designed in accordance with this unit. Thus, if the "unit" is taken to be 100, the tower will stand with its four legs on the corners of a square whose side is 40; the height from the ground of the joint at which the five members meet will also be 40, and the length of each of the legs above the ground 49. The length of the stays will be 104. In this way the load on any of the members is always a definite multiple of the transverse load applied at the head of the pole, and a full knowledge of the distribution is obtainable immediately. This enables the firm to offer a pole of standard proportions to deal with any and every condition met with in practice.

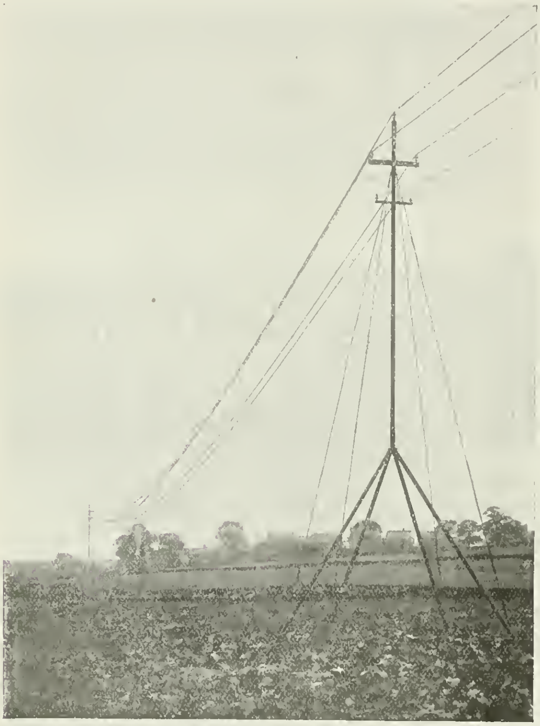


Fig. 1.—The Callender Kay Pole.

The construction of the pole is very simple. The struts may be of any suitable material, but preferably of high tensile steel tubes, which are light and easily handled. The foundations consist of buckled plates attached to their respective tubes by bolts, as shown in fig. 2. The joint at which all five tubes meet consists of a cast-iron block (fig. 3), which requires no machining and no bolts or fastenings of any kind. The various projections on the block are an easy fit in the tubes, and the block is just subjected to simple compressive forces. Under no circumstances can the block work out of place, and a load coming on the pole from any direction tends to keep it more firmly in position. The ties or stay wires are galvanised wire ropes of high-grade steel, with a tensile strength of from 100 to 110 tons per sq. in. The four ties for each pole are formed of two lengths of rope, each length passing from one leg of the pole to the top and down again to an adjacent leg. The "Kay" pole is very flexible; by suitably adjusting the stays, the vertical member may be allowed to deflect considerably before the structure as a whole offers any serious resistance to the deflecting force. This flexibility is not purchased at the price of safety.

As regards the transport of these poles, it will be seen that no difficulty is presented, and their assembly is also a simple matter.

In erection, the ground is first marked out to show the points at which the legs are to enter the ground, and the necessary excavations are made. While this is being done, the four buckled plates are attached to the legs, and the joint block is placed with its lower parallel projection in one of the legs. This leg is then lifted into one of the holes and inclined at the proper angle, when the other legs are brought up and fitted into the joint. The earth is then rammed in round the bases of the legs and the vertical tube is placed in position with a light derrick, the stays and cross-arms having been fitted in readiness. When the construction gang has erected one or two poles, each member becomes accustomed to his part of the work, and erection can be carried out rapidly.

Where it is desired to keep a line in commission day and night for years together the wrapping of the tubes with bitumen-impregnated hessian is recommended. All inner surfaces of the tubes are invariably coated with a rust-resisting compound, and legs of poles which have been erected for years have been found free from corrosion on both interior and exterior surfaces.

The makers claim that the Callender Kay pole is the cheapest as well as the best for h.p. transmission work on account of the low costs involved in freight, transport, distribution, assembly, erection, and maintenance.

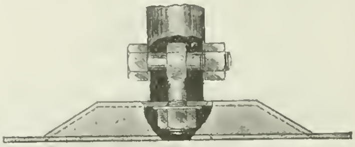


Fig. 2.—Method of Fixing Foundation Plate.

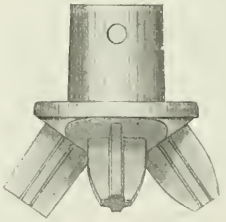


Fig. 3.—Joint Block.

Electrical Appliances for South African Railways.— Sir William Hoy, general manager of the Union of South Africa Railways and Harbours, in his official report for 1920, just to hand, states that the electrification of certain sections of the Union railways which has been authorised by Parliament (at an estimated cost of £4.385.400), will lead to considerable development in electrical schemes and the introduction of electrical appliances for railway purposes. Important schemes are in hand for large extensions in the use of electric power in Durban, Bloemfontein, East London and other workshops and also at the harbours. At Pretoria, Sir William Hoy adds, it has become imperative to supplement the generating plant by a new 250 kW set, in order to cope with the additional demand for power. New electric light plants have been installed at a number of country stations, and other installations are in hand. A new system of lighting has been introduced in several of the large goods yards to facilitate shunting work at night. The new system, known as "flood" lighting, has been found very successful, and will be extended as circumstances warrant

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Art and Utility in Lighting.

An extremely wide range of lighting fittings is disclosed in a catalogue recently issued by Messrs. J. & W. B. Smith, Ltd., 15-23, Farringdon Road, E.C. 1. From both the artistic point of view and that of utility the list can be said to cover most requirements in the way of illumination. We select two examples to illustrate the variety of the fittings included in the catalogue. Fig. 1 is a candle bracket, an ornate fixture designed for those whose minds cling to the old traditions while desiring to make use of the advantages of electric lighting. Fig. 2 is a severely plain desk fitting with a polished sheet brass reflector for use with metal filament lamps. The reflector is fitted to the brass tube by a double-knuckle joint with a tightening wing nut. This type can be used as a piano standard to illuminate music without glare.

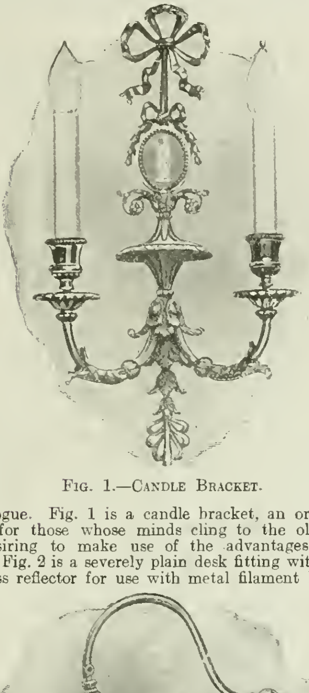


Fig. 1.—Candle Bracket.

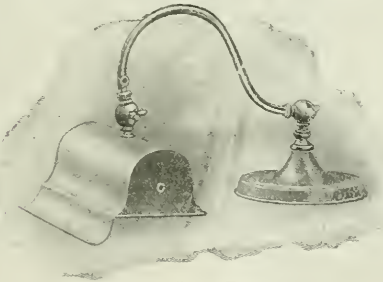


Fig. 2.—Desk Fitting.

These are but two examples from among almost a thousand fittings of all kinds. We have seen the firm's show-rooms, and were much pleased with what we were shown.

A New Mercury Cut-out.

We have received from Messrs. Sagar-Richards, Ltd., Woodbottom Works, Luddendenfoot, Yorks., particulars of a new type of mercury cut-out for which they are sole licensees for Great Britain and Ireland. This is designed to take the place of fuses, and it is claimed that by the use of the device it is impossible to over-fuse a circuit, there is no danger from arcing, and fuse replacement is dispensed with. The service type of "Emcos" cut-out is illustrated in fig. 3, where one of the pair is shown with its porcelain cover removed. It consists of an inner core possessing a chamber containing mercury. Owing to the peculiar construction of this chamber a break in the circuit, due to a short-circuit or overload, takes place in a predetermined restricted area, thus ensuring that the severing of the column of mercury occurs under a head of mercury, in an airtight chamber, without flash or noise. The displaced mercury is caught in a special chamber in this inner core, again returning to complete the column on depressing the vulcanite button seen in the illustration. The inner core is contained in a case, and is usually mounted between two porcelain blocks, which arrangement affords complete electrical protection. The mercury column cannot be re-established if the overload or short-circuit still exists, as the mercury will not remain in the restricted area until the fault is removed. The "Emcos" cut-out forms a very efficient type of current limiter, as a stoppage caused by an excess of current cannot be remedied until the extra lighting, &c., is switched off.

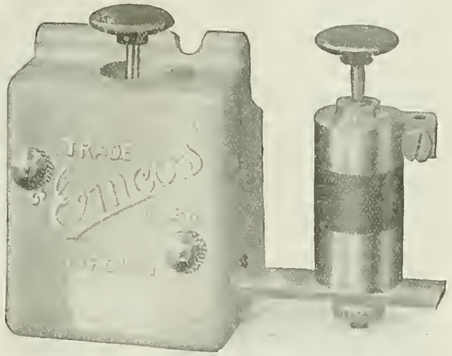


Fig. 3.—The "Emcos" Mercury Cut-out.

A Kinema Lighting Set.

Fig. 4 illustrates an interesting lighting plant supplied by Messrs. Ward & Goldstone, Ltd., Sampson Works, Salford, to one of their Indian clients, for use with a travelling kinema.

The engine is of the two-stroke type, running on paraffin, and the generator has an output of 2.2 kW at 70 volts. The engine is fitted with a fan-cooled radiator, the fan working on ball bearings; a reservoir for the cooling water is contained in the engine bedplate. The trolley is made of channel iron bolted together and floored with 1½ in. elm board.

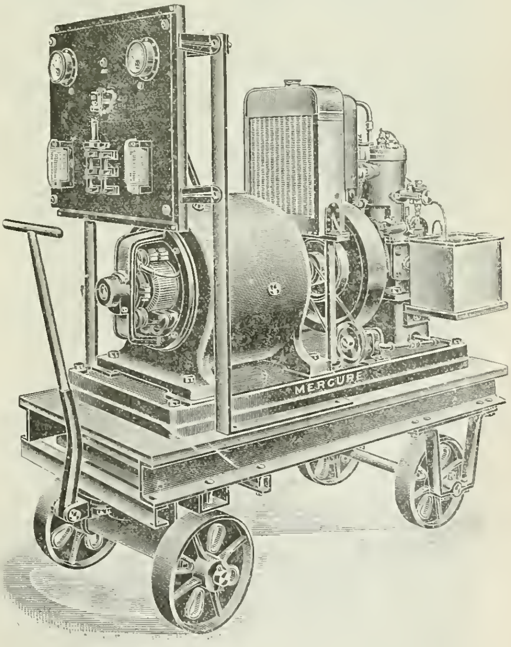


Fig. 4.—A Kinema Lighting Set.

It is intended to use animal haulage for transporting this set over the rough Indian roads for, although the complete weight of the plant as shown is over a ton, the mounting has been so well carried out that the set can be moved on level ground by one man.

THE DISTRIBUTION OF ELECTRICITY.

Discussion at Leeds.

Mr. W. B. Woodhouse's paper on the above subject, which was abstracted in our issue of December 3rd, 1920, was discussed before the North-Midland Centre of the Institution of Electrical Engineers at Leeds on January 25th. Mr. C. J. Jewell, chairman of the Centre, presided, and there was a good attendance of members.

In opening the discussion, Mr. Storr remarked that Mr. Woodhouse was to be congratulated on writing a paper of that description which was so complete in all the essentials. One portion of the paper referred to the time limit for development, and with that he was in strong agreement; speaking of normal areas of electricity supply, say, a few square miles as distinct from the whole country, there was a very definite limit beyond which it was inadvisable to plan ahead for financial reasons. With a very simple outline of an ideal area as outlined in the paper, it would not be difficult to decide what to do in connection with sub-station costs. Sub-stations together with their equipment, when they were equipped for areas not only for load grouping, but for simplified protection, had a very large effect on the cost of the distribution system, and for simplification sub-station costs should be seriously considered along with all mains work. An important point to be kept in mind was that if economy was practised with due caution in the early lay-out a greater area could be covered by the same cross sections of copper by taking an alternative route at a later date.

Mr. Johnson (Leeds) said that though the paper dealt with power as a whole, it appealed to him as a telephone engineer to some extent; his remarks would be chiefly on its application to telephone engineering work. Mr. Woodhouse stated: "The concentration of generating plant in a small number of station involves greater expense in distribution, and is only justifiable so far as the advantages of centralisation outweigh the extra costs of distribution which result." With the alteration of a few words that paragraph exactly described the problems telephone engineers in large cities had to consider when deciding whether they should put up one big exchange for the whole city or whether they would have a number of sub-exchanges on the outskirts, although the distribution was not the same, inasmuch as the telephone distribution was necessarily of a "tree" form, whereas that of power distribution might be described as of the "web" design. Yet the considerations were very similar in that they had to enter into rather elaborate calculations, and a good deal of surveying had to be done in order to decide whether a sub-exchange should be put down in a particular area or not. Then, too, they had their own density problems, inasmuch as whereas the bulk of the conversations was local, and consequently cables of a very small diameter would suffice, yet they had also got to provide for the junction and trunk traffic which required telephonic efficiency of a much higher order. The speaker was particularly struck with the fact that Mr. Woodhouse had emphasised the need for a considered lay-out at the beginning. Telephone engineers were up against similar problems; for instance, the Hull telephone area extended for several miles north, east, and west, whereas it only extended a little way to the south because of the river Humber. Even in those physical difficulties there was a great necessity for the study of the location of the station. To begin with, they found that if they once got a central station where they should have a number of sub-stations, or *vice versa*, the capital spent at the beginning with a large unexpired life made it almost impossible to put the thing right afterwards. When they built the automatic exchange at Leeds they used ordnance maps on which they plotted the location of every subscriber in Leeds. They then drew one line horizontally and one perpendicularly, not in the middle of the paper, but so that they had exactly as many stations on each side of the perpendicular, and exactly as many above as below the horizontal line. Obviously where those lines crossed was the place where they could put the central exchange with the least expenditure of labour. Had they chosen a site near the Leeds Post Office for the Leeds exchange it would have meant that thousands of wires would have had to be, perhaps, one-third of a mile longer on an average than they need have been. Telephone engineers in their surveys found that it would not do to lay cables without a very thorough understanding of what they were going to do ultimately, and before they entered upon the main scheme they plotted on ordnance maps the probable requirements for telephones within periods of five, fifteen, and twenty-five years. So that although they might only do a preliminary part of it at the time, they knew what they were working for, and they saw that they had cables at all events for five years, whereas they provided ducts for at least fifteen years. They reckoned that beyond those periods, interest and maintenance charges would wipe out the cost of adding cables when the time came. To a trained man it was comparatively easy to make a very reliable estimate of the development in any particular part within those periods, and he believed that power undertakers also found that they could make a fairly accurate forecast of the requirements in a somewhat similar way. The Institution might well devote a good deal of consideration to the necessity of having areas arranged on an intelligent basis. He knew there were immense difficulties in the way, but the advantages of getting the area properly arranged to begin with were so great that it seemed worth while doing a great deal in order to get that. If, for instance, they were going to make use of water power, the area certainly ought to be grouped round that source of supply even if local jealousies and feelings of importance on the part of local authorities stood in the way. He thought that the matter was of such importance that it ought to be possible to overcome difficulties, because if they once got away from the economic centre it seemed almost impossible ever to get the thing put right. He emphasised the importance of the preliminary survey both as regarded the area, the location of the station, and the question of whether there should be any, and, if so, how many sub-stations, and there should be an intelligent knowledge of what the station was going to serve for a good many years ahead.

Mr. Hinings observed that it was a pity that the author had not brought the 1907 figures up to date, because as they stood they were really of no value for comparative purposes. Mr. Woodhouse had mentioned the resistance losses varying with the load. Was that correct? Should not it be the square of the load?—and even that might be slightly increased on account of the temperature of the cable. As to h.p. cables, he thought most mains engineers would agree with Mr. Woodhouse that 0.05 sq. in. should be the minimum for a pressure of about 10,000 V. He knew, however, of individual cases where cables were of smaller cross-sections, *i.e.*, 0.035 sq. in. at 11,000 V, and they had given years of good service. With regard to the remark that "Some regulation of pressure will be permissible at the stations . . ." it seemed to him that a fairly definite pressure must be maintained on account of the local supplies. If that was maintained it would mean that some form of boosting would have to be employed.

Mr. C. G. Shuttleworth (Hull) said that he had been concerned with a scheme for transmitting 2,000 h.p. in bulk about 12 miles. The approximate cost of laying the cable was £80,000, and the cost of switchgear and the transformers for stepping up and stepping down was about £20,000; the whole scheme cost about £100,000. He reckoned that if they used the cable at 100 per cent. load factor they could supply from 30 to 40 million units, which would represent a cost of 0.06d. per unit. If they took an average figure of 10,000,000 units at 25 per cent. load factor the cost per unit would be 0.24d. The cost of transmission was becoming a very serious factor with the present cost of cables, and he agreed with Mr. Woodhouse that to lay light cables was a fallacy; the cost of labour was such a big proportion of the cost. The size of cable they selected was 0.15 sq. in. They had a guaranteed load of 2,000 kW, and they fixed on a pressure of 22,000 V, which allowed them about 50 per cent. for the development of the district. Their experience of a 6,000-V transmission was that it did not take them far on account of pressure regulation. They had one running for six miles; for two-thirds of the distance the cable was 0.15 sq. in., and the rest was 0.075 sq. in. They found in practice that with an approximate load of 300 kW at the consumer's premises, and with the cable fully loaded at the power station and tapped off at intervals on the way, they got as much in an afternoon as 15 per cent. variation. That was beyond the economic limit. They had to choose between 11,000 and 20,000 volts; finally they decided on 20,000 volts.

Mr. Wood asked if an overhead system of steel-clad aluminium mains using pressure regulators on the system, such as was used in Canada and the States, would not be more economical? In a country like this he imagined they would be much more reliable than an untried e.h.p. underground cable; the overhead cable was kept too much in the background in this country.

The Chairman (Mr. C. J. Jewell) held that it would be a good thing if a warning was given concerning the comparative costs of cable and site. In his experience he had found many places where, just for the sake of a few pounds in the cost of the site, they had turned away from the main road and had gone up a back street and expended many thousands of pounds on cables. When they had a fairly large sub-station and perhaps a dozen or fourteen cables and they had to take them over a distance of 300 or 400 yards, it cost what would be quite a big frontage cost for a first-class town. He had known that happen in towns with tramway systems where they had fairly large sub-stations. A static sub-station was a different thing, but even then the cost of the cable was sometimes lost sight of when the site was chosen; the people responsible for the lay-out had not taken into consideration what their costs would be, they had only looked at the first cost of land. He entirely agreed with Mr. Woodhouse on the building up of a system. To-day if one were building up a system without a very assured load, one would naturally adopt 10,000 volts. They could distribute quite a long way, feed a good many sub-stations, and keep the capital cost fairly low even with cables instead of overhead equipment. Their load or generation would always be at 10,000 volts, and they could work up to 30,000 on their main load, and come down and tap into their sub-stations wherever they liked. Mr. Woodhouse's arrangement of gradually building up and taking notice all the time of the captial cost and seeing they got a fair return, and as the load increased to be able to increase their copper or transmission, was one that should not be lost sight of.

Mr. W. B. Woodhouse, in replying to the discussion, said that Mr. Johnson's comparison with the distribution of telephones was another phase of a similar engineering problem. It was valuable to have an analogy of that kind, and to be able to check one's conclusions with one particular system by the conclusions arrived at with something of a different nature, but analogous, allowing for the differences. As to Mr. Johnson's statement that the site of the station should be selected after careful consideration of the area, he was very glad that had been emphasised, because he (Mr. Woodhouse) was afraid that even to-day engineers were talking of building power stations on utterly unsuitable sites, sites in the middle of large towns from which it was impossible to move their cable routes. The cable routes had not been considered; if they had followed out Mr. Johnson's example and laid out the scheme of what they would want in 15 years' time, it would modify a good many of those proposals. The impression Mr. Johnson's remarks left on him was the enormous value of a careful engineering analysis of those problems; the tendency had always been to say: "Well, after all, you cannot use too much copper, and there are so many variants that it is not worth while trying to analyse the problem." Mr. Woodhouse contended that it was worth doing, and it was only by proceeding in that way and trying to get some leading principles that they would ever progress. Mr. Johnson had emphasised the importance of considering the probable requirements in advance, which was particularly important in towns where they had expensive roads and pathways to break up, and where they had a greater likelihood of obstruction. It was of importance to look upon electric power supply as being something for a very wide area; in this country they were now talking of 50 or 60 miles; in America they were connecting areas over distances of 300, 400, and 500 miles, and the whole supply of an area 500 miles from end to end was being linked up. If the Americans could do that, surely they in this country must think on proper lines; for example, not merely to consider the linking up of Yorkshire, but also consider the interconnection of Lancashire and Yorkshire, Yorkshire and Tyneside, and Yorkshire and Birmingham. Those were the problems to consider, not merely what they were going to do in a small portion of the West Riding. They had got a lot to learn yet about dielectric losses; the Engineering Research Association was very busily engaged on problems of that kind, and a great many people were working on them as well as the cable makers, so that in a few years they would have something definite to go on. In the meantime one had to take into account that paper, while a very admirable insulator, was rather sensitive to temperature, and that their dielectric losses would rather increase as the temperature rose, so that they might very soon reach a dangerous point. There was no doubt that in connected systems they would have recourse to some auxiliary method of pressure regulation; whether it was by boosters, synchronous boosters, or synchronous condensers, or whether it was by regulation transformers, would depend on the particular case and the amount of load they had to deal with, but something would undoubtedly be necessary, and must be regarded as a disadvantage seeing it meant extra cost and complication, the disadvantage of a very large system. Mr. Shuttleworth's figures were rather higher than were necessary in a general distribution scheme; Mr. Shuttleworth was considering the supply in one particular case. There was no doubt at all that if they were going to distribute cheaply they must use overhead mains and use a great many mains, particularly in a district where the density of load was not very great. In Yorkshire there was already a very considerable mileage of overhead cables, and that was extending. There was a case both for overhead cables and the underground main, and both types would always have their uses. If they were considering the transmission of very large amounts of power by overhead mains, then they were almost forced to the condition that they had had to accept in other countries, that was, they wanted a tract of country on which to erect their mains and of which they would have the ownership and control. That would be a rather difficult thing in the West Riding. They had already got so many roads, so many railways, and so many other things that if, for example, they wanted a tract many yards wide to put their poles on, by the time they had paid for it it would cost more than the underground main. For a great many parts of the industrial area they must go underground, but where they could possibly go overhead he thought they must do so. Mr. Jewell's warning was one that they should remember. It was very often forgotten that if a sub-station was put out of the way it meant an extra length of main and, therefore, considerable extra cost of mains. Obviously the sub-station site should be chosen with the greatest care; the cost of those extra lengths of cable would soon swamp the additional cost of land. For the industrial districts of this country 10,000 volts was right; it was unfortunate that so many of the towns had adopted a lower pressure, but it was not too late for them to come into line with the pressure which must be adopted outside the big towns and put their extensions down at 10,000 volts. They could buy switchgear, cables, and transformers cheaper; it would be a great advantage if 10,000 volts could be standardised as the power users' pressure.

TRADE STATISTICS OF CANADA.

The following figures, showing the imports into and exports from Canada of electrical and similar materials during the year ending March 31st, 1919, are taken from the recently-issued trade statistics. Figures for the year 1917-18 are given for purposes of comparison, and notes of any increases or decreases have been added.

Imports.

		1917-18	1918-19	Inc. or dec.
Copper wire, plain, tinned, or plated.—				
Total ...	lb.	68,000	179,000	+ 111,000
	$	23,000	68,000	+ 45,000
From United States ...	lb.	68,000	179,000	+ 111,000
	$	23,000	68,000	+ 45,000
Electric motors, generators and dynamos.—				
Total ...	$	1,918,000	2,354,000	+ 436,000
From United Kingdom		22,000	32,000	+ 10,000
,, United States ...		1,894,000	2,320,000	+ 426,000
Other electrical apparatus.—				
Total ...	$	8,200,000	7,576,000	– 624,000
From United Kingdom		93,000	55,000	– 38,000
,, United States ...		8,091,000	7,494,000	– 597,000
Steam engines.—				
Total ...	$	340,000	284,000	– 56,000
From United States ...		339,000	280,000	– 59,000
Petrol and gas engines.—				
Total ...	$	6,666,000	6,380,000	– 286,000
From United States ...		6,661,000	6,369,000	– 292,000
Wire, iron and steel covered, including cable.—				
Total ...	$	235,000	193,000	– 42,000
From United Kingdom		1,000	18,000	+ 17,000
,, United States ...		234,000	174,000	– 60,000

Exports.

		1917-18	1918-19	Inc. or dec.
Engines, petrol.—				
Total ...	$	172,000	291,000	+ 119,000
To Newfoundland ...		149,000	257,000	+ 108,000
,, United States ..		11,000	29,000	+ 18,000
Mica.—				
Total ..	$	457,000	370,000	– 87,000
To United Kingdom ...		5,500	55,000	+ 49,500
,, United States ...		451,000	313,000	– 138,000
Electrical apparatus.—				
Total ...	$	2,167,000	2,168,000	+ 1,000
To United Kingdom ...		119,000	32,000	– 87,000
,, India		69,000	86,000	+ 17,000
,, Australia		59,000	287,000	+ 228,000
,, New Zealand ...		48,000	4,000	– 44,000
,, Newfoundland ...		35,000	31,000	– 4,000
,, Brazil		257,000	287,000	+ 30,000
,, France		1,068,000	707,000	– 361,000
,, United States ...		452,000	433,000	– 19,000
Machinery, other than printing, sewing, agricultural and washing.—				
Total ...	$	2,922,000	5,983,000	+3,061,000
To United Kingdom ..		897,000	131,000	– 766,000
,, Newfoundland ...		111,000	75,000	– 36,000
,, France		86,000	36,000	– 50,000
,, Japan		121,000	68,000	– 53,000
,, United States ...		1,550,000	5,248,000	+3,698,000

Trade Union Amalgamation.—At a private meeting of Bradford tramwaymen, Mr. Ernest Bevin gave an outline of the ideas behind the proposed amalgamation of 19 transport workers' Unions. He said that the Federation of Employers was at the moment stronger than that of the Unions, and only by emulating its method of organisation by amalgamation could the men hope to win eventually, and gain control of the industry. Unions must amalgamate, so that if the necessity for a strike arose, they would have sufficient funds to compete with the purses of the employers. The proposed new Union would have a membership of 500,000, an immediate capital of £624.000, and an annual income of £700.000. If the amalgamation were carried out the whole of the funds of the various Unions would be pooled and all benefits at present being paid would continue. There would be a minimum contribution of 28s. per year. At present when a Union called a strike, its income immediately stopped, and it began to draw on its capital. Under the amalgamation, if one section went on strike, the others would be working, so that they would provide income sufficient to meet the situation without touching the capital. The amalgamation would, he suggested have an accountancy department for the tabulating of wages demands and statistics for the men who went to arbitration courts, and have its own paid legal advisers as well as a staff to keep the Labour Members of Parliament fully posted with statistics and information.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

2,309. "Automatic, &c., telephone exchange systems." W. Aitken. January 17th.

2,677. "Ignition magnetos for internal combustion engines." H. W. F. Ireland and H. Lucas. January 20th.

2,678. "Electric lamps for vehicles." W. H. Egginton and H. Lucas. January 20th.

2,683. "Tumbler switches." Y. Takaoka. January 20th.

2,684. "Signalling arrangement for electrically worked railroads." F. Grunig. January 20th. (Switzerland, November 25th, 1920.)

2,685. "Electric motor control." British Thomson-Houston Co., Ltd. and H. C. Hastings. January 20th.

2,709. "Electric contacting devices." H. Lloyd and A. P. Pehrson. January 20th.

2,711. "Means for enabling electric current of low voltage to flow across proximate surfaces of two conductors in contact." T. N. Whitehead. January 20th.

2,717. "Electric discharge tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. January 20th. (Holland, January 22nd, 1920.)

2,719. "Induction apparatus for electro-therapeutics, &c." P. Bischofberger. January 20th. (Germany, December 14th, 1920.)

2,727. "Telephone switching apparatus." W. Aitken. January 21st.

2,729. "Electro-magnetic wave receiving systems." F. J. Chambers. January 21st.

2,748. "Incandescent electric lamps." F. J. Moore. January 21st.

2,754. "Electric egg-tester." F. Armstrong. January 21st.

2,766. "Production of electrical oscillations by thermionic valves." N. Lea and Radio Communication Co., Ltd. January 21st.

2,782. "Telephone systems." Western Electric Co., Inc., and Western Electric Co., Ltd. (Western Electric Co., Inc.). January 21st.

2,783. "Cancelling switch." P. D. Coates. January 21st.

2,785. "Arrangements for reinforcing weak continuous currents." D. Reichinstein. January 21st. (Germany, February 25th, 1920.)

2,791. "Electric motor control systems." T. Zweigbergk. January 21st.

2,793. "Electrically heated hand irons, kettles, &c." H. Leigh. January 21st.

2,798. "Electric signalling." B. Davies and Eastern Telegraph Co., Ltd. January 21st.

2,801. "Electric heater resistance elements." R. W. Reynolds. January 21st.

2,803. "Apparatus for suppressing earthing currents in high-voltage nets." Siemens-Schuckertwerke. January 21st. (Germany, January 31st, 1920.)

2,806. "Measuring magnetic induction." British Thomson-Houston Co., Ltd. (General Electric Co.), and General Electric Co. January 21st.

2,807. "Elastic fluid turbine-driven sets." British Thomson-Houston Co., Ltd. (General Electric Co.), and General Electric Co. January 21st.

2,816. "Terminals for electric junction boxes, ceiling roses, &c." W. W. Congdon. January 21st.

2,825. "Hydro-electric steam power systems for locomotives, tramcars, &c." W. P. Durtnall. January 21st.

2,841. "Means for transforming light impulses into electric current impulses." T. H. Nakken. January 21st.

2,850. "Electro-magnetic wave signalling systems." H. J. J. M. de Regnauld de Bellescize. January 22nd. (France, January 22nd, 1920.)

2,889. "Means for preventing theft of electric lamps." J. A. Brook. January 22nd.

2,899. "Electric accumulators." R. Rankin and Van Raden & Co., Ltd. January 22nd.

2,902. "Earthing device for lead-covered cable." L. Weekes. January 22nd.

2,911. "Electrodes, and methods of making same." British Thomson-Houston Co., Ltd. (General Electric Co.), and General Electric Co. January 22nd.

2,940. "Electric head-lights for motor-vehicles, &c." J. Eaton & Efandem Co., Ltd. January 24th.

2,953. "Negative resistance, &c., devices for radio-signalling, &c." J. Scott-Taggart. January 24th.

2,975. "Electric-wire tester." G. Westley. January 24th.

2,990. "Incandescent electric lamps." H. E. Clerk and W. W. D. Knight. January 24th.

2,992. "Telephone installations." J. P. Vinall. January 24th.

2,994. "Motor-vehicle electric lamps." H. Lucas and W. C. Turner. January 24th.

3,009. "Electron tubes." Soc. Anon. pour l'Exploitation des Procedes M. Leblanc-Vickers. January 24th. (France, April 2nd, 1920.)

3,010. "Systems of voltage regulation." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 24th.

3,012. "Mine signalling apparatus." T. Chismon. January 24th.

3,037. "Automatic electrical steering-gear for ships." G. C. Boles and W. P. Gandell and A. K. Macrorie and H. Noble. January 24th.

3,040/2. "Miners' electric safety lamps, &c." G. Oldham and J. Oldham. January 24th.

3,041. "Galvanic batteries." G. Oldham and J. Oldham. January 24th.

3,055. "Electro-magnetic switches or cut-outs." C. C. Garrard and A. H. Railing and W. Wilson. January 25th.

3,056. "Electric motor starters and regulators." C. C. Garrard and A. H. Railing and W. Wilson. January 25th.

3,066. "Electro-magnetic wave receiving and amplifying systems." F. J. Chambers. January 25th.

3,084. "Apparatus for generating electricity." J. A. Craigie and A. Greenwood and D. R. Rohie. January 25th.

3,087. "Adapters for electric-lamp holders." E. Schattner. January 25th.

3,097. "Electro-deposition of bronze, &c." A. H. Fehr and D. H. Fehr. January 25th.

3,105. "Number-dials for automatic, &c., telephone systems, &c." J. E. Collver and E. A. Petithory and Siemens Bros. & Co., Ltd. January 25th.

3,106. "Protective devices for three-phase electrical distribution systems." Metropolitan-Vickers Electrical Co., Ltd., and T. W. Ross. January 25th.

3,119. "Electric lamps." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 25th.

3,120. "Indicating instruments" British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 25th.

3,145. "Means for converting polyphase electric currents into single-phase currents and vice versa. Allmanna Svenska Elektriska Aktiebolaget and E. Hedin and S. Norberg. January 25th.

3,157/58. "Electric rectifiers." P. Freedman. January 26th

3,165. "Automatic, &c., telephone systems." W. Aitken. January 26th.

3,166. "Electrically-driven centrifugal fans." D. A. Capewell and R. B. H. Gossage. January 26th.

3,171. "Production of chemical compounds or elements by gravitational translation of amalgam formed by electrolysis to hermetically-sealed receptacle." E. B. Barnett. January 26th.

3,175. "Aerials for wireless systems." G. P. Grenfell and J. Robinson. January 26th.

3,176. "Combined portable electric light and heater." W. Margolis. January 26th

3,182. "Electric woodworker." A. D. Plowman. January 26th.

3,209. "Impulse transmitters." Automatic Telephone Manufacturing Co., Ltd. January 26th. (U.S., February 13th, 1920.)

3,211. "Electric switches" A. Shore and A. P. Witchell. January 26th.

3,230. "Plug or connection for electric irons, &c." A. E. Barber. January 26th.

3,246. "Electro-magnetic switch devices" Metropolitan-Vickers Electrical Co., Ltd. January 26th. (U.S., February 20th, 1920.)

3,276. "Trolley trucks or conveyers for overhead cableways." S. A. Rogers. January 26th.

3,279. "Push-button elevators." O. Imray (Otis Elevator Co.) and Otis Elevator Co. January 26th.

3,280. "Electric switching mechanism." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 26th.

3,308. "Electrically-controlled gas valve." D. E. W. Rees. January 27th.

3,316. "Drums for electric cables." L. Dodson. January 27th.

3,328. "Magnetic separators." A. E. Davies and H. H. Thompson. January 27th.

3,331. "Electric torch." J. A. Francis. January 27th.

3,333. "Automatic electric switch." C. Donovan. January 27th.

3,337. "Magneto accelerator with automatic cut-out." V. Crighton. January 27th.

3,358. "Switch for tapping inductance of oscillatory circuit." H. P. P. Rees. January 27th.

3,360. "Electrical measuring-instruments." R. J. Miller. January 27th.

3,364. "Electrical means for detecting, indicating, measuring or utilising minute movements." J. J. Dowling. January 27th.

3,378. "Negative electrode for electric accumulators." A. Pouchain. January 27th.

3,381. "Sparking plugs." L. Wells. January 27th.

3,409. "Electric switches." C. C. Garrad and A. H. Railing and A. F. Searle. January 28th.

3,438. "Telephone call-register and check." H. A. J. Bronncker. January 28th.

3,445. "Electric device for regulating traffic and signalling." A. E. Chapman. January 28th.

3,446. "Welded joints for tramways, &c." H. Bolton and G. Wallace. January 28th.

3,447. "Starting and plug-cleaning device for internal-combustion engines." W. E. Coe. January 28th.

3,453. "Telephone attachment." H. W. Jameson. January 28th.

3,454. "Electric burglar alarms." Alarm Ges. für Einbruchsichere Anlagen and A. Bachmeyer. January 28th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

15,193. "Sparking plugs for internal-combustion engines." Soc. Clerget, Blin, et Cie. September 19th, 1917. (136,851.)

1919.

16,404. "Electric arc welding and like operations and electrodes therefor." C. J. Holslag. June 30th, 1919. (156,280.)

23,097. "Electric switches." Crompton & Co., Ltd., and W. F. Jones. September 19th, 1919. (156,301.)

23,450. "Electric generating plants." Austin Motor Co., Ltd., and C. B. Walker. September 24th, 1919. (156,303.)

23,496. "Minimum electric current indicators." T. Powell. September 24th, 1919. (156,304.)

23,739. "Process for the manufacture of metallic tubes." S. O. Cowper-Coles." March 22nd, 1920. (156,309.)

24,225. "Apparatus for the operation of a receiver with a plurality of separate receiving elements by a transmitter, applicable particularly for statistical or tabulating purposes." C. Borel. October 3rd, 1919. (156,322.)

24,406. "Amplifying device for use in wireless telegraphy and telephony." J. B. Bolitho. October 6th, 1919. (156,330.)

24,780. "Electric photographic printing or copying machines." J. Halden & Co., Ltd., and J. B. Halden. October 10th, 1919. (156,339.)

15,177. "Control of electric motors driving planers and the like." S. Gowan, L. Miller, and Metropolitan-Vickers Electrical Co., Ltd. October 14th, 1919. (156,343.)

25,199. "Terminal caps for electric conduits." F. I. Johnson. October 14th, 1919. (156,344.)

25,333. "Electric motor controllers." British Thomson-Houston Co., Ltd. (General Electric Co.). October 15th, 1919. (156,346.)

25,560. "Electro-magnetic mechanisms applicable to telegraphic and like purposes." Automatic Telephone Manufacturing Co., Ltd., and S. R. Smith. October 18th, 1919. (156,353.)

25,669. "Telephone transmitters." C. H. Pritchard and J. Mangles. October 20th, 1919. (156,354.)

26,487. "Starting devices for electric motors." British Thomson-Houston Co., Ltd. (General Electric Co.). October 28th, 1919. (156,363.)

27,608. "Automatic electric regulator." Y. Gehrig. November 7th, 1919. (156,372.)

28,296. "Sparking plugs." J. A. Moreau. August 6th, 1919 (Patent of addition not granted.) (149,924.)

30,278. "Spark-plugs for internal-combustion engines." H. G. Longford and W. A. Clark. December 4th, 1919. (156,391.)

31,220. "Electrically-propelled road vehicles." P. A. H. Mossay, Mossay & Co., Ltd., and Ransomes, Sims & Jefferies, Ltd. December 12th, 1919. (156,398.)

31,940. "Telephones." C. Kearton and G. B. Riley. December 19th, 1919. (156,403.)

32,327. "Electrically operated mechanism suitable for driving clockwork trains or the like." F. Holden. December 24th, 1919. (Addition to 118,329.) (156,408.)

1920.

52. "Enclosed bulb electric devices." General Electric Co., Ltd., and O. Durdle. January 2nd, 1920. (156,411.)

1,499. "Magneto generators." O. Imray (R. Bosch Akt.-Ges.). January 16th, 1920. (156,415.)

3,077. "Connectors for electrically-heated apparatus." K. W. Johansson. February 24th, 1919. (139,461.)

4,479. "Electrical illuminating-apparatus for kinematographic projecting-apparatus and the like." G. Teppati. August 27th, 1919. (150,297.)

5,421. "Gyro-compasses." Sperry Gyroscope Co. November 8th, 1917. (139,474.)

8,923. "Apparatus for the manufacture of copper cable tubes and other metal articles by electro-deposition." S. O. Cowper-Coles. March 26th, 1920. (156,441.)

10,319. "Method of and means for controlling resistances for electric circuits." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). April 13th, 1920. (156,443.)

10,542. "Electric gas-ignition devices." J. O. Delen. April 15th, 1920 (156,445.)

11,066. "Electric wave filters." Western Electric Co., Ltd. July 15th, 1915. (142,115.)

12,644. "Apparatus for taking kinematograph records." Petra Akt.-Ges. fur Elektromechanik. August 13th, 1919. (152,286.)

15,775. "Electro-osmotic separation of substances." Elektro-Osmose Akt.-Ges. (Graf Schwerin Ges.). April 8th, 1918. (144,710.)

15,902. "Apparatus for the automatic protection of three-phase current circuits." C. Zorzi. June 11th, 1920. (156,462.)

16,521. "Magnetic separators." F. Krupp Akt.-Ges. Grusonwerk. July 11th, 1919. (147,546.)

18,982. "Magnetic compasses particularly for use in submarines and the like." Werkstatten fur Prazisions-Mechanik und Optik Bamberg. May 24th, 1917. (147,032.)

33,806. "Electric arc welding and like operations, and electrodes therefor." C. J. Holslag. June 30th, 1919. (Divided application on 156,280.) (156,476.)

THE

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WORK AND PROSPERITY.

WE have shown, on several occasions recently, that plenty is essential to peace and prosperity; and this view is proclaimed on all sides by everyone who devotes serious thought to the subject. Mr. Clynes has said that plenty is the friend of the worker, scarcity the friend of the profiteer. *The Observer* calls on us all to get ahead with the work that wins, and in this phrase lies the gist of the truths we have endeavoured to put forward, in season and out of season, ever since the cessation of actual hostilities put peace among some of the less remote possibilities of a not too distant future. The debt incurred during the war amounts to the mortgaging of production. Without production there cannot be plenty, and production involves work, hard work, and continuous work. We have had our excitement, and now we have got to pay for it. We can only pay for it by work. Production has been one of the catchwords of the day, and it is time it was realised that plenty will be reached, permanent prosperity attained, only when everybody awakens to the fact that it is his or her duty to get on with the job immediately in hand.

This duty, according to our own impression, has been best realised by Belgium, of the allied nations, less well by Great Britain, and hardly at all by France. We expect it is realised in Germany more keenly than in Belgium, and it is from knowledge of the German temperament, not from ignorant fear, that we repeat our former warning that danger to British prosperity is more to be apprehended from impoverished Germany than from prosperous America. Adversity is a great producer of unity of effort. This was proved during the war, so far as the British nation was concerned, and adversity is unifying Germany now. Unless there is a very great increase in the co-operative spirit of which everyone was talking only yesterday—there are already ominous signs of weariness of the topic on both sides—unless this spirit manifests itself more certainly, the British Empire, having emerged victorious from the war, will be in a fair way to lose the peace.

But, it may be said, what is the use of telling everyone to work hard when a million workers are unemployed? Unemployment, as we said in a recent article, will be remedied when there is more business. Slackness of business is due to several causes, prominent among which are the restriction of credit and the crushing incidence of taxation upon industry.

The restriction of credit by the banks is an early step in the policy of monetary deflation to which the Government is committed. The Right Hon. Reginald McKenna, whose appointment to the important position of chairman of the London Joint City & Midland Bank, Ltd., and statesmanlike speeches in that capacity, may well make many people realise what a Chancellor of the Exchequer was here despised and rejected, threw a good deal of much-needed light on the financial situation in his address to the shareholders of that bank on January 28th last. The first step in inflation is taken when a bank makes a loan; the first step in deflation, therefore, is taken when that loan is redeemed, either willingly or under pressure. Deflation reduces prices, because purchasing power is diminished. Here it is necessary to discriminate carefully between the two meanings that can be attached to the expression "purchasing power." The purchasing power of the sovereign has diminished, and on the whole that is a bad thing, although, so far as the National Debt is concerned, there are redeeming features about the phenomenon. Purchasing power, in the sense in which Mr. McKenna used the expression, is created by the issue of loans, or paper money, in excess of gold reserves, and in the absence of commodities, the result is a general forcing-up of the number of paper tokens charged for such commodities as are obtainable. When credit is withdrawn, prices fall; but here care must be taken. They fall for the reason that the proportion of commodities to the purchasing power in existence increases; but they may fall, and are falling now, as a result of the compulsory liquidation of assets, the forced throwing upon the market of stocks of goods which the holder must turn into money, no matter at what loss, in order to live. This second fall operates to bring about scarcity, and if it lasts long enough, is bound to produce another rise in prices, so that the last state will be worse than the first.

For the reason that we are all accustomed to think in pounds, shillings, and pence, it is generally regarded as undesirable to obtain fewer pounds for a thing than were originally given for it. Hence a period of good trade is a period of rising prices. The falling prices, said to have brought about already a reduction of some 12 or 15 points in the cost of living, will not and cannot last beyond the time required for the realisation of stocks, unless more commodities are produced and made available, and that, too, without increase in the cost of production. In order to get to the beginning of a period of prosperity, prices will have to fall very considerably.

The question is one that is perfectly familiar to electrical engineers. Up to the point where the load factor, whether of a supply station or a factory, is 100 per cent. the total cost of production can always be reduced, because the standing charges are distributed over a greater number of units or manufactured articles. It is often thought that when this point is reached, further economies are impossible, because extensions are involved, and more capital has to be expended. But it must not be forgotten that if such extensions are carried out as economically as possible, the standing charges may not only not be increased, but may actually be further reduced, by the averaging process; and not only so, but the economy of operation of the new plant, being usually superior to that of the old, will tend to lower the running costs. Electrical engineers have learned that when an undertaking is threatened with a loss, the best way to avoid it, and to change the prospects from dull to bright, is to reduce the price per unit. The famous Bermondsey clause, by which the gas supply authorities endeavoured to make a loss on the electricity undertaking involve a compulsory increase in the price per unit, was not, of course, dictated by solicitude for the welfare of the electricity supply. It was directly against the interests of electricity, and was calculated, and intended, to play into the hands of the gas supply.

When a business is not making a profit, it is because of two reasons, which may operate together or separately. Either it is spending too much, or it is earning too little—generally both are true. If it is spending too much, economy must be practised. If it is earning too little—what then? Increase the fares at the holiday season, force up the telephone charges without discussion or notice? That is the Government way, and it is, in our opinion, a very bad way. Anyhow, no business firm could adopt such autocratic methods and expect to remain in business.

We venture to suggest that a better policy would be to encourage traffic, to endeavour to spread the load and increase the load factor. We see signs of an intelligent policy of this nature in cheaper evening telephone calls, and cheaper midday rides on the London tramcars and omnibuses. But week-end telegrams are dearer than ordinary telegrams; there are few excursion facilities, and those there are, are apparently grudgingly granted; the telephone service is not only dear and to be dearer, but it is inefficient to boot.

We constantly urge production—work and production. It is absolutely necessary to get the most out of the machinery available to us. It may be objected that none but standard goods can be produced except against definite orders, and what are we to do about non-standard apparatus, such as many classes of electrical goods? Here we are faced with the problem of selling, and we shall return to this in another article.

Compensation for Officials.

We hear that the Association of Staff Officers in Electricity Supply is keeping a sharp eye on the various schemes that are being formulated for the "electricity areas" delimited by the Commissioners. This Association, it will be remembered, took energetic action when the Electricity (Supply) Act was before Parliament. Section 16 covers compensation for deprivation of employment, but it does not define the exact compensation; it is, in general, such as a referee or board of referees may award. There is a proviso that such compensation shall, in the case of an officer employed at an annual salary, be based on, but not exceed, that possible in the Civil Service at the date of the local Government Act, 1888. There is much virtue in the definition "officer employed on an annual salary." The definition narrows down if interpreted very literally. We understand, however, that the Association is taking steps to secure, if possible, that a uniform basis shall be embodied in the administrative or financial section of each scheme, so as to make the compensation perfectly definite, and avoid quibbles and contention afterwards, which is very wise on the part of the Association. The Civil Service scale is its desideratum. The Association is evidently going to take no chances.

Directors are left out in the cold in this deal, no mention of them being made in Sec. 16. As a matter of fact, when the Act was before the House there was just a sporting chance that they would be included. One worthy member had tabled on the order paper an amendment to include directors in the share-out—but waiting his turn to move his amendment, the member lost his chance. The opportunity was lost in one of those sudden merry-go-rounds which sometimes happen in the Committee Room when clauses are being reshuffled. "And so the poor dog had none!"

What Constitutes Intimidation?

During recent years employers have become so accustomed to acceding to the demands of trade union officials that the necessity of solving the question: Has there been intimidation? has not often arisen. But the question does sometimes fall for decision in the courts. The case of *White v. Riley*, which is reported in the January number of the *Law Reports*, is a useful illustration. It was there held that the mere statement to an employer by a number of workmen that they will not work with another workman, and that if that workman is retained in the employer's service they will strike, even where they have knowledge that he cannot dispense with their services, does not of itself constitute an unlawful threat, and is, therefore, not of itself actionable. The facts of the case were that the plaintiff was a member of the Workers' Union. Having obtained work with a firm of curriers, he was asked to join the Curriers' Union, which he refused to do. The defendant was a prominent member of that union, who signed a letter on behalf of the other men in the shop which was addressed to the employers. The letter stated: "We hereby give you notice that we shall cease work on Friday next unless E. White either joins our society or leaves your employment." In consequence of this the employers gave the plaintiff a week's notice. He thereupon brought suit against the members of the union who had been employed with him, alleging that by conspiracy, threats, intimidation, and coercion they had caused his dismissal from his employment, and procured a breach by his employers of their contract with him. Mr. Justice Astbury found for the plaintiff, but his judgment was reversed by the Court of Appeal. The Master of the Rolls, in the course of his judgment, said: "It is clear that if a set of men object to work with another man or another set of men they have a perfect right to say that they will not work with him any longer, and, more than that, they have a perfect right to tell their employer what they are going to do. It is sometimes expressed by saying that they have a right to give him a warning, but they have not a right to threaten. Of course, both of those words are difficult to define, and I prefer to say that they have the right to make the statement to him that they are going to do it, and that whatever epithet or substantive you may apply to it, if they do not go beyond that there is no cause of action."

Industrial Efficiency.

The terms "industrial fatigue" and "industrial psychology" have become fairly familiar during the past few years in relation to the attempts that have been made in this country, following on the more detailed work that has been done in America, to diagnose industrial fatigue, and, in short, increase output. There are signs, however, that the temperament of the British worker (by which we do not necessarily mean the manual worker) does not lend itself kindly to the processes of self-analysis which seem to have found so much favour in America, and it is not surprising, therefore, that there is an inclination on the part of the British school of industrial psychologists to abandon the rather narrower scope of their investigations into industrial fatigue, and to adopt a broader and more comprehensive outlook by extending their studies and embracing within them the whole subject of industrial efficiency, thereby dropping the two terms mentioned above, which, together with another, namely, "scientific management," have not altogether impressed themselves favourably in this country, outside, of course, those who wish to impose the results of them on industry.

In spite of the volumes which have been written upon the subject, it is now admitted that there is not, and, we venture to think, never will be, a satisfactory definition or a satisfactory test of fatigue, for, as Dr. C. S. Myers, F.R.S., Director of the Psychological Laboratory at the University of Cambridge, recently pointed out, a mechanical dead level of factory output throughout the day, which seems to have been the aim of a good many psychological students, is surely unrealisable, having regard to the many human factors that must come into play in relation to a man's work, no matter whether it be manual or mental. If this limitation is accepted, and we think that it must be, greater progress will be made in the application of some of the principles which have come to us from the United States by a closer attention to the general question of industrial efficiency, and, looked at in this light, it can be at once said that we in Great Britain do not compare so unfavourably with America in this respect as some would have us believe. It is a curious thing that in all discussions of this kind almost sole reference is made to what has been done in America, and it is not surprising that this is just a little apt to get on the nerves of those to whom these discussions are addressed. As a matter of fact, a great deal of good, solid work has been done in the various industries in this country with regard to improving industrial efficiency, and at the same time lessening the strain on the workers and improving their conditions generally, although not much has been said about it, because, perhaps, dealt with in this general way it does not lend itself to that picturesque presentation to the hearer that some of these specialised inquiries carried out elsewhere have allowed of.

One or two similar inquiries were carried out in this country under war conditions, but even the Industrial Research Board itself now admits that they have little bearing upon the commercial aspect as it presents itself in peace time. Things have, to some extent, crystallised themselves by the formation of the National Institute of Industrial Psychology, which has been established by voluntary support, and provides a body to which employers of labour can now turn for assistance and guidance as regards their own particular problems, leaving it to the Industrial Fatigue Research Board to carry out its inquiries on behalf of the Government for industries as a whole. Many employers of labour, and most employés, will welcome this change of attitude, for it is another instance of the folly of bringing from other countries ready-made theories, and endeavouring to adapt them to practical conditions, elsewhere, which are very far from fitting those theories. Industrial efficiency is a sphere of study and investigation which is bound to appeal to everybody, and the employé's co-operation can be the more readily obtained when he realises that the whole of his industrial conditions are under consideration, rather than the application of some particular theory which it does not take a very keen intellect to imagine, rightly or wrongly, has one object, *i.e.*, greater output, without any broad consideration of the human side of the problem.

The Severn Barrage Scheme.

The discussion at Birmingham in which members of the Institutions of Civil, Mechanical, and Electrical Engineers took part was not only interesting in itself, but also marks a new departure which may lead to very useful results. Joint meetings, it is true, are not novel, but a conference of the three leading institutions on an engineering project which is still in the lap of the future is a welcome innovation.

It was pointed out that the cost of the scheme under existing conditions would be prohibitive; on the other hand, Mr. Addenbrooke showed that in any event it would not be possible to commence work on the site for at least four years, and that the type of plant to be employed need not be settled for two years longer. Hence there is ample time for consideration of the details, and by that time the cost of labour and materials may, and probably will, have been reduced to a more practicable level.

Mr. Chattock held that by adopting the Thury system the cost could be greatly reduced, and on this basis Mr. N. Rosher estimated that to transmit 100,000 kW to Birmingham would require overhead lines costing one million sterling; assuming the cost at the Severn to be ½d. per unit, the selling price in Birmingham could be 0.8d. per unit. There was, however, plenty of opposition to the scheme from speakers of considerable weight. We think that the discussion was a fruitful one; it will be reported in our pages at an early date.

THE ELECTRICITY (SUPPLY) (No. 2) BILL, 1920.

By A LEGAL CONTRIBUTOR.

The Electricity (Supply) Bill (Bill No. 67 of 1920) having been dropped, a new Bill (No. 263) has been introduced to take its place. The first Bill was said to have reproduced "subject to one or two small amendments, the provisions of last year's Bill as passed by the House of Commons which were struck out by the House of Lords," but the "striker out" has also been at work on Bill No. 263, from which some very important clauses have been excluded.

The provisions relating to the establishment of district electricity boards, together with certain important clauses referring to the vesting of generating stations and main transmission lines by those boards are all deleted, but notwithstanding these and other changes, the legislation now proposed involves questions of far-reaching importance to those who are concerned with the supply of electricity. It is proposed to refer to some of these in the hope that Parliament may realise their importance to the industry. In a recent article on "The Jurisdiction of the Electricity Commissioners,"* the present writer was dealing only with the Act of 1919 which was and is *un fait accompli.* The following notes, which refer to a mere Bill which may still be amended or even withdrawn, may, therefore, serve a more practical purpose in drawing attention to some points which are only to be discovered by a very careful scrutiny of the language of the proposed measure.

Clause 1 empowers a joint electricity authority to borrow money: (*a*) for the payment of the purchase price of any generating station or main transmission line transferred to, acquired by, or vested in a joint electricity authority under the Act of 1919, or of any undertaking or part of an undertaking acquired by the authority under that Act; (*b*) for the purpose of any other payment or of any permanent work or other thing which the authority is authorised to execute or do, the cost of which ought, in the opinion of the Commissioners, to be spread over a term of years; (*c*) during the first three years after the establishment of the authority for the purpose of providing working capital.

All money so borrowed may be charged on the undertaking and the resources of the joint authority or on any specific property forming part of the undertaking. It is to be repaid within such period as the Commissioners may determine. The annual provision required to be made by a joint electricity authority or by a local authority for the repayment of money borrowed for the purposes of the Electricity Supply Acts may be suspended whilst the expenditure out of such moneys remains unremunerative for a period of not more than five years.

When the duties and powers of a joint authority under the Act of 1919 are considered, the importance of its being able to borrow money will be realised.

The *duties* of a joint authority are: —

1. To provide or secure the provision of a cheap and abundant supply of electricity (S. 8 (1)).
2. When so *ordered* by the Commissioners, to supply electricity in such areas and on such terms and conditions as may be specified (S. 12 (3)).
3. To furnish accounts, statistics, and returns to the Electricity Commissioners.
4. To establish a fund into which all its receipts are carried, and out of which all payments by the authority shall be made (S. 28 (1)).

Joint authorities also have certain powers, of which the following can be exercised without the consent of the Electricity Commissioners: —

(*a*) The supply of electricity within their districts (S. 12).

(*b*) The right to obtain wayleaves (S. 22 (1)).

(*c*) The right (where authorised by order or special Act to supply electricity) to repair, maintain, or remove electric lines and fittings (S. 23 (1)).

(*d*) The right where so authorised by order or special Act to manufacture and sell electric lines and fittings (S. 23 (1)).

The following powers are exercisable by a joint authority with the consent of the Commissioners: —

(*a*) Purchase (by agreement with the owners) of any generating station or main transmission line (S. 9).

(*b*) The right of compulsory purchase of an undertaking which is at present vested in a local authority (S. 13 (2)).

(*c*) The right to purchase the whole or any part of the undertaking of any authorised undertakers by agreement (S. 13 (4)). Incidentally it may be observed that the right so to sell is by this Act expressly conferred upon all authorised undertakers.

(*d*) To enter into agreements for the use of water power, waste heat, or other form of energy (S. 15 (2)).

(*e*) The right to erect, maintain, alter, and renew any by-product plant (S. 16 (4)).

(*f*) To subscribe to associations (S. 30).

Having regard to the fact that money will be required for exercising the above powers and carrying out the above duties, it seems that the Act of 1919 may become to a large extent a dead letter if the financial provisions of the new Bill of 1920 are not retained.

Some questions of a practical rather than a legal nature appear to arise upon this proposal to grant extensive borrowing powers to these new bodies. What effect will the Bill—even if it only remains a Bill—have upon existing authorities which, in circumstances of extraordinary financial difficulty, are now endeavouring to supply the public with electricity? Suppose that *they* want new capital, will the fact that other bodies, their potential rivals, may borrow money also help them to raise it? Were the financial world all agog to supply existing companies with fresh capital to build new stations or lay new mains the present might be an opportune time to enable the joint authorities to enter the money market as borrowers; but in the existing state of affairs, the policy of enabling any new "local authority" to borrow money appears to be highly inexpedient.

Clause 3 enables the Commissioners to authorise a joint authority to issue stock bearing interest at such rate as the authority with the consent of the Commissioners may determine.

Clause 4, which enables undertakers to give financial assistance to a joint authority, rather suggests that in the view of those responsible for the promotion of the Bill, a joint authority may have some difficulty in raising money. It provides that authorised undertakers in the area, local authorities, and other bodies or persons who receive or intend to receive a supply from the joint electricity authority may lend money to the joint authority, subscribe for any securities issued by that body, and guarantee or join in guaranteeing the payment of interest on any money borrowed by the authority. If a local authority advances money for any of these purposes the amount so advanced is not to be reckoned as part of the total debt of the Council for the purpose of any limitation on borrowing.

Clause 5 makes further provision for the expenses of the Electricity Commissioners. S. 29 of the Act of 1919 provided, in effect, that the expenses of the Commissioners were to be paid by "the several joint electricity authorities and authorised undertakers within the United Kingdom in proportion to the number of units of electricity generated by or on behalf of those authorities and undertakers respectively in the preceding year." The new Bill provides that where an undertaker obtains a supply from any source other than the joint electricity authority or an authorised undertaker the number of units of electricity so obtained by such authorised undertaker shall be deemed to have been generated by that authorised undertaker. It seems from this that undertakers who take a supply in bulk from an authorised distributor or a power company will not be liable to the levy. Those liable to the levy must make a return to the Commissioners of the number of units generated or obtained by them. If no such return is made, the Commissioners may make an apportionment based on estimates, and the apportionment will be conclusive.

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* Elec. Rev., Dec. 10th, 1920, p. 646.

Perhaps the most remarkable clause in this Bill is that which specifies the powers exercisable by the Electricity Commissioners when authorised undertakers are unable or unwilling to give facilities. The clause in question (Clause 8) (which was Clause 17 in the former Bill) provides that on the application of any joint authority, the Commissioners may, after hearing the parties interested, by order require any authorised undertakers to give such reasonable facilities for the supply of electricity within their area of supply as may be specified in the order, including the provision of new works, and if any authorised undertakers are unable or unwilling to comply with any such order, "the Minister of Transport, on the representation of the Commissioners, shall have power, notwithstanding anything in the principal Act or this Act or in any order or special Act, either :—

(*a*) To order that the undertaking of the authorised undertakers, or any part thereof, shall be transferred to the joint electricity authority upon the terms prescribed by Section 2 of the Electric Lighting Act, 1888; or

(*b*) To confer on the joint electricity authority power to supply electricity within the area of supply of such authorised undertakers or any part thereof."

Certain observations upon this very important clause suggest themselves. In the first place, the Commissioners can only be called upon to act by a joint electricity authority if and when that body is called into being. The Commissioners cannot act *mero motu*. The clause, therefore, can only affect a particular undertaker after a joint authority has been formed in the district.

Again, while it is difficult to imagine the Commissioners listening to any complaint by a joint authority unless they are satisfied that the joint authority is ready and willing to step in and make good the defect itself, there is nothing to compel the Commissioners to defer the hearing of an application. "Reasonable facilities" are not defined in the Bill or in the Act of 1919. It is conceived that even if the undertakers could show that they were unable to grant a supply, either because the Commissioners had refused to allow them to erect a generating station, or because owing to high working costs and the smallness of their authorised charges they were unable to provide electricity on a commercial basis, the Commissioners would still have power to make a requirement. It is presumed that the phrase "after hearing the parties interested" involves that the Commissioners before making a requirement shall hold an inquiry pursuant to Sec. 33 of the Act of 1919.

The Commissioners having made a "requirement," and the undertakers having expressed themselves "unable or unwilling" to comply with it, the Minister of Transport may do one of two things. He may order that the undertaking shall be taken over by the joint authority on "compulsory purchase" terms, or he may give the joint authority power to supply in the area.

There is nothing in the Bill to show what steps the Minister shall take before making such an order. It is not, apparently, like a special order within the meaning of Sec. 35 of the Act of 1919, which cannot be confirmed unless an inquiry is held by an independent person appointed by the Minister. Yet it is inconceivable that the Minister would make an order depriving statutory undertakers of their statutory rights, or which, by letting a joint authority in to compete, would reduce those statutory rights to a nullity, without an independent inquiry. He might accept a ruling of the Commissioners that their requirement was proper in justice and in reason; but there is grave reason to doubt whether the undertakers would always so accept it.

There is another point about this clause which undertakers in general and power companies in particular should be careful to note. It takes away a privilege, or at any rate a seeming privilege, conferred by the Act of 1919. Observe that the Minister may exercise his power "*notwithstanding anything in the principal Act.*"

Turning to the Act of 1919 it will be found that Sec. 12 (1) (*b*) provides that a joint authority may not supply power in any part of the area of a power company without the consent of the company, which consent is not to be unreasonably withheld. If the Bill now before Parliament becomes law, the fact that the power company withholds consent is of no consequence, provided the Commissioners have made a requirement with which the company is unable or unwilling to comply. It is true, of course, that if a power company withholds consent, Sec. 12 (1) of the Act of 1919 allows the joint authority to appeal to the Commissioners, and the Minister of Transport may in certain circumstances dispense with consent. Thus they may dispense with consent if consent is unreasonably refused or withheld, and the consent shall be deemed to be unreasonably refused or withheld if the company is not willing and in a position to give the requisite supply upon reasonable terms and within a reasonable time, and in considering what are reasonable terms and what is a reasonable time the Minister shall, amongst other things, have regard to the terms upon which and the time within which the joint electricity authority and the power company are respectively willing and able to give the supply.

It is obvious that while this provision remains in force, those responsible for the management of a power company who are manfully endeavouring to carry out their statutory duties are in a large measure protected. They cannot be required to do what is unreasonable—*e.g.*, to supply energy at 1d. a unit which costs 2d. a unit to produce; nor (it is submitted) can the question whether their refusal is unreasonable or not be entertained unless there is a joint electricity authority able and willing to give a supply within a specified time. As soon, however, as the Bill of 1920 becomes law (if it ever does) the question of reasonable facilities will fall to be decided not by the Minister but by the Commissioners, who may, if so advised, pay no attention to the fact that the joint authority is neither ready nor willing to step in and do the work. This, of course, is to put an extreme case, and to make a very unlikely supposition; but Acts of Parliament—and still better Bills before Parliament—are best criticised in the light of extreme cases. Moreover, it is to be borne in mind that (as already indicated) the joint authority is to supply electricity in such areas and on such terms and conditions as may be specified (see S. 12 (3) of the Act of 1919). The Commissioners would certainly have power, if they thought fit, to exercise it and to authorise the joint authority to supply on terms much more favourable than those conferred by Act of Parliament upon the unfortunate power company.

New Zealand Public Works.—The Department of Overseas Trade has received from H.M. Trade Commissioner in New Zealand (Mr. R. W. Dalton) a copy of the Annual Statement of the Minister of Public Works for the year 1920. The statement, which embodies the report of the chief electrical engineer, contains results of the working of existing hydro electric installations and information concerning progress on the Government's hydro-electric schemes in North Island, as well as particulars concerning the work of electric power boards which have been set up. The statement deals also with railway and harbour works as well as tramways and irrigation, and may be examined by interested United Kingdom firms on application to the Inqniry Room of the Department of Overseas Trade, 35, Old Queen Street, S.W. 1.

THE EFFICIENCY EXHIBITION.

A period of trade depression and low output might, at first thought, be characterised as an inopportune time at which to hold an exhibition. Nevertheless, a slack time offers many opportunities to those possessing foresight and imagination for reorganisation with a view to business improvement, and to this end the Efficiency Exhibition at Olympia, which has been organised by the *Daily Mail* [Associated Newspapers, Ltd.], should be of some assistance. Its scope may be gauged from the fact that an attempt has been made to cover scientific, industrial, commercial, civic, national, and personal interests, the aim of the organisers being to direct the light of publicity on to ideas, methods, and devices which are calculated to conserve time, energy, and money, and to increase the results obtained by means of human and mechanical energy by the elimination of waste in its broadest sense.

The Exhibition, which remains open until the 26th inst., was opened in a somewhat unconventional manner on Thursday last week by the Right Hon. Sir Robert Horne, President of the Board of Trade. Standing on the platform of the Marconi Co., Sir Robert spoke into a wireless telephone receiver, and his words were conveyed to the far end of the hall and echoed back by means of a combination of wireless apparatus and the "Stentorphone," so that they were heard plainly by all. After the opening ceremony, Sir Robert and the guests proceeded to inspect some of the 200 stands, of which about two dozen are of more or less electrical interest, on which the exhibits are demonstrated. Displays have been arranged by the Ministries of Labour and Health, the Overseas Trade Department, the Federation of British Industries, the Industrial League and Council, and a number of universities, hospitals, technical colleges, and associations.

The programme of conferences which have been arranged to take place at Olympia during the run of the Exhibition covers a variety of interests, and amongst the subjects to be discussed the following are to be found:—Commercial education, fatigue elimination, traffic control, roads, management, co-operation, production and unemployment, fluorescence and ultra-violet light, X-rays and their uses, and radium and its rays. A conference on electric power in industry, arranged by the Electrical Development Association and presided over by Mr. C. H. Wordingham, C.B.E., was to be opened this morning by Mr. J. C. Wigham, and in addition, a number of important technical associations are to hold receptions on various dates, that of the Electrical Development Association having been held yesterday afternoon. In order to encourage attendance at the Exhibition, the *Daily Mail* has offered four four-years' external scholarships, each of the total value of £250, to British-born students, men or women, who are engaged, or about to be engaged, in whole-time business or industrial employment. The scholarships have been arranged with the authorities of the University of London, who will undertake the administrative work in connection with them, and the degree for which successful candidates will prepare is that of Bachelor of Commerce.

One of the most important exhibits is that illustrating the work of the **Ministry of Labour's Industrial Training Department**, which is responsible for the intensive training of ex-Service men in skilled trades, and the whole of the Olympia annexe is devoted to showing how ex-soldiers and sailors are quickly trained, and to working exhibits, representing some 48 different trades, from the various schools. The whole of the fittings of the 39 stands in the annexe, together with the decorations and notices, have been made and fitted up by disabled ex-Service men undergoing training. An electrical stand is always attractive, and on the one in this section many modern appliances are on view, such as examples of electric irons, armatures, radiators, switches, signs and circuit-breakers. Men at work on jointing, winding, &c., can also be seen.

Briefly outlined, the training system is this :—The disabled man is interviewed and allocated to a congenial and suitable trade in which his disabilities will prove no, or as small a handicap as possible. Then, for a period of from six to twelve months on an average he is trained in one of the Government Instructional Factories, afterwards being transferred to a private workshop for a further training period which varies according to his trade. During this latter period of improvership the employer is asked to pay a learner's wage. The training is designed to give the man a practical knowledge of the processes he will be required to undertake in an ordinary workshop, but supplemented by demonstrations in essential theory, and the atmosphere of the Institution is such that the man's transition from the school to the factory is as frictionless as possible. The intensive system of training considerably reduces the time necessary to train a craftsman, but it cannot make private workshop experience superfluous, and it is in this respect that employers can help. The appeal of Dr. J. T. Macnamara, Minister of Labour, to the public, and in particular to all employers to visit the Exhibition, see what has been done, and then give them a helping hand, should meet with an immediate response ; 36,000 men have been trained, 25,000 are receiving their training, and there is a waiting list of 16,000 names. We owe these men not only admiration, but also gratitude, and our debt will not be paid until a place such as they deserve has been found for them in the national industry.

In one respect the exhibits of the **Middlesex Hospital Research Departments** may be regarded as an integral portion of the hospital ; the tests being carried out on the stand are identical with those used to aid diagnosis and indicate treatment in practice, they represent part of the hospital's daily routine. In another respect the methods of research as employed in the advancement of medicine and in teaching students are represented. Research is of many kinds and needs special apparatus ; some of this is demonstrated, including a set to illustrate the evolution of apparatus used in the examination of the heart in living subjects, beginning with a simple roll of paper, and ending with the complex electro-cardiograph which has been lent by the Cambridge and Paul Instrument Co. A complete outfit for the employment of X-rays in diagnosis and research has been lent by Messrs. Watson & Sons (Electro-Medical), Ltd., and a selection of X-ray photographs and negatives is also on view. Messrs. Schall & Son have lent a viewing box for examining X-ray negatives, and the Cox-Cavendish Electrical Co., Ltd., a 1921 model of a vertical stand for screening and radiography in an upright position. For the examination of the chest or alimentary tract the radiographer has to be able to make a fluoroscopic examination, and then to be able to take a radiograph immediately afterwards ; to effect this safely and conveniently is the function of the apparatus. For the protection of the operator the tube is enclosed in a large box covered with 2 mm. of lead sheet, and a second line of protection is provided by means of a large lead-lined screen between the patient and the operator. All controls are on the front of the stand, and the inward movement of the screen and plate holder is unique. The indicator on the front of the stand automatically registers the tube to plate distance, and both 6 and 10 cm. stereoscopic stops are provided ; the freedom of the moving system depends upon the use of ball and roller bearings. Finally, the action of radium rays on germinating beans comprises another of the numerous interesting demonstrations on this stand, and it will be noted that the result is to check the growth.

Messrs. Sheringham Daylight, Ltd., claim that accurate artificial daylight can be obtained from ordinary electric lamps by the addition of the "Sheringham daylight shade" and duplicate-coloured objects shown on the stand, and illuminated by means of the two kinds of light, demonstrate the truth of the claims made for the invention. Shades of various types are now being manufactured and used in this country, and attention is directed to the

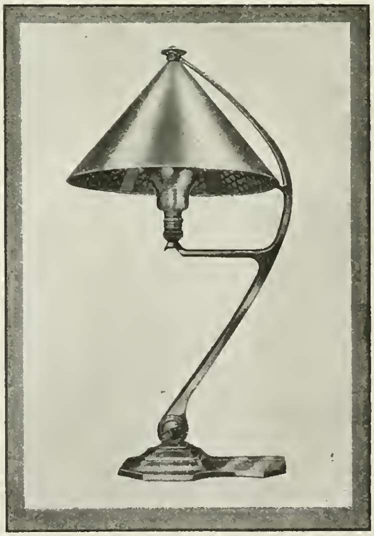


Fig. 1.—Sheringham Daylight Table Lamp.

new table lamp type illustrated in fig. 1 ; this lamp is 30 in. high, the diameter of the shade being 14 in., and the lamp used should be a 150-watt gasfilled one ; the fitting is made of polished aluminium.

Messrs. Scholey & Co., Ltd., exhibit a variety of fractional horse-power electric motors for every domestic and industrial purpose, in sizes of from 1/50 h.p. upwards of the series-wound "Universal" self-cooling type. "Kutmore" portable electric drills possess original features, and the "Croydon Premier Handelek" electric suction cleaner has been specially designed for industrial work where the domestic pattern would not be suitable. The popular British-made "Scholeymotor" has been fully described in our columns ; fig. 2 shows the machine adapted as a charging set for motor garages, medical purposes, &c., while fig. 3 shows an electric blower which has a wide range of usefulness in forge and factory. *(To be continued.)*

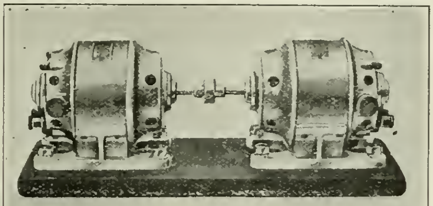


Fig. 2.—Scholeymotor Battery-Charging Set.

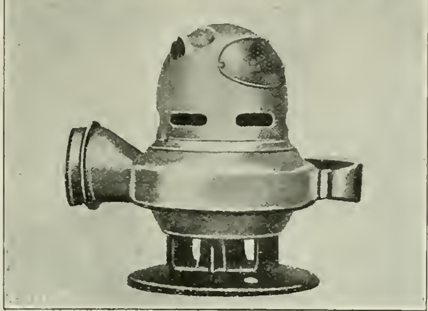


Fig. 3.—Scholey Blower.

THE MAGNETIC FIELD.

By A. G. WARREN, B.Sc., A.M.I.E.E.
(Professor of Electrical Engineering, University of Hong-Kong.)

The energy of an electrostatic field is usually considered as being due to some form of stress in the ether. The magnitude and distribution of the energy is expressed by the relation $W = \lambda F^2/8\pi$, where F is the intensity of the electric force, λ the dielectric constant, and W the energy per unit volume. It is not intended to question seriously this view of the situation ; it probably represents accurately the facts as already known ; at least it is a convenient working hypothesis and, with our modern catholicity of view, it serves whatever one's beliefs may be about the ether in which the energy is supposed to be resident.

When an electric field is set in motion, forces of another nature, namely magnetic forces, are experienced. The fundamental facts of both electric and magnetic forces were known long before the interconnection between them was realised ; magnetism and electrostatics grew up as two strangely parallel, but different sciences. As such they remain largely to-day, despite early suggestions that magnetic phenomena might be electric in their origin. The magnetic field is treated in a manner very similar to the electric field, the energy stored in it is expressed in an exactly similar way ($W = \mu H^2/8\pi$), almost without question regarding the validity of the conception underlying this mode of representation.

The alternative method is to regard the electric field as capable of possessing, like matter, both potential and kinetic energy. To the retention of the terms "magnetic field" and "energy of the magnetic field" as convenient expressions in a mental "shorthand," no objection can be raised, but until it has been shown that a magnetic field can exist independently of a moving electric field, its assumption as a separate entity is unphilosophic and violates the fundamental principles of scientific method.

The unscientific process of multiplying existences beyond what are really necessary for the description of phenomena is, perhaps, inevitable while a science is still in the empirical stage. But with a growth of knowledge, "Occam's razor" must be ruthlessly applied in cutting away all redundant conceptions which have no further service than that of veiling the facts. A theory disproved is a theory rejected, but unfortunately a theory which is merely redundant is often allowed to continue its existence. To this, from the point of view of the acquisition of facts, little objection might be taken. Redundancy of concepts is unscientific, yet it does not seem to offend the scientific mind as often and as definitely as it ought, but it is believed that the conception of the magnetic field can, and does, lead occasionally to erroneous results.

The facts of both permanent magnetism and electromagnetism present little difficulty in terms of the electron theory of matter. In the case of a conductor conveying a current, the "magnetic energy" may be considered as the kinetic energy of the moving electric field ; it is not necessarily to be expected that the moving electric field should be evident from its electrical effects. In the steady flow of a current along a conductor the loss of free electrons from any element of volume is accompanied by a statistically equal accession, and the electric force experienced at any point due to the element is unchanged, except in so far as the motion of the electrons modifies their fields of force. In fact, the force due to any particular element may be zero, and there still be considerable kinetic energy.

But it is when we come to consider the relativity of energy that the conception of the magnetic field as a separate entity fails to satisfy. The kinetic energy of a moving mass with respect to an observer is measured by the product of one-half its mass and the square of the relative velocity of the body and observer. Without an observer, kinetic energy is meaningless.

The same body may possess different amounts of kinetic energy for different observers ; to an observer moving with the same velocity as a bullet the latter possesses no kinetic energy, and is harmless. These features of moving material bodies are also characteristic of moving electric fields. Let us consider the radiation of an electromagnetic wave. This does not consist of the radiation of electric *and* magnetic energy ; it consists of the radiation of an electric field. To an observer this field possesses energy of two kinds, one potential and the other kinetic, the magnitude of the latter being conditioned by the relative velocity of the field and observer.

If the direction of motion of the wave be from left to right in the plane of the paper, a stationary observer with the proper instruments will experience an inwardly directed magnetic force when the electric force is downwards, and an outwardly directed magnetic force when the electric force is upwards. As far as all stationary observers are concerned, the actual conditions could be exactly imitated by the fictitious radiation simultaneously of electric and magnetic fields suitably disposed. If such were actually the radiation, motion of the observer towards, or away from, the source of radiation would result only in a change of frequency of the observed effects. But this is surely not the case. The magnetic effect of a moving electric field is proportional to its velocity ; to an observer travelling opposite to the direction of the wave the magnetic force is enhanced ; in other words, the kinetic energy of the moving field is increased to such an observer. To one travelling in the same direction as the wave the magnetic force is diminished with the decreased kinetic energy, and to an observer travelling at the same velocity as the wave there is no magnetic force ; for him the wave possesses no kinetic energy.

The magnetic field is not radiated with the electric field ; it is not a self-existing entity. It only exists for observers over whom the electric field passes. The "magnetic field" is a function of two entities, viz., the electric field and the observer or detector ; if either be absent, the phrase is meaningless.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR JANUARY, 1921.

A slight improvement occurred in the position during January; exports rose by £71,018, or just over 4 per cent., while imports fell £75,454—17 per cent. Re-exports also showed a decline of 35 per cent. The principal increase in the export figures was represented by "other motors and generators," which rose 27 per cent.; appreciable increases also occurred in the export of insulated wire, glow lamps, meters, and telegraph and telephone wire and cable. The lower import figure was occasioned by declines in telegraph and telephone instruments and apparatus (44 per cent.), glow lamps, unenumerated electrical machinery, &c.

Values of Electrical Exports and Imports for January, 1921.

	Exports.	Imports.	Re-exports.
Electrical goods and apparatus (unenumerated)	£248,659	£109,941	£14,682
Insulated wire	392,250	11,838	—
Glow lamps	42,865	19,719	4,212
Arc lamps and parts	1,959	4,060	—
Batteries	86 008	17 764	—
Meters	49,141	16 329	4,750
Carbons	18,775	18,107	204
Electrical machinery:—			
Railway and tramway motors ...	33,287	—	—
Other motors and generators ...	243 397	—	—
Electrical machinery (unennmerated)	168,448	111,001	8,600
Switchboards (not telegraph or telephone)	22,408	218	60
Telegraph and telephone cable and material:—			
Telegraph and telephone wire and cable (not submarine)	197,482	15,851	—
Submarine telegraph and telephone cable	93,498	—	—
Telegraph and telephone instruments and apparatus	141,853	28,816	6,590
Totals... ...	£1,740,030	£353,644	£39,098

The total number of electric glow lamps exported during last month was 598,077 as against 134,968 in January, 1920, and 286,496 in January, 1913. The electrical glow lamps imports for the same periods were 226.591, 382,919. and 309 825 lamps respectively.

The weight of electrical machinery exports for January, 1921, reached 1.846 tons, as compared with 942 tons and 2,528 tons for January, 1920 and 1913.

LEGAL.

Failing to Fence Machinery.

David Muir, colliery manager, Auchterderran, and James Macfarlane, colliery manager, Bowhill Fife, at Dunfermline Sheriff Court, on Monday, were charged with failing to have properly fenced an electrically-driven shaft at a sawmill at the pithead of Bowhill Colliery, as a result of which a girl was caught and received injuries, from which she died. Both pleaded guilty. Agent stated a *bona fide* attempt had been made to fence the place, and for five years work had gone on without accident. The pit was the largest in Fife, there being a large number of officials upon whom duties devolved, and it was difficult for the two managers to see that everything was done. About five-sixths of the machinery was fenced, and in the opinion of the workers the place was perfectly safe. The Sheriff fined each £5 with the option of 30 days' imprisonment.

Quitman *v.* Amalgamated Electric Works.

In the Lord Mayor's Court, before the Common Serjeant (Mr. H. F. Dickens, K.C.), a claim was made by Messrs. Carl Quitman, glass merchants, 3, Cloth Street, Long Lane, E.C., against the Amalgamated Electric Works, Ltd., St. Mary Axe, E.C., for £35 2s. for white opal globes sold and delivered, or in the alternative, for goods bargained and sold.

Judgment was entered for the plaintiffs for the amount claimed, £35 2s., with costs.

Hartley *v.* Lancaster Corporation.

An action was brought against the Lancaster Corporation Electricity Committee at Lancaster County Court by Mr. W. Hartley, electric boot repairer, to recover £17 3s. 4d., alleged to have been overcharged in his electricity accounts during the past nine years. It was pointed out that under the Statute of Limitations only six years were recoverable, if anything. Plaintiff, who conducted his case in person, said he had recently discovered that he was charged for his motor as if it was 2½ h.p., when it was only 2 h.p. The difference in the rate was £1 against 16s. 9d. After a lot of argument, the chairman of the Electricity Committee offered him £4 to square the account, but he told him he would have half or nothing of the £17. For 40 bills he had been charged at the 2½-h.p. rate.

Major Milnes, electrical engineer, said the motor was in when he came to Lancaster, and plaintiff had made no complaint till now when he tested the motor and found its capacity was 2 h.p., but he had been charged at a comparatively easy rate. A motor could intermittently increase in load about 25 per cent.

His Honour sympathised with the plaintiff, and recognised he had been overcharged, but pointed out the accounts were settled and could not be reopened, though the Corporation had made a mistake.

Mr. Oglethorpe, for the Corporation, agreed to repay £4, and the case was withdrawn.

"Hotpoint" Electrical Household Appliances: Application for Trade Mark.

Mr. Justice P. O. Lawrence, in the Chancery Division, on Thursday, February 10th, gave judgment in an application by the Hotpoint Electric Heating Co., of Ontario, California, for the registration of a trade mark under paragraph 5, section 9, of the Trade Marks Act, 1905.

Mr. Kerly, K.C., who appeared for the applicants, said the opposition came principally from the Dowsing Radiant Heat Co., Ltd., who said that they had succeeded to the business interest of Messrs. Eastman & Sons (dyers and cleaners), Ltd., and Warne in the sale of "Hotpoint" flat irons.

Mr. Arthur Colefax, K.C., for the respondents, said the Dowsing Co. took over that business as from 1914.

Mr. Kerly, continuing, said that on January 23rd, 1917, the applicants applied to register as a trade mark the word "Hotpoint" for a considerable range of electrical appliances for cooking, washing, heating, and cleaning purposes, but the application was referred to the Court, and they were directed to serve notice upon the present respondents. He did not think there would be any question as regarded all kinds of electrical apparatus except flat irons. "Hotpoint" had for many years been distinctive of the applicants' goods, but he claimed that for flat irons as well. He could not dispute, however, that to his knowledge since 1910 the respondents had used "Hotpoint" for certain flat irons which were not the applicants', but he would ask his Lordship to say that the latter began business before the respondents. There was a good deal of confusion in the minds of the public with regard to the word "Hotpoint," and the respondents' irons had been mistaken for those of his clients. He was not suggesting that there had been any fraud, but it might be that there ought to have been concurrent registration. Confusion, he said, had been constant with regard to the applicants' irons, which had frequently been sent to the respondents for repairs.

Mr. P. H. Booth, vice-president of the applicant company, said there was substantial use of their flat irons in this country before 1911 under the name "Hotpoint." He knew that from 1909 onwards the respondents had been advertising "Hotpoint" irons here. He was unable to say whether the first newspaper advertisement of the applicants here was on May 13th, 1915.

Mr. Danckwerts, who represented the Board of Trade, contended that the word "Hotpoint" being descriptive, the evidence as to user, in order to make it distinctive, must be clear and satisfactory, which was not so in this case. User, in fact, was comparatively short, and there was every possibility of confusion in the case of the flat irons, as "Hotpoint" irons were made by other people.

His Lordship held that apart from flat irons, the word "Hotpoint" had become distinctive of the applicants' goods; and he saw no ground for saying that, because there might be some confusion in the minds of persons buying flat irons, this was a good reason for refusing the mark in respect of the other appliances. He directed the Registrar to proceed with the application.

Craig-McKerrow *v.* Matthews & Yates, Ltd.

Mr. Pollock, High Courts Official Referee, on February 14th, concluded an action in which Mr. Robert Craig-McKerrow, trading as the Rowley Mills, Avington, Gloucester, claimed from Messrs. Matthews & Yates, Ltd., electrical, ventilating and heating engineers, of the Cyclone Works, Swinton, Manchester, £5,309 for breach of contract in the erection of a drying plant and loss of profit from the failure of the plant to perform the duties required of it.

It was alleged that the defendants failed to complete the installation within the specified time, and that when erected it was found to be inefficient and incapable of doing the amount of work required of it.

The Official Referee decided that it was a condition precedent with regard to the delay that a class A certificate should be procured, and as to the damages claim on the ground that the machinery did not do the work required of it, he found that the defendants had done all the work they contracted to do. He therefore gave judgment for the defendants on the claim, and on the counterclaim for the price of the machinery. The judgment would be for the defendants for £1,055 10s., with costs of both claim and counterclaim.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Charging Batteries for Motor Cars.

The letter from Messrs. Rootes, Ltd., in your issue of January 28th has made me wonder why the mercury vapour rectifier for converting a.c. to d.c. is not better known, as applied for charging purposes.

I, for one, until recently, imagined that the mercury vapour rectifier was only suitable for use in the laboratory, but have found, however, that the mercury vapour rectifier is a sound commercial proposition, especially for charging accumulators, as mercury vapour rectifiers lend themselves admirably for this purpose, being efficient and exceedingly flexible.

I would recommend Messrs. Rootes to get into touch with the Hewittic Electric Co., Ltd., of 80, York Road, King's Cross, the manufacturers of these outfits, who could no doubt give them any information regarding the question.

Watford. **D. V. Tustain.**
February 10th, 1921.

The Reduction in Price of Lamps.

I am pleased to see the letter of Mr. Scarborough in your issue of February 11th, as I think this business has been mismanaged.

I proposed to the E.L.M.A. that as so many dealers had large stocks of lamps on hand a clearing house should be established to which any dealer who chose to do so could send up a list of his stock. When any order was received at any lamp factory, the clearing-house list would first be consulted. If the lamps required could be supplied from any stock they would be, instead of manufacturing a further lot and adding to the congestion. In this way a glutted market would be cleared, and the makers would then have been free to reduce prices without hardship, or increase them without fear of an overstocked market. In other words, a more healthy condition would have been created.

Any dealer availing himself of the clearing house would pay a percentage fee to cover costs. I am sure most dealers would have borne the slight loss this might have entailed.

In other trades a dealer is free to have a clearance sale if he finds himself overstocked or stocks moving too slowly. In the lamp trade we are tied hand and foot, and may not even deal fairly with our customers, as, if a lamp is broken in transit in January and the maker delays to credit it till February, he does so at a lower price. The breakage or fault may have occurred on January 31st, and the credit be granted on February 1st, nevertheless the purchaser will lose by the amount of the price reduction.

I trust the matter will be pursued further or that the E.L.M.A. will see how much they are in danger of injuring their own cause unless they reconsider their scheme.

Glasgow, *February 14th,* 1921. **J. A. Rudd.**

I have read Mr. Scarborough's letter in your last issue with some amusement. My sympathy will be with him in his complaint if he will convince me that he sent a cheque to the "wicked" members of the Electric Lamp Manufacturers' Association for the increased value created in his stock when the price of lamps was put up some time ago.

Some people want it all ways.

The fact is, the credit he is to receive on his January stock is a generous gift.

Lamp Salesman.
February 12th, 1921.

The Electrical Wholesalers' Federation, Ltd.: A Correction.

With reference to the report in your paper of the annual meeting of the Electrical Wholesalers' Federation, Ltd., permit me to correct an error in the last paragraph, as I am sure you like your reports to be accurate. I am as proud of my name as I am of being a member of the E.W.F. and of its chairman; perhaps you will be good enough, therefore, to correct it.

H. Boden How.
Sheffield, *February 14th,* 1921.

[We tender our sincere apologies to Mr. Boden How for the unfortunate mistake in our report.—Eds. Elec. Rev.]

A Flashing Problem.

Referring to the above problem by "Dense," dated February 5th, I would have suggested, had he not stated that his connections were correct, that in changing the direction of rotation, he was doing this by reversing the current through the armature only and not, as of course, should be done, by reversing the current through the armature and interpole windings together.

F. W. B.
Birkenhead.
February 12th, 1921.

In reply to "Dense's" question in your issue of February 11th, I would suggest the following:—

1. Test the current taken by the motor when running in each direction with full load, to prove that the motor is not overloaded.

2. Test the polarity of the main and interpole coils; it is probable that the polarity of the interpole may be reversed.

(For a motor the polarity of the interpole is the same as that of the main pole behind it following the rotation, and a small compass needle will indicate the polarity.)

For a reversing motor the brushes should remain in the neutral position immediately under the centre of the interpole coil, as it is certain a movement in one direction must react when reversing if the motor is giving full-load output in each direction.

If the motor is fitted on a crane or charging machine, it is possible that the trouble may be due to the method of control or braking, and particulars should be given as to the motion, if arranged for creeping speeds by armature diverter or high speeds by series field diverter, if rheostatic braking is employed, if the shunt solenoid brake coil is wired across the motor terminals, or if it is coupled electrically or mechanically with another motor working on the same load.

From my experience, the mechanical brake fitted on a crane may give rise to trouble due to "locking," and to unlock may require excessive current. To test if the trouble is due to mechanical or electric braking it would be better to uncouple the motor and arrange a brake test or electric loading test, running the motor in each direction with half and full load, using a plain series reversing controller. (Care must be taken not to run the motor with no-load, as it may exceed its critical speed.)

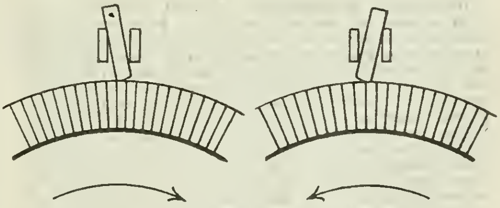
It would be interesting to hear if the above suggestions have been tried.

G. W. T.
Glasgow.
February 14th, 1921.

Perhaps my own experience of similar troubles may be of some assistance to "Dense" (February 11th).

It is evident that the sparkless brush position of the machine when running in one direction, which becomes a flashing position on reversal, is not the true reversing position, and I would suggest that possibly the solution to the problem is one of the following cases:—

Either the brushes may be a trifle loose in their holders which would cause uneven wear, as they would be dragged forward by their friction with the commutator in the direction of rotation, as per diagram.



It will be seen that this fault will automatically vary the real brush position slightly on reversing from either direction, as the brush only beds on one half at a time, and this is sometimes sufficient to cause the flashing noticed by "Dense."

Or the interpoles may be a little too strong or weak. To test for this:—

(1) Impose a small current on the interpole coils from a low-voltage generator, varying it while attempting to find a brush position which gives sparkless commutation and the correct load speed curve in either direction.

(2) Divert current from the coils with a variable resistance and test as above.

R. W. Kinch.
Woking.
February 14th, 1921.

Referring to a letter under the above heading in your issue of the 11th inst., the trouble here is caused by local currents in the short-circuited coils of the armature. These local currents may be of considerable magnitude owing to the low resistance of the armature coils, and can do much harm by overheating the armature, overloading the brushes, and more particularly by dissipating their energy in the form of a series of sparks, and in extreme cases flashes, at the brushes when the short-circuit is broken, thereby burning the brushes and damaging the commutator.

To get good commutation and to prevent the waste of energy, these local currents must be brought within reasonable limits, and the nearer they can be completely stopped the better.

To try and stop these local currents it is essential that the short-circuited coils should be in the weakest part of the magnetic field. It is interesting to note that when the brush position was altered on this particular machine the flashing stopped, and the effect of altering the brushes was to bring the short-circuited coils into a weaker field. Then the commutating poles should be examined to find out if they are functioning correctly, for their object is to keep the weakest part of the magnetic field in as fixed a position as possible so that the brushes need not be shifted at any time. Then it is very important that the brushes should have sufficient resistance at their face to stop these local currents. There is a material, called the M.P. commutator compound, which considerably helps in this direction. It is put up in the form of a stick, and the end of the stick is gently rubbed on the surface of the commutator when running. Some of this material gets under the faces of the brushes, and, amalgamating with the carbon, forms very thin but high-resistance films, and these high-resistance films have been successful in stopping the local currents.

By making certain that the short-circuited coils are always in the weakest part of the magnetic field, and that the brushes have sufficient resistance at their faces, this machine can be cured, and I have no hesitation in saying so, for in some twenty years' experience in commutation I have yet to find a case that could not be cured when working on the above lines.

S. W. Martyn.

London, *February 15th*, 1921.

Electricity Supply from Surplus Sources.

I have read with very great interest the letters by Mr. Pain in your issue of January 14th and of the 4th inst., also Mr. Hugh Seabrook's addition to the subject.

This subject is of vital importance, not merely as concerning individual companies but as a national economy. I notice that blast-furnace and coke-oven gas has been mentioned, and although I have dealt with this subject previously, I would like to add to it now, as some advancement has been made during the past year.

Mr. Pain mentions "ghastly waste." Now, in the Middlesbrough district there are about 75 blast furnaces and a good number of coke ovens working, and a tremendous amount of this gas is discharged to the atmosphere, so much in fact that it has been reported by aviators that Middlesbrough is obscure on an ordinary day, and yet Middlesbrough is purchasing power supplied from coal-fired boilers at a very heavy cost, and consuming a commodity of vital importance for export to increase our overseas trading.

One large works in this country has set an example, and is still working hard for even better results, and so far as fuel economy and efficiency on waste products are concerned has excelled the Americans and our continental neighbours, its efficiency now being in the neighbourhood of 25 per cent. above any figure obtained abroad.

We have the spare gas in this country, and we have the gas engines, home-designed and built, and have performances second to none in the world.

I am not surprised to read that Mr. Seabrook was unable to work up any enthusiasm at 2¼ lb. of coal per kWh at, say, 31,500 therms., when this is being produced for 15,000 therms. per kWh on gas engines.

Regarding the exchange or sale of this surplus energy, it could be sold to the power companies or corporations at a figure much below their coal costs per unit generated; both parties would be in hand financially, and the nation would have reserved or available for export several million tons of coal per annum.

Fuel economy now is one of the many lines open to reinstate this country in a prosperous condition, and should be taken up seriously by the Government. We have stuck too long to our steam-electric plants, until most people are very loath to leave them even for greater efficiencies and lower working costs.

If we ever come to a time when we are restricted to therms expended per b.h.p.-hour, I hope it will not even be based on 2¼ lb. of coal per kWh, but something very much below that figure; then we may hope for cheaper production and greater outputs. The economy of fuel is just as important as the wages question.

I do not hope that our total power requirements can be supplied from waste heat, but a great portion can, and should be, in place of coal-fired boilers.

With the surplus supply stations linked up with the larger coal-fired stations we should have a very good combination, and would in many cases reduce the spare or stand-by plant at the larger stations.

S. H. Fowles, A.M.I.E.E., A.M.I.Mech.E.

Jarrow, *February 14th*, 1921.

BUSINESS NOTES.

Bankruptcy Proceedings.—William Drysdale, electrical engineer and contractor, 24, Paxton Street, Barrow.—The debtor appeared at the Barrow Bankruptcy Court for his public examination on Friday last. In answer to the Official Receiver, he said he started business with £200 capital, and £150 given to him by his father. He did chiefly jobbing work, but also carried out some big contracts, including that of the local workhouse. For the last six or nine months he had been pressed by creditors, and had five judgments outstanding against him, and when the Sheriff's officer took possession, he filed his petition. He estimated his liabilities at £2,025, and the stock-in-trade he put at £1,249. There were in addition the fixtures, &c. His deficiency he estimated at £661. After taking stock he found there was a tremendous loss on English manufactured goods. He had drawn £5 10s. per week out of the business for himself, and had also at one time spent money in travelling to Manchester and Liverpool once a week. He personally superintended the books, and had not spent an unusual amount in expenses. At one time he thought of taking a partner, and after an inspection of the books it was estimated that the income from the business for 1918 was about £800, without taking into account management charges. On the same basis, the estimate this year was £1,000. The business had fluctuated during the war and since, and he had been left with only one man. One of the causes of his failure was want of capital, and the stock was much heavier than he thought it was. In December, 1919, the cash sales were £264, but he did not think they would be £160 in December, 1920. He had had a nervous breakdown, and suffered from neuritis, and had attended his business when hardly able to walk. Answering the Registrar, the Official Receiver said the books had been fairly well kept until recently, and the trustee was of opinion that it was not necessary to ask for a further account. The examination was closed.

J. V. Bell, electrical engineer, 21, North Bar Within, Beverley, York.—Receiving order February 7th on debtor's own petition.

A. E. Channon, H. S. Naden, and C. G. Channon (A. E. Channon & Co.), electrical engineers, Cheltenham.—First and final dividend of 4s. 8¾d. in the £, payable February 18th, at the Official Receiver's Office, 26, Baldwin Street, Bristol.

J. Jones and J. R. Jones (J. Jones & Son), electrical engineers, 7, Chapel Street, Penzance.—Receiving order made February 9th on debtor's own petition.

J. C. Thomson, electrician, lately electrical engineer and contractor, late of Station Street, Mansfield, Notts.—Last day for proofs for dividend, February 25th. Trustee, Mr. E. W. Humphreys, Official Receiver, 4, Castleplace, Nottingham.

A. Lord, electrical contractor, 33, Westgate, Burnley.—First meeting February 25th, at the Official Receiver's Offices, 13 Winckley Street, Preston; public examination, March 10th at the County Court House, Burnley.

A. Dickinson (Crown Electrical Co.), electrical engineer and contractor, 157, Hunslet Road, Leeds.—Receiving order made February 5th on debtor's own petition. First meeting February 23rd, at Official Receiver's Offices, Leeds; public examination, March 8th at the County Court House, Leeds.

B. E. Thomas, electrical engineer, 12, Castlemeadow, Norwich.—Last day for proofs for dividend. March 2nd; trustee, Mr. H. P. Gould, Official Receiver, 8, Upper King Street, Norwich.

Copper and Lead Prices.—Messrs. F. Smith & Co. report February 15th:—Copper (electrolytic) bars, £79, £2 inc.; ditto sheets, no change; ditto wire rods, £95, £2 inc.; ditto h.c. wire, 1/0⅜, ¼d. inc.; silicium bronze wire, no change.

Messrs. James & Shakespeare report February 15th:—Copper bars (best selected), sheets and rods; no change. English pig lead, £23; £1 dec.

Dissolutions of Partnership. — Blower & Cooper, electrical and engineering suppliers, 3, Paul's Bakehouse Court, E.C.—Messrs. A. E. Blower and A. Cooper have dissolved partnership so far as concerns Mr. A. Cooper, who retires from the firm.

Andrews & Morland, electrical engineers, 21, Westbourne Street, Kingston-upon-Hull.—Mr. J. Andrews and Mr. F. H. Morland have dissolved partnership. Mr. Morland will attend to debts and continue the business in his own name and at the same address.

Smith & Scragg, motor and electrical engineers, Nantwick Road, Crewe.—Mr. W. Smith and Mr. G. J. Scragg have dissolved partnership. Mr. Smith will attend to debts.

A. H. Foster & Co., motor and electrical engineers, &c., 679a, Romford Road, E.—Mr. A. H. Foster and Mr. J. Froelicher have dissolved partnership. Mr. J. Froelicher will attend to debts and continue the business.

Company Liquidations.—Leeds Alliance Electrical Manufacturing Co., Ltd.—Winding-up voluntarily. Meeting of creditors was called for February 17th, at 62, Albion Street, Leeds. Liquidator, Mr. S. S. Tadman, 1, Albion Street, Leeds. Particulars of claims to be sent to the liquidator by March 16th.

Britannia Lamp and Accessories Co., Ltd.—A meeting of members is called for March 15th, at 24, Coleman Street, E.C., to hear an account of the winding-up from the liquidator, Mr. R. E. Tayler.

Rotax Motor Accessories Co., Ltd.—Winding up voluntarily for reconstruction purposes. Liquidators, Mr. W. Morris, 6, Cavendish Square, W., and Mr. A. Bell, Rotax Works, Willesden Junction, N.W.

Argentine Electricity Co., Ltd.—Winding up voluntarily. Liquidator, Mr. T. S. Hamilton, 62, New Broad Street, E.C. Meeting of creditors, February 23rd, at New Broad Street.

Trade Announcements.—Messrs. Albert Lee & Co., Ltd., of 8 and 9, New Zealand Avenue, London, E.C. 1, have opened an illuminating engineering department, under the management of Mr. Sydney Smith, who was for some time demonstrator for the Metropolitan-Vickers Electrical Co., Ltd., and previously to that was with the Holophane Co. Mr. Smith will take charge of the sales of the helium fittings and other scientific types of glassware for use in special forms of lighting, and will give expert advice regarding lighting methods for shops, factories, offices, &c. He will lecture in various parts of the country.

Messrs. Southgate (Birmingham), Ltd., of Birmingham, manufacturers of electric, gas, and oil fittings, have appointed Mr. Wm. Broadbent, 11, Wellington Street, Moss Side, Manchester, as their representative in Lancashire and the North-Western Counties.

Messrs. H. W. Smith & Co. (1920), Ltd., have appointed Mr. W. T. Rushton, late of the Fuller Electrical and Manufacturing Co., as one of their representatives for the sale of cables and wires in London.

The business of Messrs. Macdonald & Co., electrical engineers, of 15, Bridge Street, Rotherham, has been amalgamated with that of Messrs. Slack & Co., of 98, Main Street, Rotherham.

Mr. J. T. Baring has entered into partnership with Messrs. Williams & Pell, of 5, Chancery Lane, London, W.C. 2, agents for the Electrical Alloy Co., the Industrial Filtration Corporation, La Métallurgique Electrique, and the British Electric Plant Co., Ltd. The business will be carried on under the style of Williams, Pell and Baring, at the same address.

Mr. C. B. Maurice, who has been appointed sole selling agent in London for Messrs. Cranmore & Co., Ltd. (conduits and fittings), Birmingham; J. Hall & Co. (switches, fittings, &c.), Birmingham; W. H. Cheadle & Waltho, Ltd. (lampholders), Wolverhampton; Electric Heating and Hardware, Ltd. (electric irons, kettles, and heaters), Birmingham; Seneffe Cable Works, Belgium; and "Regina" and "Bissell" electric suction cleaners, has opened offices and showrooms at Berwick House, 139, Oxford Street, W. 1, and a warehouse at 3, Manette Street, W. 1. Telephone: Museum 3627.

Messrs. Scholey & Co., Ltd., 56, Victoria Street, Westminster, announce that from February 21st their head office will be transferred to their works. After that date their address will be:—Scholey & Co., Ltd., Victory Works, Gloucester Road, Croydon. Telephone: Croydon 2164.

Catalogues and Lists.—The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4. Folder L,2449. Illustrating and describing "Sonorus" high-voltage electric trembling bells and "Link" and "All-china" bell-pushes; all items fully priced. Folder No. H,2446, giving details and prices of "Magnet" electric irons. Installation Leaflet P. 2,452.—An illustrated description of the electrical equipment of the Brighton diamond-cutting factory.

English Electric and Siemens Supplies, Ltd., Foster's Buildings, 22, High Street, Sheffield.—Leaflet B4, a priced, illustrated and dimensioned description of "Britannia" "half-watt" lanterns for lamps up to 1,000 watts. Leaflet 54, an illustrated folder giving prices of "Britannia" vacuum and gasfilled lamps.

The Edison Swan Electric Co., Ltd., Ponders End, Middlesex. —List No. A.A.178, dealing with "Ediswan" enclosed oil switches with full specifications and illustrations. Progress Sheet No. 48, illustrating and describing "Revo" house service switches and fuse-boxes. Priced.

Messrs. Phillips & Turner, 115, Edmund Street, Birmingham. —A leaflet illustrating ceiling fittings—galleries and ceiling plates.

Messrs. E. Shipton & Co., 52, Floral Street, Covent Garden, W.C. 2.—A leaflet illustrating and setting forth the advantages of an "interphone" system; it also deals with "Westophones" for short-distance telephony.

Messrs. Hollings & Guest, Ltd., Thimble Mill Lane, Birmingham.—List No. 109A, an illustrated and priced list of hydraulic presses with hot plates for various purposes; List No. A110, a priced catalogue illustrating hydraulic forcing presses for fixing or removing wheels, armatures, commutators, &c.

Mr. L. Rosengart, 4, Oxford Street, W. 1.—Folder, dealing with "Alterna" cycle-lighting outfits.

Southern Electric Co., Ltd., 138, Southwark Street, S.E. 1.—Net trade price-lists of electrical accessories and appliances, including cut-outs, switchgear, adapters, bells, irons, flexibles, &c.

Messrs. Henry G. Richardson & Sons, Wordsley Flint Glass Works, Stourbridge.—A leaflet showing applications of "Levahook" fittings to lighting bowls.

Messrs. Crow, Toogood & Co., 15, Wardour Mews, D'Arblay Street, Wardour Street, W. 1.—An illustrated catalogue of electrical fittings and accessories, including bowl fittings, cast-iron watertight fittings, brackets and pendants. Also a net trade price list of electrical fittings of a large variety.

Messrs. E. P. Allam & Co., 107-109, Gray's Inn Road, W.C. 1.—Monthly Stock List (No. 6) of d.c. motors, for sale or hire.

Messrs. Harry H. Gardan, Ltd., Staines.—Stock list of dynamos and motors.

Calendar.—Messrs. Moir & Watts, of Weardale Road, Lee, S.E. 13, have issued a pictorial calendar with monthly tear-off sheets.

For Sale.—The Z Electric Lamp and Supplies Co., Ltd., of 73, Newman Street, W. 1, has issued a schedule of stocks of electrical accessories, electrical heating apparatus, &c., of which it is disposing on behalf of the liquidator of the Z Electric Lamp Manufacturing Co., Ltd.

Stoke Newington Borough Council Electricity Department invites offers for a battery and charging plant.

By direction of the Disposal Board, Mr. C. D. Phillips will sell by auction, on March 10th, at No. 18, C. S. Depôt, Swindon, machine tools, and electrical and general plant, &c.

By direction of the Disposal Board, Mr. C. D. Phillips will sell by auction on March 15th and following days, at the National Cartridge and Box-Repair Factory, Newport, plant, machinery, &c.

By order of the High Court, Chancery Division, Messrs. Davis and Moon will sell by auction on March 1st, at Clapton, and March 3rd, at Battersea, the stock, plant, fittings, &c., of Messrs. Foot and Milne, electrical contractors.

By direction of the Disposal Board, Messrs. Harris & Gillow will sell by auction, on February 23rd and following days, at Shoreham Camp, Shoreham-by-Sea, camp equipment, saddlery, and tools, telephones, Fullerphones, &c.—For particulars see our advertisement pages to-day.

Electrical Wages in Scotland.—The Scottish Contractors' Association has suggested to the Scottish District Committee of the Electrical Trades Union that a conference should be held to consider the wages question. The operatives have put in a claim for an increase of 6d. per hour on present rates, while the employers, on the other hand, desire a reduction of 3d. as from February 28th.

Socials.—A number of well-known artistes appeared at a concert in the Cambridge Hall, Southport, on February 9th, in connection with the Southport Corporation Tramway Employés' Social and Athletic Society. There was a large audience, and the proceeds were divided between the Society's funds and the Infirmary.

A social in connection with the Assembly Department (Lamp Works) of the English Electric Co., Preston, took place at the Canteen Theatre, on February 11th. The M.C.'s were Messrs. A. De Boeck and A. Handley.

On Thursday, February 10th, a fancy dress carnival was held by members of the Igranic Electric Co. with their friends, at the Café Dansant, Bedford, when a most enjoyable evening was spent by about 350, fully two-thirds of whom were in fancy costumes. During the interval, supper was served, after which there was a grand spectacular parade. The judges experienced great difficulty in making their choice for the six prizes. Dancing continued into the small hours.

The staff of the General Electric Co., Ltd., Newcastle Branch, held their second dance of the season, on Friday last, at Heaton Assembly Rooms. The company numbered 200, and the Committee also arranged a whist drive, for which handsome prizes were given. Music was rendered by Mr. R. Jackson's orchestra, augmented by two members of the staff—Mr. F. E. Winnard and Mr. C. N. Baston. Prizes were presented to the successful whist players by Mrs. J. Spence.

Applications for British Trade-Marks.—Appended is a summary of the recent applications for British trade-marks in respect of articles and goods associated with the electrical trades and industries:—

Apex. No. 401,508, Class 6.—Dynamos, dynamo brushes, electric motors, &c., Wm. J. Goodebridge, Colmore House, 21, Waterloo Street, Birmingham, March 5th, 1920.

SB. (letters and design), No. 409,357, Class 13.—Incandescent lamps (ordinary) and other electric fittings, John Agerup, Vulcan House, 56, Ludgate Hill, London, E.C. 4, November 2nd, 1920.

Graham (lettering and design). No. 407,386, Class 8.—Permanent magnets sold separately, E. G. Graham, trading as Alfred Graham and Co., St. Andrew's Works, Crofton Park, London, S.E., August 30th, 1920.

Amplion, No. 408,176, Class 8.—Telephonic Apparatus, E. G. Graham, trading as Alfred Graham & Co., St. Andrew's Works, Crofton Park, London, S.E., September 25th, 1920.

Benjamin, No. 404,928, Class 13.—Electric fittings and motor accessories, Benjamin Electric, Ltd., Brantwood Works, Tariff Road, Tottenham, N., June 2nd, 1920.

Rotomotor, No. 406,900, Class 6.—Dynamo-electric machinery, Leonard Barlow, trading as Barlow & Young, Buckingham House, Palace Street, Westminster, S.W., August 13th, 1920.

Geeko, No. 406,388, Class 6.—Telephones and parts of telephones, General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C., July 23rd, 1920.

Lyken, No. 409,572, Class 8.—Apparatus for electro-deposition, Hockley Chemical Co., Ltd., 1, Hockley Hill, Birmingham, November 10th, 1920.

The Bergmann Electricity Works.—It is reported that negotiations are proceeding in Germany with a view to the establishment of a close connection between the Klockner group (Haspe Steel Co., Lorraine Hutten Verein, &c.), and the Bergmann Electricity Works, Co.

Wolfram Lamps.—The share capital of the Wolfram Lamp Co., of Augsburg, is being increased to 5,000,000 marks to defray the cost of extending the filament factory.

Burglary.—The premises of the "Xtra" Lighting Co., Sunderland, were recently broken into, and a number of electric torches, &c., were stolen. By good fortune the managing director, Mr. A. J. Harrison, had occasion to return to the shop after the closing hour, and disturbed the thieves.

Jugoslavia Electrification Development.—The following translation of an article from the *Agramer Tageblatt* of Jan. 20th, 1921, has been received in the Department of Overseas Trade from the Commercial Secretary to His Majesty's Legation at Belgrade (Captain E. Murray Harvey) :—

"For some time past the Ministries of Communications and Public Works have been in consultation regarding the formation of a technical commission for the purpose of drawing up a plan for the electrification of Jugoslavia. This plan is now adopted, and all the general lines of the work have been laid down. Henceforth the State will have the first right to create any electrical undertaking, but private individuals may carry out electrical undertakings where the State has not constructed such; the special permission of the Ministry of Public Works is necessary in such cases. The State is enabled if necessary, to expropriate such individuals on condition of indemnification. The State may also nationalise existing undertakings so far as is conducive to the above end. The upkeep of the transmission and cables devolves on the electrical administration of each Commune. The highest advisory body on electrical questions is the Electro-technical State Council, which is composed of 15 members and 16 deputisers (substitutes). The Council will include representatives from the Ministries of Commerce and Industry, Public Works, Agriculture, Forestry, and Health, the Electro-technical Engineering Faculty, and the Law Society. As a means for controlling the revenue from electric power, an electro-technical finance committee will be set up at the Ministry of Trade. The manner in which the Ministry of Works will carry out the scheme will be promulgated in a special order. As present conditions render this project very urgent, the preamble will be laid before the Constituent Assembly as soon as drawn up."

The Dalmatian Bauxite Deposits.—The deposits of bauxite in Dalmatia and Istria first attracted special attention during the war, when it was found necessary by Germany to replace the French product. Exports of small quantities were first sent to Germany in 1916, the tonnage being considerably increased in the following two years. Italian newspapers state that only the deposits in the vicinity of the sea, both in Dalmatia and Istria, have yet been worked, and the production only extends to a depth of a few metres. Nevertheless, the deposits are said to be very productive, and the question of establishing an aluminium industry in Dalmatia has been brought forward, as the deposits in this region alone are sufficient to justify the erection of a works, while the existing waterfalls would supply the necessary power.

E.D.A. Activities.—Another bunch of pamphlets has reached us from the director and secretary of the E.D.A. "The World's Right Hand" is a little review of man's deliverance from slavery; the slavery of other men and that of circumstances which from the earliest times have forced him to employ laborious methods to accomplish his necessary tasks. It leads up to the electrical era, and forecasts a bright future to be brought about by electricity. Another leaflet illustrates a number of electrical appliances, and says: "There is an electrical appliance described here that will interest you." "E.D.A. 72" shows how the fuss and trouble attendant upon that hardy perennial "spring cleaning" may be disposed of by electrical means. Two book markers deal with electric irons and lighting, and cooking is treated of in "A Message to the Housewife Who Knows." A pamphlet illustrated in colour exhorts the reader to "Use Electricity—The Silent Servant," and emphasises the ease of control of electrical cooking operations, as well as the many other inherent advantages of this means of preparing food. These items can be obtained from the Director at 84, Kingsway, W.C. 2.

Proposed Increases in Spanish Tariffs.—The *Bulletin* of the F.B.I. states that the reduction in freight rates to Spain, announced in January, should do much towards the development of Anglo-Spanish trade. It is feared, however, that a serious check to such development may be presented by the duties imposed under the Revised Spanish Customs Tariff, to be issued shortly. It is understood that a provisional tariff, embodying the suggestions of the Tariff Advisory Committee, will be substituted for the present tariff in March next. This will, in its turn, be succeeded by a permanent new tariff, which should have replaced the 1912 tariff in 1917, but whose introduction has been delayed from year to year. Further information—not yet confirmed—announces the introduction of a permanent tariff in March, without the provisional stage. Opinion among Spanish consumers, who are anxious to reap the benefit of the present tendency for prices to fall, is strongly opposed to tariff increases. The iron and steel interests of the north and the textile manufacturers of Catalonia, on the other hand, are pressing vigorously for a drastic heightening of the Spanish tariff wall, in order to ensure their war-time level of profits. The F.B.I. is keenly alive to the urgency of the situation from the point of view of the British manufacturer. Firms interested in the Spanish trade are invited to communicate with the South European Section, at head office, as early as possible.

New Indian Companies.—Among the new companies recently formed in India are the following:—The Kadi New Industrial and Electric Co., Kadi, Baroda, capital 250,000 rupees, to carry on business as engineers and pressers of jute, and to supply electricity, &c.; the Sidhapur Electric Industrial Co., Sidhapur (Kadi), capital, 700,000 rupees, to manufacture cloth by electric power; the Electric and Automobile Engineering Co., Delhi, capital 2,000,000 rupees, and the East India Electric Supply and Traction Co., 11, Portuguese Church Street, Calcutta, capital 2,500,000 rupees.

Electrical Manufacture in Belgium: British and American Interest.—An account of the steps taken by British and United States electrical manufacturing interests to participate in Belgian developments is given in a recently issued report by the American Consul-General at Brussels. The movement has, of course, for its principal object the capture of a share in the contracts for the electrification of the Belgian State Railways. The centre of this electrical manufacturing industry is Ghent, where great activity has prevailed since the Armistice, largely through the influence of British and American engineers and financiers. During the year 1919 the two concerns most occupied before the war were entirely reorganised and merged into large international companies with greatly increased capital.

Three concerns are now engaged in the business:—"The Société d'Electricité et de Mécanique" (international), the "Constructions Electriques de Belgique" (international), and the "Ateliers de Constructions Electriques des Flandres." The first-named is the result of a merger which absorbed the "Usines Carels Frères" (a pre-war Belgian company making Diesel engines). and its capital stock of 10,000,000 fr. The new company increased its capital to 36,500,000 fr., an American, a British, and a French electrical manufacturing company each having a quarter interest in the new concern. Belgian banks and a large Belgian financial and industrial company are also interested. Its plans include the production on an increased scale of steam engines and Diesel engines, with the addition of electrical material, the latter being undertaken with the assistance of American experience and designs.

In November, 1918. there was formed at Paris a company called the "Constructions Electriques du Rhone," for the purpose of constructing electrical material. This concern secured a contract for using the patents and processes of the English Electric Co. The "Constructions Electriques du Rhone" then increased its capital to 40,000,000 fr., and changed its name to "Constructions Electriques de France." Before this, with a view to further extension, it had created in Belgium a subsidiary company called the "Société Auxiliaire de Constructions Electriques de Belgique." Later, this company secured the help of the "Compagnie Internationale d'Electricité de Liége," and bought up the "Société Anonyme des Anciens Ateliers van den Kerchove," of Ghent. In April, 1920, the "Compagnie Internationale d'Electricité," of Liége, and the "Etablissements van den Kerchove," of Ghent, were merged under the name "Constructions Electriques de Belgique," with a capital stock of 40,000,000 fr. and administrative offices at Brussels. Before the war the "Etablissements van den Kerchove" constructed engines and steam turbines. Since fusion the plant is being greatly enlarged, and has included the construction of electrical material of all kinds. The English Electric Co. is helping both the French and the Belgian companies in every way possible, and is perfecting the plant at Ghent. A third company, the "Ateliers de Constructions Electriques des Flandres," has been formed at Ghent lately with a capital stock of 2,000,000 fr., made up of 2,000 shares of 1,000 fr. each. Its purpose is the manufacture and repair of electrical material, as well as the installation and production of electromotive power in all forms.

Research Association for Cast Iron.—The Secretary of the Department of Scientific and Industrial Research announces that the Research Association for the Cast Iron and Allied Industries has been approved by the Department as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. As the Association is to be registered as a non-profit-sharing company, the promoters have applied to the Board of Trade for the issue of a licence under Sec. 20 of the Companies' (Consolidation) Act of 1908. The secretary of the committee engaged in the establishment of this Association is Mr. Thomas Vickers, 174, Corporation Street, Birmingham.

A Canadian Copper Works.—The Eugene F. Phillips Electrical Works, Ltd., of Montreal, is proceeding immediately with the construction of a copper rod rolling mill having a daily capacity of 100 tons. In designing the mill, provision has been made to allow for an extension for the rolling of copper sheets and the drawing of copper tubes, as well as for the erection of a small refinery to take care of the copper scrap from the mill, and also from the company's large wire and cable factory. For the immediate future the company will import electrolytic copper wire bars, but it is hoped that within the course of a few years these bars will be produced in Canada in sufficient quantities to make the electrical industry in the Dominion self-supporting so far as copper is concerned. The managing director of the firm is Mr. Lawford Grant, formerly with the British Insulated and Helsby Cables, Ltd.

British Industrial Films, &c., Wanted for University of Hong-Kong.—The Acting British Commercial Secretary at Hong-Kong has been approached by the University of Hong-Kong for assistance in a new scheme for commercial training, which has recently been started there. The course of study for the Degree of Bachelor of Commerce includes lectures on Industry, Trade and Transport. In connection with these, the University has expressed the desire to receive from United Kingdom manufacturers for exhibition purposes lantern slides and, if possible, kinematograph films illustrative of the processes used in a number of industries, including textiles, tools and machines. Illustrated catalogues and large-sized photographs of works, &c., would also be welcomed. It will probably be of interest to United Kingdom manufacturers to supply the University with material of the nature indicated, and communications should be sent direct to Prof. W. J. Hinton, University of Hong-Kong.

Flexible.—In their advertisement appearing in this issue, the Edison-Swan Electric Co., Ltd., give certain particulars for specifying size of conductors, quality of insulation, and finish, which are intended to form a useful guide to buyers.

Australian War Precautions Act Repealed.—An Act to repeal the War Precautions Act, 1914-18, was passed by the Australian Commonwealth on December 2nd last. Among the regulations which are still to be enforced are those relating to companies, firms and businesses. The protection of commerce and industry from undesirable outside influence is to be continued. If without the consent in writing of the Treasurer of the Commonwealth, any person seeks to secure the registration of any company or firm, or any change in any firm or company already registered, if such firm or company has partners who are not natural-born British subjects, that person commits an offence. The same applies to the person who seeks to register in Australia any foreign company or any firm or company with foreign capital. In other words, Australian industries are to be guarded against the free entry of non-British firms and money. Agents of overseas companies and firms are required to supply special annual returns within three months of the commencement of the Act, and those subsequently appointed, within one month of their appointment or arrival in Australia.—*Board of Trade Journal.*

Lead.—Messrs. James Forster & Co., reporting under date February 12th, stated:—"Closing prices yesterday were £21 10s. for February and £22 for May, against £22 15s. and £23 5s respectively at the end of last week, representing a loss of 25s. on the week. Each day has seen a fall in values, and prices closed yesterday at the lowest. . . . . The metal certainly looks cheap at present values, but the general sentiment seems to-be that prices will go still lower unless a much more active demand from consumers is forthcoming, and that lead, like other metals, is still largely influenced by the financial position is evidenced by the fact that a fairly large arrival of the metal at once had a depressing effect on values."

Trade-Union Rivalry.—According to the *Sheffield Independent*, last week's discussions at York between representatives of the craft unions in railway workshops have practically led to a severance of relations between the N.U.R. and the Shipbuilding and Engineering Federation of Trade Unions. The Central News Agency states that the craft unions have definitely decided that in no case will they permit their skilled members in a railway workshop to be members of a general industrial union such as the N.U.R.

Electrical Supplies in South Africa.—The *S.A. Mining and Engineering Journal*, of January 22nd, says that dealers in electrical goods report business generally as very slack. The shortage in gasfilled lamps has not yet been relieved. Consignments of electrical materials are coming in well, and prices show a tendency to go down slightly. Plenty of Continental goods are arriving, and although these are very much cheaper than British wares, the tendency of the former is to go up, while the price of British goods remains more or less stationary. Continental electrical materials are rising to day.

Bennis Contracts.—The following are among the contracts that have been placed with Messrs. Ed. Bennis & Co., Ltd., during the past two months:—

Sunderland Corporation Electricity Works, Dunning Street, Sunderland.—Six chain grate stokers, with coal-elevating plant for Woodeson water-tube boilers.

Wimbledon Electricity Works, Durnsford Road, Wimbledon.—Four chain grate stokers for spearing water-tube boilers; ash elevating plant.

Metropolitan Railway Co., Power Station, Neasden.—Twelve chain grate stokers, adapted for forced draught, for Thompson's water-tube boilers (repeat order).

Guest, Keen & Nettlefold, Ltd., for Power Station, Dowlais (per Angus Scott & Partners, Ltd.).—Complete mechanical coal and ash-handling plant, including rotary truck tippler; rotary chain conveyor; six "Bennis" automatic boiler elevators; six automatic "Avery" coal weighing machines; ash hoist.

New Italian Companies.—There has been formed at Bergamo the Società delle Alte Valli Bergamasche, with a capital of 1,000,000 lire, for the production and distribution of electrical energy.

With a capital of 2,000,000 lire, Mecciche, De Vecchi e Ca., Società Elettrica Agrigentina, have been embodied a company at Girgenti for the production and distribution of electrical energy.

There has been launched at Lecce the Società Elettrica Industriale S.E.I., with a capital of 480,000 lire, for the production and distribution of electric light and power.

With a capital of 375,000 lire, Ing. Granda, Rabossi e Ca have been registered a company at Milan with the object of trading in electrical material and insulated conductors.

There has been formed at Milan L'Italia, Società Anonima Riscaldamenti Elettrici Industriali S.A.P.R.I., for the manufacture of electric heating appliances. Capital 750,000 lire.

The Ora Elettrica, Società Anonima Orologi Elettrici has been launched at Milan (Via Borromei 9), for the installation of electric clockwork for all purposes. The capital is 300,000 lire.

A new company has just been formed at Borgosesia, Italy, with a capital of three million lire, and the title La Società Hidro-Elettrica de l'Arogna.

Water Power of Rumania.—A pamphlet on this subject in Rumanian, and a translation of the more important passages, together with a small map, may be inspected by United Kingdom firms interested on application to the Inquiry Room, Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W. 1.

An Anti-Trade-Union Policy.—The *Daily News* states that the Association of Engineering and Shipbuilding Draughtsmen is protesting against the action of a number of firms in adopting superannuation schemes which contain a clause that the participating employés must not be members of a Trade Union. A movement is being organised with the object of persuading technical and other workers not to participate in any scheme which contains this prohibition.

British Branch Works for Canada.—A meeting of the British Empire Producers' Organisation will be held at the offices, 3, 5 & 7, Old Queen Street, S.W. 1, to-day, Friday, at 4 p.m., at which the chairman of council, Mr. Ben H. Morgan, will preside, and an address will be given by Mr. F. W. Field, H.M. Trade Commissioner in Toronto, on "Canadian Industrial Development and the Establishment of Branch Works in the Dominion." Anyone interested in Canadian affairs will be admitted on presentation of his card.

Book Notices. — "*Mechanical World* Electrician's Pocket Book, 1921." Manchester: Emmott & Co. Price 2s. net.—Among the important improvements made in the present issue of this handy work of reference is a lengthy section on motor starters and controllers. The previous matter has been rewritten and considerably extended. Other sections which have been rewritten and extended are those dealing with transmission conductors and cables, wiring systems and methods, and electric lifts. The section on electric heating and cooking has been added to. Another addition is a list of the principal abbreviations used in the volume.

Bibliotheca Chemico-Mathematica. A catalogue of works in many tongues on exact and applied science, with a subject index. Compiled and annotated by H. Z. and H. C. S. In two volumes; pp. xii + 964, and 127 plates. London: Henry Sotheran & Co. Price £3 3s. net.—This remarkable catalogue was begun in 1906, and has been growing ever since; by the time the end of the alphabet had been reached so much more material was available that a supplement was begun, which eventually exceeded the original scheme in size; and when that was done, a final supplement was added, and the whole was indexed (the index alone occupies nearly 100 pages). It is claimed that this work is the first historical catalogue of science published in any country, giving the price of each book and many other particulars. It is, as a compiler's preface claims, of very considerable human interest, and constitutes a very valuable addition to the bibliographic literature available to the scientific worker, embracing the whole field from the Middle Ages almost to the present day. The reproductions of plates and pages from ancient volumes are exceedingly interesting, full of quaint notions and ingenious devices, and—some of them—calling to our minds feelings of profound reverence for the triumphs of our forebears. We have before us, for example, the title-page of the first issue of the first edition of Newton's "Principia," published in 1686—fittingly described by the compiler as "the greatest work on exact science ever published." We have not space to linger over the literary and scientific riches of this catalogue, but we must offer our hearty congratulations to the compilers and publishers on the completion of a work of the greatest value to the scientific world.

"The Electrical Contractor's Year Book for 1920-1921." London: The Electrical Contractors' Association. Price 2s. 6d. The new features of the present issue of this handbook include notes on the constitution and functions of the National Joint Industrial Council and District Councils for the Electrical Contracting Industry, and a memorandum of agreement between the N.F.E.A. and the E.T.U., August 7th, 1920. The working rules for the various districts have been amplified and brought up to date. The frontispiece is a portrait of Mr. P. Collinson, President of the Associations.

"*Transactions* of the Illuminating Engineering Society." Vol. XV, No. 9. December 30th, 1920. 880 pp. Easton (Pennsylvania): The Society.—Part I of this volume deals with the activities of the various sections of the Society, and gives the *personnel* of Councils and Committees. Part II embodies a number of papers of great value and diversity, including papers on "Recent Applications of Colour in Lighting," "An Improved Method for the Illumination of Motion Picture Theatres," "Measurement of Reflection Factors," and "Some Applications of the Photoelectric Cell to Practical Photometry."

"Hydro-Electric Development in Ontario." By E. B. Biggar (202 pp.). Ontario: The Biggar Press, Ltd.—This volume is an historical survey of water-power administration and development under the Hydro-Electric Power Commission of Ontario. After a dissertation on public ownership generally of public utilities and roads, the author gives a number of interesting facts regarding water power in the Dominion and the United States. Then the history of the Commission and its work is traced step by step, showing a vast amount of energy and enterprise. The public life and achievements of Sir Adam Beck, the chairman of the Commission, form a chapter, and an appendix describes the laboratories, shops and inspection departments, with details of the conditions under which leases are granted, and a section dealing with future developments. A financial summary and a bibliography are also included.

The Bulletin of the Hydro-Electric Power Commission of Ontario. Vol. VII, No. 9. November, 1920. (36 pp.).—This number contains articles on the purchase of the Toronto Power Co. and its subsidiaries by the Commission, with a description of the plants and transmission systems; also illustrated notes on the new Nipigon power development, and "Hydro Power in the St. Lawrence District."

Proceedings of the Fourth Convention of the South African Association of Municipal Electrical Engineers, Pretoria, 1920. (76 pp.). Pretoria: Buckley & Van Duyn.—This gives a full account of the meetings and reports, as well as the President's address, and regulations framed by the Convention.

Scientific Paper No. 404 of the U.S Bureau of Standards, "Magnetic Reluctivity Relationship as Related to Certain Structures of a Eutectoid-Carbon Steel." (19 pp.) Washington: Government Printing Office. Price 5 cents.—Records of experiments carried out upon samples of steel under various heat treatments.

"Automotive Engineering." Part 1. February 15th, 1921. (12 pp.) London: The Standard Air Press, Ltd. Price 6d. net.—This is the first of a series of 26 fortnightly issues of a publication designed to supply the latest data bearing on all branches of automotive engineering. The present number contains notes on the compression and expansion of gases, the design of laminated springs, materials, &c.

"The Metropolitan-Vickers Gazette." Vol. VI, No. 94. January, 1921. (21 pp.) Price 1s., post free.—This issue contains, *inter alia*, articles on "Testing Equipment for Large Electrical Machines," by E. P. Hill, B.Sc (Tech.), A.M.I.E E., and a reprint from the *Electrician*, "Comparison of Welsh and American Practice in Electrically-driven Tin Plate Rolling Mills," by W. E. Taylor. The index to Vol. V is issued with this number of the "Gazette."

"An Introduction to Technical Electricity." By S. G. Starling. Pp. xii + 182; figs. 158. London: MacMillan & Co., Ltd. Price 3s. 6d.

"Small Single-Phase Transformers." By E. T. Painton. Pp. x + 96; 40 figs. Price 2s. 6d. net.

"Elementary Principles of Continuous Current Armature Winding." By F. M. Denton. Pp. x + 102; 44 figs. Price 2s. 6d. net. London: Sir I. Pitman & Sons, Ltd.

A Bradford Exhibition.—The Bradford Corporation electricity department has a big display of electrical apparatus at the Bradford Grocers' Exhibition now being held. Among the appliances shown are vacuum cleaners, electric washing machines, toasters, cooking and heating apparatus, coffee grinders, meat mincers and electrically-driven sewing machines. The display of indirect and semi-indirect electric lighting also is very pleasing and interesting. The stand is one of the most attractive in the exhibition.

The Cuban Market.—The *Electrical Review* of Chicago states that, owing to the increasing use of electricity and the comparatively slight development of the electrical market in Cuba, the island presents an important field for the sale of electrical appliances and fixtures of all kinds. The elimination of German rivalry has left the United States practically sole occupant with a firmly established footing. There are practically no electrical manufacturers in Cuba, and only a few minor concerns make chandeliers and drop lights, which are in great demand.

Italian Workmen Directors.—Signor Giolitti, on February 8th, presented to the Chamber a Bill for the supervision of industries by workmen's committees of nine members elected by the workmen for three years. The preamble defines the objects of the Bill, to give working men a knowledge of how industries are worked, to improve their technical education, ensure the application of the Factory Acts, and to ameliorate methods of production and the relations between Capital and Labour.—*Morning Post.*

Babcock Works in Australia.—MESSRS. BABCOCK AND WILCOX have purchased 20 acres at Regent's Park, New South Wales, on which they intend to erect a boiler-making and engineering factory, costing £100,000. A thousand men will ultimately be employed.—*Reuter's Trade Service* (Melbourne).

Fire.—The contents of the electrical fittings shop at MESSRS. HENRY BESSEMER & CO.'s Forge, Bolton, were destroyed by a mysterious fire on February 9th.

South American Trade.—We have received from the London and Brazilian Bank, Ltd. (London), a copy of its quarterly trade reports (No. 12) from South America and Portugal, to January, 1921.

LIGHTING AND POWER NOTES.

Aberystwyth.—CHANGE OF OWNERSHIP.—At a meeting of the Town Council on February 8th, a letter was received from Mr. Holroyd, owner of the Pier, asking for the formal consent of the Council to the proposed purchase, by the writer, of the undertaking of the Aberystwyth and Chiswick Electricity Supply Co., which supplies lighting and power to the town. The matter was considered in committee.

Aberdeen.—STREET LIGHTING.—Owing to the excessive cost of electric light standards, the Lighting Committee is experimenting with lamps suspended from overhead wires. If satisfactory results are obtained, King Street is to be illuminated in this manner for a great part of its length.

Ammanford.—PURCHASE OF UNDERTAKING.—After protracted negotiations, the Urban Council has finally purchased the Ammanford Electricity Supply Works from its owner, Mr. W. Herbert, at the figure of £14,375. The Council is now applying for an order enabling it to generate and distribute electricity within its area.

Australia.—THE MORWELL POWER SCHEME.—Two Bills were placed before the Victorian Legislative Assembly on December 14th last. The first provided for the raising of a second loan of £1,430,000 with which to carry out the Morwell (brown coal) power scheme. The capital cost of the scheme, which aims at a plant capacity of 45,000 kW, is estimated at £1,766,029, excluding terminal stations; the latter will cost another £230,000. It is proposed to supply power to areas at a maximum distance of 250 miles. The second Bill dealt with the constitution of the Electricity Commission, on which it was proposed to appoint General Sir John Monash, chairman, to be assisted by the three then existing Commissioners.

TASMANIA.—Mr. J. H. Butters, chief engineer and general manager of the Tasmanian Hydro-Electric Department, has submitted his report for the year ended June 30th last. The accounts record a total revenue of £60,575. Working expenses and capital charges amounted to £55,179, leaving a balance carried to depreciation suspense account of £5,396. About £3,000 was made by the Operations Branch, and the balance by the Hobart District Branch, which is considered satisfactory. Work on the Great Lake Dam has been held up on account of the delay in delivery of the necessary cement, but it is hoped to bring the dam up to the 20-ft. level during the present summer, and to complete it by next summer. The Waddamana Canal has been widened, and the work is expected to be completed in proper time. The Risdon sub-station has been designed, and the plant is on order. Time lost during the war has been partly made up for in the amplication of the Hobart distribution system, and the route for the Launceston transmission line has been laid out and clearing has started; a specially-designed steel tower is being employed on this line. Difficulty has been experienced in finding a suitable site for the Arthur's Lakes dam, but the problem has now been solved, and tenders are being invited for the construction of the dam. During the year it was found necessary to increase substantially the salaries of some of the officers, as it was found that in many cases the men working under them were receiving higher rates of pay.

Barnsley.—LOAN SANCTIONED.—The Town Council has received permission to borrow £14,200 for electricity purposes.

Barrow.—LOAN SANCTIONED.—The Electricity Commissioners have forwarded formal sanction to the borrowing of £35,000 for the purposes of the electricity undertaking, on the understanding that actual details of the expenditure will be furnished in due course, and so far as the item of £2,500 for radiators is concerned, on the condition that the total sums expended and received, including interest and sinking fund, shall be shown separately in the published accounts each year.

Canada.—EXTENSIONS AT WINNIPEG.—The Chief Engineer of Winnipeg has contributed to the *Electrical News* some interesting details of the extensions being carried out to the city's electrical undertaking. The original installation consisted of five hydraulic turbo-generators, each of 5,200 h.p., with two 400-h p. exciters and two banks of transformers each of 9,000 kW capacity. Later, three 6,800-h.p. machines and one 9,000-kW three-phase transformer were installed. In 1920 the contract was let for the completion of the power house building, consisting of an extension to the generator room 268 ft. long, 63 ft. wide and 50 ft. high. This extension will house eight 7,000-h.p. units, two 18,000-kW transformer banks and the necessary switchgear and controlling apparatus. The completed building will then house a plant having a capacity of over 100,000 h.p. The estimated cost of the present extensions is $300,000.

Continental.—SWITZERLAND.—The Commercial Secretary to H.M. Legation at Berne states that there are now in operation in Switzerland 16 power stations which produce a minimum of 20,000 h.p. The Löntsch Works (Glaris), recently enlarged, is the greatest power producer, but owing to the irregularity or excessive diminution of water pressure at certain times its production is stayed considerably for some months in the year. It is equipped for an output of 66,000 h.p. The control exercised by the State is inconsiderable, and there has been no unity of direction in the consideration of water-power schemes, which have been taken in hand by the railways, by cantons, towns, or industrial groups (or by combinations of one or more of these). An official summary shows that there is approximately 4,000,000 h.p. available, of which only about 720,000 h.p. is being utilised. According to these figures only 18 per cent. of Swiss potentialities in this sphere had been realised up to the close of 1919. Since the commencement of 1920 the increased power obtained represents, perhaps, another 2 per cent., so that there remains approximately 80 per cent. of Swiss water-power capacity to be turned to account.—*Board of Trade Journal.*

FRANCE.—A new agreement is proposed between the Paris Municipal Council and the Compagnie Parisienne de Distribution d'Electricité for the purpose of ensuring the most economical working of the latter's undertaking in the general interest. The scheme also aims at the reduction of the prices to 0·85 fr. per kW-hour in the first place and eventually to the pre-war charge, 0·70 fr. per kW-hour.

NORWAY.—The Commissions appointed by the Norwegian and Danish Governments to study the question of the transmission of electricity from Norway to Denmark have held their first joint meetings, and discussed the bases of further co-operation.—*Reuter's Trade Service* (Copenhagen).

GREECE.—On February 6th the tramway and gasworks employés ceased work, and on February 10th were joined by the men of the electric power works and the Athens Piræus Railway. The Government were threatened to mobilise the strikers if the terms offered them were not accepted.

The strikes were finally ended by the intervention of the King, who championed the cause of the strikers.

Doncaster.—Loan Sanctioned.—The Electricity Commissioners have sanctioned the borrowing of £8,665 for the provision of transformer equipment, mains and services for the Carr House Estate.

Dorchester. — Purchase of Undertaking.— It is reported that the draft agreement whereby the Council is to purchase the local undertaking of the Dorset Electric Supply Co. has been approved by the Lighting Committee. The Council is to take over the books of the company and all contracts if these are found to be fair. It is expected to complete the transfer by June 1st next, and sanction is being sought to borrow £16,000. for the purpose.

Dunblane.—Electricity Supply.—The Town Council has assented to an order being obtained by a local company for the purpose of providing a supply of electricity for the town, on condition that the Council does not waive its rights to grant powers to another company, or to apply for an order itself.

Ealing.—Electricity and Housing.—It is compulsory for all tenants of the new local municipal houses to use only electricity for lighting purposes.

Eton.—Supply by Overhead Cables.—The Rural District Council has consented to the extension of the overhead cables to Farnham by the Slough and District Electric Supply Co., by which electricity will be supplied to the parish.

Fareham.—Year's Working.—The accounts of the electricity undertaking for the year ended March 31st last show a total income of £3,427 and working expenses amounting to £2,977, leaving a gross profit of £450. Capital charges, with a debtor balance from the previous period, absorbed £1,566, leaving a net deficit of £1,116.

Guisborough (Yorks.).—Bulk Supply Approved.—The Urban District Council has decided in favour of obtaining a supply of electricity in bulk from a power company, and the clerk has been instructed to ascertain the cost of an order to distribute a supply in the area.

Harrogate.—Loan, &c.—The Town Council decided on February 8th, at a special meeting, to oppose the Harrogate Gas Co.'s Bill which is being promoted in Parliament. The Council has resolved to apply for sanction to borrow £2,500 for electric lighting services, and a like amount for transformers; it was also decided to ask for sanction to borrow £39,486 for extensions to the electricity works generating plant.

Heywood.—Minimum Charge Increased.—The Town Council has confirmed a proposal of the Electricity and Tramways Committee to increase the minimum charge for any consumer of electricity from £1 to £2.

Huddersfield.—Extension of Area of Supply.—The Corporation is applying to the Electricity Commissioners for a special order authorising it to extend the supply of electricity to the urban districts of Kirkheaton, Lepton, Kirkburton, Meltham, and Slaithwaite.

Hull. — Extension of Supply Area. — A special meeting will precede the March meeting of the City Council to consider the propriety of applying to the Electricity Commissioners for a special order authorising the Corporation to supply electricity at Anlaby, North Ferriby, Melton, Welton, Swanland, Willerby, Kirkella, and Westella.—*Eastern Morning News.*

Ilford.—Claim Against Corporation.—An Ilford firm is claiming damages from the District Council owing to the failure of the Council to supply electric power to the firm's factory during the recent strike.—*The People.*

Ilkley.—Extensions.—At a recent meeting of the Council a letter from the Electricity Commissioners was read, desiring that the extensions being carried out at the electricity works should be confined to the minimum necessary for the housing of a 170-kW set, for which a loan was sanctioned last year. This is in consequence of the negotiations with the Keighley Corporation for a bulk supply; the Commissioners do not wish further extensions to be made if a supply can be arranged to meet adequately the needs of the town.

Keighley. — Extension of Supply. — A contract has been entered into between the Craven and District Private Telephone Co., Ltd., and the Keighley Corporation for the supply of electricity at 6,600 V from Keighley to Eastburn, for the purpose of supplying Messrs. Dixon's stone quarries, near the latter village. It is understood that eventually the system will be extended to the village itself, as well as to Steeton, Silsden, and Crosshills.

Kingston-on-Thames.—Price Increase.—The decision of the Corporation to increase the charge for electricity for lighting from 8d. to 1s. has received the sanction of the Electricity Commissioners. The fact that the increased charge is retrospective to September has called forth a storm of protest from all classes of consumers, and many meetings have been held.

London.—Hammersmith.—The Finance Committee of the London County Council has been informed by the Electricity Commissioners that the Hammersmith Borough Council wishes to borrow £174,000 for extension of generating plant, and the Commissioners ask for the London County Council's observations upon the question of the outstanding debt on the plant to be displaced. Five old generating sets are to be scrapped, and a large second-hand set is to be purchased in lieu of them, the balance of cost being met from revenue account. The Council has replied that there is no financial objection to this course provided that if the estimated life of the second-hand set is less than the outstanding period for the repayment of the existing loans on the sets to be sold, the repayment period be correspondingly reduced.

With reference to the bulk supply of electricity which the Council agreed to furnish to the Chiswick Electricity Supply Corporation, Ltd., for general purposes, in addition to that taken by it for a supply to a factory in its area, for some time past, negotiations have been in progress with the Electricity Commissioners. The town clerk and the borough electrical engineer recently attended before the Commissioners in order to consider representations submitted by the Metropolitan Electric Supply Co., Ltd., to the effect that it was the proper authority to give the supply, and that, consequently, the agreement should be terminated upon the expiration of three years. After hearing the arguments of both sides, the Commissioners approved the draft agreement submitted to them, with the addition of a proviso relating to the maximum demand.

Hackney.—The accounts of the electricity undertaking for the year ended March 31st last record a total income from all sources of £118,572, as compared with £115,883 in the previous year. Working expenses totalled £76,163, as against £67,805, leaving a gross profit of £42,409 (£48,078). Loan charges, bank interest, and other payments amounted to £39,707 (£38,469), and the result was a net profit of £2,754, a considerable decline from the previous year's figure—£9,609. The number of units generated and sold fell from 16,217,325 to 14,774,198. The closing down of the National Projectile Factory deprived the undertaking of a very valuable bulk load. This would have been replaced by ordinary consumers but for delays in the provision of new mains and substation plant.

New Zealand.— Local Supply Authorities.—The *Commonwealth Engineer* reproduces statistics regarding local authorities' electricity undertakings from the report of the Chief Electrical Engineer of the Dominion. The figures show that more than half of the total plant capacity is hydro-electric in character. The exact figure is 23,998 kW, or 52·4 per cent. Steam plant is next in order with a capacity of 16,122 kW, or 35·2 per cent. The dominant system of supply is a.c. three-phase, 50 cycles, representing 58·3 per cent. of the whole, while the d.c. three-wire system at 460 volts constitutes 24·6 per cent., leaving but a small proportion of non-uniform supplies at various frequencies. In these circumstances it is not surprising that the three-phase 50-cycle system has been adopted as a standard to which all future developments will conform. In two years' time it is estimated that 75 per cent. of the installed plant will be of this type. It is stated that out of 55 plants, 27 were operating at a profit after payment of capital charges, and to remedy the condition of the balance of the plants, economy in operation, increased output and higher charges are recommended. The load factor and output are higher in the South Island owing to the cheaper cost of production. The average cost per unit sold is 1·3d. in the South Island, and 2·4d. in the North.

Lake Coleridge.—The annual report upon the Lake Coleridge hydro-electric undertaking shows that the total revenue rose from £37,324 to £45,831, representing an excess over all charges of £3,585, which is the first credit balance for five years. The total connected load increased from 23,992 kW to 30,854 kW, and the highest simultaneous load reached 7,066 kW—an 18 per cent. overload.

Nottingham.—Temporary Station.—To meet immediate needs while the large station at Clifton is being erected, the Council has decided to provide a temporary station, with a capacity of 4,000 kW, on the site, at a cost of about £50,000.

The Colwick Park Estates Co. recently applied to the Electricity Commissioners for permission to erect a power station of its own, but the Commissioners requested it to approach the Corporation with a view to obtaining a bulk supply. The Corporation is accordingly asking for powers to extend its area of supply to the Colwick Park Estates and other districts which it is deemed desirable to include.

Perth.—Extensions.—As a result of the inquiry by Col. Ekin, the Electricity Commissioners recommend the early installation of a 1,000-kW generating set, and that the question of a new boiler be considered as well. The Electricity Committee has accordingly requested the Town Council to apply for sanction to a loan of the necessary amount to carry the recommendations into effect. The electrical engineer estimates the requirements at between £40,000 and £50,000.

Rochdale.—Electricity in Sanitary Department.—In connection with the Corporation's application for sanction to borrow £19,500 for installing plant and effecting improvements at the sanitary works, the superintendent's proposals include the provision of an electrically-driven aerial runway or ropeway for the conveyance of ash and clinker, at a cost of £5,000, an enclosed high-speed engine coupled to a 100-kW dynamo, and motors, at an estimated cost of £4,500.

St. Andrew's.—Price Increase.—Regarding a recent inquiry at St. Andrew's into the application by the Electric Supply Corporation for an increase in the lighting charges, it was stated at a Town Council meeting that were the increases allowed, St. Andrew's consumers would be called upon to make up the deficit in other places where the company was not making a profit.

Sunderland.—Loan.—The Town Council is applying to the Electricity Commissioners for sanction to borrow £12,000, which is the amount estimated to be necessary to meet substation requirements upon capital account during the ensuing three years.

Wanstead (Essex).—Suggested Electricity Scheme.—The Urban District Council has referred to a special Committee the question of securing a supply of electricity for the town.

Warrington.—Breaking-up of Road.—In laying the necessary cables for a supply of electricity to the works of Messrs. N. Greening & Sons, the Electricity Department has found it necessary to open up a new road. The Paving Committee has objected to this, pointing out that before the road was completed, notices were sent to all departments likely to be affected to enable them to lay any pipes or cables that would become necessary. The chairman of the Electricity and Tramways Committee stated that Messrs. Greening had been approached at that time, but did not require a supply. The Corporation was bound to give a supply if it was able to do so.

TRAMWAY AND RAILWAY NOTES.

Blackpool.—Collision.—Two tramcars on the Blackpool to Fleetwood tramway route collided in the fog on February 9th. The fronts were damaged, but the drivers escaped with slight injury; several passengers complained of shock.

Bradford.—Inquiry into Accident.—The inquiry as to the cause of the recent tramway accident in the Idle Road district, in which a tramcar overturned and injured about 40 passengers, was held at Bradford on February 10th by Major Hall, R.E., of the Ministry of Transport. The testimony of the driver of the car, Fred Benson, was that the fog was so thick as to obscure the landmarks, and that he had lost his bearings when the car struck the points. The car was being driven at reduced speed because of the fog, and despite the application of the brakes, it continued its course off the rails until it struck a wall and overturned. The points were found to be in good order after the accident, as was also the car gear. The Inspector's report will be published in due course.

Burnley.—Track Renewals.—In view of the financial position of the tramway undertaking, the Committee has arranged to spread the work of relaying the lines over six years instead of three. Residents only are to be engaged on the work.

Chile.—Railway Electrification.—The Government has postponed the final date for sending in tenders for the electrification of the railways, in consequence of several British firms desiring to compete for the work.—*Reuter.*

Continental.—Italy.—Work is steadily progressing on the electrification of the railway system between Trieste and Pola. An electricity distribution system is also being established throughout the Bas-Ferranese and Bas-Polesine districts, with the object of substituting electricity for steam, particularly in connection with agricultural operations.

Cork.—Tramway Dispute.—The Corporation has passed a resolution approving of the appointment of a committee consisting of a representative of the Corporation, one of the tramway company, and one of the tramway men on strike, to investigate the demand for increased wages and arrange for a settlement, the strikers to resume work meantime at a 3s. a week increase.

Dublin.—Tramway Employes' Demand.—The employés of the Dublin Electric Tramways Co., Ltd., have ballotted on the question of a strike unless the demand for the 12s. increase was acceded to; 1,055 voted in favour, and 37 against. They have decided to withhold their notices, as the Ministry of Labour is intervening, and it is generally hoped that a satisfactory settlement will be reached.

Edinburgh.—Electrification of Tramways.—At a recent meeting of the Corporation, several motions urging the electrification of tramways were put forward. The routes which were selected for conversion were that from Hanover Street to Goldenacre, to join the Leith system, and that from Goldenacre to Queen Street.

Halifax.—Track Renewals.—It is estimated that there will be a loss on the tramway undertaking of about £9,000 for the present financial year. The effect of the increased fares has not yet been felt. A Sub-Committee recommends that the Tramways Committee should arrange for the renewal of the tramway track on several of the principal routes during the next three years. The cost of this will approach £200,000, and £90,000 of this may have to be included in the next financial year.

Hull.—New Track.—With a view to relieving the congestion in the centre of the city, the Tramways Committee after considering several schemes at a special meeting, has adopted one which will involve the laying of a double line along a portion of Jameson Street.

Lancashire and Yorkshire Railway.—The report for 1920 gives the following particulars:—Trains worked by electric power, 233, with 18,445 seats; electric traction mileage run, 2,251,421, against 1,968,058 in 1919. Estimated further capital expenditure on electric power stations, &c., £89,200; subsequently, £132,700.

Lancaster.—Accident Insurance.—The desirability of being adequately insured against third-party risks was demonstrated at the meeting of the Town Council, on February 9th, when it was agreed to pay £1,170 compensation to the widow and children of Thomas Stackhouse, a pedestrian killed by a runaway car on the Bowerham route, on September 27th, 1920. The policy only gave £500 in case of death and £2,000 for any one accident, so that the Corporation loses £670. It was pointed out that if 20 had been killed, the loss which would have fallen on the shoulders of the Corporation would have been about £18,000.

Liverpool.—Contract with L. & N.W. Railway.—The Corporation has renewed its agreement with the London and North-Western Railway Co. for the supply of electrical energy for a further period of 12 months.

London.—Report upon Arcing.—A Ministry of Transport Inspector has reported on the causes of the excessive electrical arcing which took place on the London Electric Railway on November 7th last between Piccadilly Circus and Oxford Circus stations. The train in question was composed of three trailer cars with a motor-car at each end. The arcing commenced under the front car, and gave rise to heavy fumes and smoke, and the train was brought to a halt in a tunnel, and passengers were transferred to another. Although nobody was seriously affected, several employés experienced ill-effects for some days afterward. It appears that the trouble was due to the fracture of the connecting cable of one of the shoes at a point where a metal sleeve connector had been fitted. It was admitted that this form of connection was unsuitable in character, and that all shoe cables in which the sleeve had been used were being replaced. On the same evening, fusing of a less serious character occurred on the same line, but in this case it was found to be due to the breaking down of the insulation of a negative shoe. The Inspector states that: "these two cases illustrate how rapidly atmospheric conditions in a tube, as the result of electrical fusing, become noxious, if not actually dangerous. Electrical pressure in such an emergency must, therefore, be removed at the earliest possible moment." The company is to be asked to state the results of experiments in connection with devices for a more direct interruption of the supply, in such cases, upon the section of line occupied.

Competition for Designs for New L.C.C. Electric Tramcars.—The report of Mr. A. L. C. Fell, the general manager of the L.C.C. tramways department, and Mr. J. P. Crouch, general manager Metropolitan Carriage and Wagon Co., Ltd., states that no one of the proposals submitted is of sufficient merit to justify serious consideration or adoption, nor does any design submitted offer any material improvement on the existing standard type of car from any point of view. There is also a conspicuous dearth of proposals in respect of the electrical equipment, and trucks or bogies; so much so that in the majority of cases, a complete lack of electrical and mechanical knowledge is apparent with regard to these most important features of car design. The assessors state that in their opinion the result of the competition is distinctly disappointing, in that nothing really new, and at the same time practical, has been suggested.

Hammersmith.—The L.C.C. has given the Borough Council sanction to borrow £788 for the provision of the necessary charging plant for the recently-purchased electric vehicles. The present cost of charging is 4d. a unit, and it is estimated that the price per unit will fall to 1½d. when the charging set is installed.

Newcastle.—Railway Electrification.—A correspondent of the Newcastle-upon-Tyne *Daily Chronicle* states that a start will be made shortly with the work of converting the main line between Newcastle and Darlington to electric traction, which will be extended later to York. This important project with which it has now been decided to proceed is only one of the several schemes for the improvement of the North-Eastern Railway services that are being considered.

Sunderland.—Parcel Transport.—The Sunderland District Tramways Co. has instituted a system of parcels transport from Sunderland to the villages in the district served by its cars. The scale of charges is:—Up to 7 lb., 3d. a package for any distance; 7 to 14 lb., 5d.; 14 to 28 lb., 7d.; and 28 to 56 lb., 9d. The Sunderland Corporation, over whose track the parcels are carried as far as Grangetown, will benefit financially by the scheme.

TELEGRAPH AND TELEPHONE NOTES.

Austria.—Cable Rates Doubled.—*The Times* announces that, as from February 15th, the rates for cable telegraph messages to all foreign countries, except those bordering on Austria, were doubled.

Germany.—Wireless Service to England.—A public wireless service between this country and Germany was begun early this month. The transmitting station on this side is at Stonehaven, Scotland, and the main telegraph office at Berlin acts as the German station. Messages handed in at Berlin are sent by wire to Königs-Wusterhausen, where they are automatically transmitted by wireless. The receiving station at Tetlow automatically transfers the messages to Berlin by wire Telegrams are received between 5 and 8 p.m., the charges being the same as the cable tolls. —*The Times*.

Sweden.—Anglo-Swedish Wireless Communication. —*Dagensnyheter* learns that a new telegraphic route between Stockholm and Stonehaven, Scotland, will shortly be inaugurated. Telegrams will be sent by special wire from Stockholm to the wireless station at Karlsborg, whence they will be automatically transferred and transmitted by wireless.—*Reuter's Trade Service* (Stockholm).

Telephone Service.—New Charges.—With regard to the new charges for telephone service, notices are being issued to terminate many yearly agreements three, six, or nine months before the course of the agreement has been run, and the P.M.G. states that subscribers will be entitled, in the event of a discontinuance of the service, to a rebate for the unexpired portion of the period.

U.S.A.—Cable Communication Conference. — The Cable Communications Conference, which adjourned last December, was to meet again on February 11th at Washington, says the *Morning Post*, at the instance of Mr. Davis, Acting Secretary of State and Chairman of the Conference. In the absence of Sir Auckland Geddes, the First Secretary of the Embassy will represent Great Britain. The American Government is anxious that an agreement shall be reached before the present Administration goes out of office.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Aberdare.—March 4th. Urban District Council Electricity and Tramways Department. Stores for one year, including cable, meters, lamps, &c. (February 11th.)

Australia.—Melbourne.—March 2nd and 9th. Victorian Railways. Reactances and condensers (for power signalling), electric crabs and equipment for cranes.*

Brisbane.—March 30th. P.M.G.'s Department. Switchboard apparatus and parts.*

Belfast. — February 26th. Tramways Committee. —Tramway stores, including electrical accessories, cable, lamps carbon brushes, &c. (January 28th.)

Tramways Committee. Two 500-kW, 500/550-V converters. (See this issue.)

Belgium.—February 26th. The municipal authorities of Nil-Saint-Vincent (Province of Brabant). Establishment of an electricity distribution system in the town. Particulars may be obtained from, and tenders are to be sent to, La Maison Communale.

Croydon.—March 7th. Electricity Department. Two natural draught cooling towers. (See this issue.)

London.—H.M. Office of Works. February 21st. Supply of electric bell fittings for six months. (February 11th.)

March 2nd. Six or twelve months' supply of electric lamps. (See this issue.)

Camberwell.—February 28th. Libraries Committee. Installing electric light, &c., in the Central Library, Peckham Road, S.E. (See this issue.)

Manchester.—April 4th. Electricity Committee. 33,000 and 6,600-V switchgear, induction regulators, &c., for controlling sub-stations of large capacity. (See this issue.)

New Zealand. — Wellington. — March 1st. Public Works Tender Board. Seven 4,000-kVA single-phase transformers, with accessories, for Lake Coleridge electric power scheme.*

March 5th. Government Railway Department. Two overhead travelling cranes.*

Portsmouth.—Electricity Supply Department. Three 1,500-kVA Scott-connected transformer groups, 3-phase, 6,600-V switchgear. (February 11th.)

South Africa. — Pretoria.—March 10th. Municipal Council. One 20-ton overhead crane, six boilers (350-lb. working pressure), three 3,000-kW steam turbo-generators with condensing plant, five 750-kW converters. Further particulars can be obtained from Mr. T. C. Wolley-Dod, general manager, electric lighting department. Specifications (five guineas) from the town clerk.

May 3rd. S.A. Railways and Harbours. Plant for the electrification of the Cape Town-Simonstown and Durban and Pietermaritzburg Railways. (February 11th.)

Stockton-on-Tees. — February 28th. District Fund. Gas and Electricity Committees. Articles and stores for six months. (See this issue.)

Uruguay.—Monte Video.—March 29th. State Power House. Single and three-phase meters.*

March 31st. A telegram from H.M. Minister at Monte Video (Sir C. C. Mallet, C.M.G.), to the Department of Overseas Trade, states that general tenders are invited until March 31st for the construction of the projected port works at Paysandu, for which an expenditure of $280,457 30 has been sanctioned. The construction of a dyke, the acquisition of electrical handling and lifting apparatus, the extension of the mole and the construction of anchoring grounds, are included in the scheme.

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Belgium.—Six firms submitted tenders recently to the municipal authorities of Antwerp for the supply of a converter set and switchboard for the transformer station in connection with the No. 7 Canal Basin. The lowest offer was that of the Société de Constructions Electriques de Charleroi, which quoted alternative prices of 165,950 and 207,900 francs.

Sunderland.—Town Council. Accepted :—

Meters.—Ferranti, Ltd.

Wolverhampton.—Electricity Committee :—

Eight "A" type stokers and accessories, £9,093.—Underfeed Stoker Co., Ltd.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, February 18th. At the Institution, Storey's Gate, S.W. At 6 p.m. Annual general meeting. Paper on "Desirability of Standardisation in the Testing of Welds," by Mr. F. M. Farmer.

Junior Institution of Engineers.—Friday, February 18th. At 39, Victoria Street, S.W. Social evening.

Friday, February 25th. At Caxton Hall, Westminster, S.W. At 8 p.m. Lecture on "Measurements of Precision in Engineering," by Mr. H. T. Davidge.

Manchester Wireless Society.—Wednesday, February 23rd. At 7.30 p.m. At the Albion Hotel, Manchester. Lecture on "Aerials," by Mr. P. G. Thomason.

Paisley Association of Electrical Engineers.—Wednesday, February 23rd. At the Y.M.C.A. Buildings, 25, High Street. At 7.30 p.m. Paper on "Thermometry and Pyrometry," by Mr. J. Savage.

Chelmsford Engineering Society.—Thursday, February 24th. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Engineering as Applied to Town Planning," by Mr. P. T. Harrison.

Illuminating Engineering Society.—Thursday, February 24th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Discussion on "The Use of Light as an Aid to Publicity." (*a*) "Shop Window and Spectacular Lighting," introduced by Capt. E. Stroud; and (*b*) "Illuminated Signs, &c.," by Mr. E. C. Leachman.

Institution of Electrical Engineers.—Thursday, February 24th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Lecture on "Magnetic Susceptibility of Low Order: Results of Scientific Research" (Lecture II), by Prof. E. Wilson.

(Students' Section).—Friday, February 18th. At King's College, Strand, W.C. At 6.30 p.m. Presidential address, by Mr. Ll. B. Atkinson.

North-Midland Centre.—Tuesday, February 22nd. At the Hotel Metropole, Leeds. At 7 p.m. Ordinary meeting.

North-Western Centre.—Tuesday, February 22nd. At the Engineers' Club, Manchester. At 7 p.m. Paper on "Magnetos for Ignition Purposes in Internal Combustion Engines," by Mr. E. A. Watson.

South-Midland Centre (Students' Section).—Tuesday, February 22nd. At the University, Birmingham. At 7.30 p.m. Paper on "Turbo-alternators," by Mr. J. P. Ellis.

South-Midland Centre.—Wednesday, February 23rd. At the University, Birmingham. At 7 p.m. Discussion on "Electric Appliances for Domestic Purposes." To be introduced by a paper by Dr. E. Griffiths and Mr. F. H. Schofield on "Some Thermal Characteristics of Electric Ovens and Hot Plates."

Edinburgh Electrical Society.—Friday, February 25th. At the Philosophical Institute. At 8 p.m. Paper on "Telephone Troubles," by Mr. J. McEwan Brown.

Physical Society of London.—Friday, February 25th. At the Imperial College of Science, South Kensington. At 5 p.m. Ordinary meeting

NOTES.

The King's Speech.—In the speech with which His Majesty the King opened the Parliamentary Session of 1921, on Tuesday, reference was made to a Bill which will be introduced for extending the provision made for the unemployed under the Unemployment Insurance Act; a measure to deal with the safeguarding of essential key industries of the country and with certain aspects of unfair and abnormal industrial competition. "It is proposed that the forthcoming removal of control over the home price and export quantities of coal shall be followed at the earliest possible moment by the complete restoration of the industry to its normal condition of freedom." A Bill will be submitted for the reorganisation of the railways of Great Britain.

Smoking Concert.—The L.E.E.O.C.A. is holding a smoking concert at the Bridge House Hotel, London Bridge, on Friday, March 4th, at 6.30 p.m. Admission by membership card only. Mr. F. Frankling (hon. sec.), 108, Heathwood Gardens, Charlton, S.E. 7.

Running Costs of Electric Vehicles.—A correspondent to *The Commercial Motor* protests against what he describes as "glaring exaggeration" on the part of a contributor in an article on the running costs of electric vehicles. He asserts that full justice has not been done to the "electric" in comparing it with other means of road transport, and quotes figures of "definitely attained results" to show that the advantage of the electric vehicle over the petrol vehicle is much more marked than the contributor of the article admitted. The correspondent first takes the case of a large railway company, and compares two 1-ton vehicles—petrol and electric. The fuel in the case of the former cost £83 per year (3,000 miles) and the energy for the electric vehicle £20. The next item is attested by the borough surveyor of Gillingham. Comparing two vehicles of 5·cb. yards capacity employed in the collection of refuse, the petrol type cost £17 4s. 8d. per week, as against £12 6s. 10d. for the electric. The third case is a comparison of a 1-ton petrol vehicle and a 15-cwt. electric, carrying approximately equal loads, in the service of a "well-known firm of contractors, Lancashire." With an annual run of 5,000 miles, the cost of the petrol vehicle was about 10s. per day in excess of that of the electric vehicle.

Service Notes.—Lieut. A. C. Box, from the City of Edinburgh Fortress Royal Engineers (Electric Lights Company) has been appointed in the same rank to the Territorial Reserve of Officers, from the 9th inst.

Recruiting for electrical departments of both the Army and Navy is very good, but additional electricians are needed for wireless work and Royal Air Force.

Lieut. A. C. Petherwick has been appointed to H.M.S. *Jumna*, Bombay, to take charge of the wireless station at Colombo, Ceylon.

Electric Industrial Truck Taxes.—The Electric Vehicle Committee some little time ago, as reported at the time in our columns, obtained a statement from the Roads Department of the Ministry of Transport that it would not be necessary to take out licences for electric industrial trucks in cases where these little vehicles were used to cross or only run a short distance along a public highway from one factory to another where both factories were in the same ownership. The Ministry stated that if necessary it would issue instructions to the Treasury regarding this matter. The Electric Vehicle Committee having found that in many cases the local authorities were insisting upon licences being taken out for such vehicles, the Committee has again taken the matter up very strongly with the Ministry, and has at last received a letter which states that no steps will be taken by the police or registration authorities to enforce the requirements of the Acts for the time being, and accordingly it is hoped that the owners of electric industrial trucks will have every opportunity of submitting the facts relating to their vehicles for consideration by the Ministry without being put to any inconvenience by the police or registration authorities in the meantime. It was found to be impracticable to deal with cases of this character by legislation or by regulations, and the Minister undertook to consider whether cases of this character could be dealt with in administration. He, therefore, requests Councils, should any such cases arise within their area, to verify and furnish to the Ministry particulars of the vehicles and the extent to which they use public roads, and he further suggests that, pending consideration of this report by the Minister, Councils should not take any steps to enforce the taking out of licences by the owner.

The Electro-Harmonic Society's Concert.—The concert provided on Friday last (Ladies' Night) calls for special mention as one of the best that the Society has ever enjoyed. Captain R. J Wallis-Jones, O.B.E., T.D., was in the chair, and pointed out that the chairs in the parks were not the only things that had not "gone up"—the Society had not put up its subscription (but can it hope to maintain that generous policy ?). From the start things went with a swing; the opening solo, by Mr. Bernard Flanders, was enthusiastically encored, and the same compliment was paid to all the other artistes—some, indeed, being twice recalled. Miss Violet Oppenshaw was at her best; Mr. Wilson James was really humorous; and of the combination of cornet, concertina, and piano, by Messrs. Lloyd Shakespeare and Ernest Rutherford, and Miss Gladys Millage, the audience never had enough; the chairman had to point out that time would not permit of further recalls. Altogether it was a gala night.

Educational.—POLYTECHNIC, REGENT STREET (Electrical Engineering Department).—A special course of six lectures by Mr. D. J. Bolton, on "Electricity Control," will be given on Friday evenings, commencing on February 25th, at 7.45 p.m. Fee for the course, 7s. 6d. See our advertisement pages to-day.

Messrs. George Wills and Henry Wills, directors of the Imperial Tobacco Co., who gave princely sums towards founding the University of Bristol, have just contributed a further £200,000 to finish the substantial extension which is being erected entirely at their expense, and the completion of which, it is stated, will place the University buildings of Bristol among the finest in the country, apart from Oxford and Cambridge.—*Financial Times.*

Fatalities.—George Smith (29), mining machineman, Gartsherrie, Coatbridge, received fatal injuries while working at a coal-cutting machine in No. 10 Rosehall Colliery, owned by Robert Addie & Sons' Collieries, Ltd. His leg accidently came in contact with the picks attached to the coal-cutting bar, and he was dragged under the bar.

According to the *Dundee Advertiser*, a sudden stoppage of electrical power on a part of the Glasgow Corporation's system caused a fatal accident. In the Fairfield shipyard a heavy piece of work was being lifted by an electric crane, and when the power was cut off the load fell among some workmen, causing instantaneous death to one of their number.

Joint Electricity Authorities.—On Tuesday last the inquiry into the schemes proposed for the North Wales and Chester district was opened at Llandudno by the Electricity Commissioners. Sir John Snell presided, and Mr. J. H. Dickson, Town Clerk of Chester, made a statement with regard to the scheme developed by the Chester Corporation (summarised in our issue of Jan. 14th), explaining that it was not proposed that the Joint Electricity Authority should buy out any existing generating station or interfere with the North Wales Power Company. It was held that the transmission of electricity from the west to the east of the area was out of the question, but the demand in the east was very urgent. The Corporation, therefore, proposed to erect a steam power station on the Lower Dee, to work in conjunction with water power stations on the Upper Dee, to meet the demands of the east. Eventually the eastern and western networks would meet and be interconnected. Mr. Dickson then referred to the attitude of various local authorities towards the scheme, there being a good deal of opposition.

Evidence was heard in favour of the Chester scheme, the first witness being Mr. E. N. Humphreys, of Chester, who was cross-examined by Mr. Harper for the North Wales Power Company; Mr. Tyldesley Jones, K.C., for the railway companies; Mr. A. Moon, for the Dee Conservancy Board; and Mr. W. O. Jones, clerk to the Anglesey County Council.

On Wednesday morning Mr. Humphreys was further cross-examined by Mr. W. Fennell, engineer and secretary of the Northwich Electric Supply Co., the representative of Rhyl Urban District Council, and the Commissioners. In the afternoon Mr. S. E. Britton, electrical engineer to the Chester Corporation, gave evidence.

The inquiry proceeded on following days, and will be reported in our pages in due course.

The inquiry at Liverpool is to be resumed on March 8th. The adjourned Bristol inquiry will not be resumed, as anticipated, on March 1st.

Electric Power Development.—In an article under this heading, a correspondent of the *Financial Times* points out that the development of electric power, which is of paramount importance to our industries, is at a standstill, the whole country having to wait upon the wholly problematical issue whether joint electricity authorities can be formed.

There are now 13 districts delimited by the Electricity Commissioners, and all of these are supposed to be at work forming schemes. The Electricity Commissioners have held hearings in respect of schemes for two of these districts, and the results can only be described as most unpromising.

The schemes practically depend upon all the authorities in the districts, municipal and company, mutually agreeing; then they have to gain the confidence of the public sufficiently to borrow anything from 4 to 20 million pounds.

"We cannot but think that the Electricity Commissioners must themselves know by this time that the schemes as a whole are failures. In such case the question is whether it is justifiable to hang up the electricity supply of the country for the next year or so simply to have documentary proof through the various hearings that these schemes are unworkable. In the critical state of the industry of the country the time lost will turn out to be a national disaster.

"Were the Electricity Commissioners to decide in their own mind that these schemes are impracticable there would be nothing to prevent the present undertakings themselves developing to meet the necessities of the case. In a number of cases company undertakings are only too willing to go forward. The Yorkshire Electric Power Co. is a case in point. This company is in a position to develop the whole of the supply in the West Riding of Yorkshire, but a prospective electricity authority stands in the way.

"Again, in London the Electricity Commissioners have in their hands an offer of the County of London Electric Supply Co. to erect a large power station at Barking, but this is held over until the problematical Joint Electricity Authority for London has been disposed of. The recent legislation on electricity supply, instead of helping electricity supply as was anticipated, has proved to be the most formidable hindrance."

Refractories for Electric Furnaces.—In an article on this subject in *Chemical and Metallurgical Engineering*, December 22nd, 1920, Mr. R. M. Howe emphasises certain factors concerning the service secured from refractory bricks. They should be protected from rain while being stored, in order to prevent the weakening of their structure. They should be laid up with a material similar to the bricks themselves, or one which will not corrode or flux them, using as small a joint as possible. The furnace should be constructed so that heat will be conducted away from the hotter portions. The ratio of heating to cooling area should be made as low as possible. Refractory bricks or shapes should be heated from one side only in order to keep the heating surface low, and in order to avoid the effect of pressure at high temperatures. Insulation lowers the margin of safety, and should, therefore, be avoided, even to the extent of allowing dust to accumulate on the roof. When the furnace is being heated this should be done gradually, especially where magnesite and silica brick are involved. When the furnace is being cooled it should be remembered that cold blasts produce or accelerate spalling.

The London Engineers' Club.—On Thursday, last week, the first meeting of the Provisional Committee was held at 39, St. James's Street. Mr. Edmund L. Hill was asked to take the chair, and, after reading letters of apology and support from several members of the Committee, including Lord Montagu of Beaulieu, Sir Robt. Hadfield, Mr. C. H. Wordingham and Mr. Ll. B. Atkinson, made an opening statement on the subject of the meeting. He said they met to carry out the mandate given by some 850 engineers to endeavour to establish a club in London for the engineering and allied professions. Some preliminary work had already been done, and it was suggested that the annual subscription should be, for London members, 10 guineas; for country members, 5 guineas; and for oversea members, 2 guineas. The club ought to have every modern convenience, including 80 to 100 bedrooms, lunching and dining accommodation, &c.; they might be able to secure a temporary home in which to make a start whilst looking round for a permanent home. The meeting would be asked to appoint a temporary Executive Committee, representing many branches of engineering, to investigate the possibilities, frame rules, &c., and to report to a general meeting of supporters. In the mass of letters that he had received he had been struck with the smallness of the opposition; the prevailing note was the need of an Engineers' Club, and wonder that it had not come about sooner.

On the motion of Mr. Harry Allcock, it was unanimously resolved that it was desirable "to establish a club in London to be called 'The Engineers' Club.'" The Chairman proposed, Mr. G. Layton seconded, and it was unanimously resolved, that an Executive Committee should be appointed, consisting of Messrs. Howard Foulds, A. H. Allen, R. W. Hughman, G. Layton, W. Prescott, P. C. Pope, H. T. Wilkinson, A. R. Fenn, C. T. Colpitts, H. C. B. Sainsbury, H. W. Couzens, T. C. Pulman, D. Wilson, J. S. Huddleston, H. Scholey and W. Hewison. Mr. A. L. Churchill proposed, Mr. W. W. Hughes seconded, and it was unanimously agreed, that the members of the Provisional Committee should be asked to subscribe £5 each to cover preliminary expenses. The meeting throughout was entirely harmonious and wholly bent on carrying out the proposal to form the Club as soon as possible.

Installation Symbols.—The *Electrical News*, of Toronto, recently published a list of symbols representing various features of electrical installations for the use of architects and electrical contractors. The list is a very comprehensive one, covering practically everything electrical likely to be installed in a house from wall "outlets" to motors. The adoption of such a method in indicating details of this nature on drawings should save a great deal of time and complication.

Appointments Vacant.—Gas manager and electrical engineer (total remuneration, £573) for the Malvern Urban District Council; electrical engineer (£700 + 50 per cent.) for the Government of Kenya Colony; sub-station attendant (£5 13s.), for the Stoke Newington Borough Council Electricity Department; permanent-way foreman, for the Borough of Keighley Tramways Department; telegraph foremen (£440), for the Government of Nigeria. See our advertisement pages to-day.

INSTITUTION NOTES.

Institution of Electrical Engineers.—The annual smoking concert in connection with the Informal Meetings Section of the Institution will be held at Anderton's Hotel, on Monday, Feb. 28th, at 7.30 p.m. Tickets (2s. 6d. each) may be obtained from the Secretary of the Institution, or from any member of the Informal Meetings Section Committee.

At the ordinary meeting of the Institution, on the 10th inst., the President announced that Mr. S. L. Pearce had been compelled to vacate his office of vice-president of the Institution, owing to ill-health, and the Council had elected Mr. A. A. Campbell Swinton, F.R.S., to fill the vacancy.

North-Eastern Centre.—The members of the North-Eastern Centre, in arranging their annual social function, departed from the usual course of having a dinner, and substituted for it a conversazione, which they held in Armstrong College, Newcastle-on-Tyne, on February 11th. The Centre is numerically so strong (possessing as it does 400 members), that it was felt that no undue risks were being taken in arranging such an entertainment, and this judgment was borne out by no fewer than 250 acceptances of invitations being received. The President of the Institution, Mr. Ll. B. Atkinson, and Mrs. Atkinson, who had travelled from London in order to be present, and were supported by Mr. J. R. Beard, chairman of the Centre, and Mrs. Beard, received the guests in the fine King's Hall of the College.

After the reception, the President, in the course of a few remarks, dealt in a humorous manner with the use of electricity in the home, and he did so, he remarked, because of the presence there of so many ladies. They had had a discussion on the matter in London the previous evening, and for the most part it was in connection with the properties, habits, and whims of electric ovens. The ladies would agree that it was an impudent piece of bravado on the part of 200 men to discuss such a subject. What could they know about ovens? They even discussed the evenness of temperature in an an oven. He did not know much about ovens, or cooking, but he did know that everything they put into an oven required either bottom heat or top heat; consequently, these men went well adrift in trying to make an oven of even temperature. Then, again, they talked about taking the temperature in an oven by a thermometer, when it was well known that oven temperatures could not be measured by thermometers, but were either swift, slow, or fierce. But, seriously, he wanted to make an appeal on the subject of domestic appliances. It was necessary that they should be investigated, and the ladies should carry out experiments in their own homes. Women who were unwilling to receive mechanical appliances into their homes were dooming themselves to domestic slavery. It was said that the hand that rocked the cradle ruled the world; it would rule it quite as well if the cradle were rocked mechanically.

For the entertainment of the guests, several features had been arranged. A lantern exhibition of photography in natural colours was given in the Physics Theatre by Mr. F. G. C. Baldwin, and in the Armstrong Laboratory Mr. J. H. Holmes gave some striking illustrations of the effects of high-frequency currents produced by the Tesla coil. In the Electrical Engineering Laboratory there were continuous demonstrations of electrical and other scientific experiments arranged by Prof. W. M. Thornton, D.Sc., and an exhibition of early electrical appliances had been arranged by Mr. J. H. Holmes, in the Herschell Laboratory. The application of electricity to domestic purposes was demonstrated by a varied collection of apparatus shown by Mr. W. F. T. Pinkney. After a round of inspection of these attractions, the guests made their way to the refreshment room, and the evening concluded with a dance in the King's Hall, where Smith's Royal Band during the whole evening rendered a pleasing programme of music.

North-Western Centre.—The President of the Institution, Mr. Ll. B. Atkinson, was present at the meeting of the North-Western Centre, at Manchester, on February 8th, and explained fully the position of the Institution. The proceedings were of a private and somewhat informal nature; in the course of the discussion, several suggestions were made by members with a view to improving the financial position of the Institution, and the President promised that they should be laid before the Council.

A Joint Discussion.—On February 10th and 11th a joint meeting was held by the Institutions of Civil, Electrical, and Mechanical Engineers, at Birmingham, to discuss the Severn Barrage Scheme and its bearing upon the interests of Birmingham. Mr. J. D. Watson, M.Inst.C.E., presided. Mr. R. A. Chattock opened the discussion, advocating the adoption of the Thury system, at a cost of £11,000,000. Other speakers were Prof. F. C. Lea, Messrs. H. P. Raikes, F. H. Clough, G. L. Addenbrooke, N. Rosher, Prof. Burstall, Mr. C. M. Shaw, Mr. F. W. Young, and Profs. W. Cramp and G. Kapp.

Informal Meetings.—At the informal meeting of the Institution on February 14th, a discussion on "Some Notes on the Design of a large Power Station" was opened by Mr. J. R. Cowie (Member of Council). Mr. Cowie had Dalmarnock (Glasgow) station in continual reference for his subject, and he was provided with copious plans and photographs kindly lent by Mr. R. B. Mitchell, chief engineer of this station. He proceeded to describe in detail the super-station. First determining the site by study of a map of the district, then the position of load and accessibility to rail and water. Next the erection from the concrete raft of the footings to the superstructure. He allotted the site its due proportions for stores, boilers, machines, &c., and described in detail and with reasons, the lay-out, system and voltages he would adopt. He asked members to give experiences of economisers with steel tubes, and he also thought further information was required regarding the enormous accretions of ash with post-war fuel. In the discussion, Dr. R. D. Gifford offered the idea of cooling by liquid air, and on the question of the drive of the station auxiliaries, advocated a d.c. house set.

Mr. S. Utting referred to the extension of furnace air heating methods, and Dr. Kapp thought it was making a virtue of necessity as the hot air had to be evacuated. Mr. W. N. C. Clinch spoke of steel economisers, and Mr. E. F. Hetherington knew of a case where galvanising the tubes did not prevent pitting. Mr. A. F. Harmer elicited Mr. Cowie's preference for keeping all metering on the low-pressure side.

Mr. W. J. Oswald, Mr. H. B. Jenkins, Mr. L. M. Jockel, Mr. W. Dargavel, Mr. A. E. Gott, Major K. Edgcumbe, Major R. Grierson and Mr. A. B. Eason also spoke.

Institution of Engineers (India).—The inaugural meeting of the Institution of Engineers (India) has been fixed for February 23rd, in Calcutta. Elections to membership on a very large scale have been made, and it is said that over 500 have already received their notices of election. The president is the Hon. Sir Rajendra Nath Mookerjee, K.C.I.E. The secretary is Mr. Hugh W. Brady, M.I.Mech.E., The Institution, Clive Buildings (Post Box 669), Calcutta.—*Indian Engineering.*

Faraday Society.—The general discussion on "The Failure of Metals under Internal or Prolonged Stress," which is being organised jointly by the Faraday Society, the Institution of Mechanical Engineers, the Institute of Metals, and the Iron and Steel Institute, will take place on April 6th. There will be both afternoon and evening sessions. The North-East Coast Institution of Engineers and Shipbuilders, the Institution of Engineers and Shipbuilders in Scotland, and the West of Scotland Iron and Steel Institute are also participating in the discussion. A preliminary programme has been issued, which states that the discussion will be opened by Dr. W. Rosenhain, F.R.S., who will give a general survey of the subject.

Chelmsford Engineering Society.—On February 10th a lecture on "Electric Welding" was given by Mr. J. H. Johnson, M.I.E.E., illustrated by lantern slides and numerous sample welds, Mr. T Clarkson, M.I.M.E., presiding. The author gave a few historical details of electric arc and resistance welding, and afterwards described the different systems at present in commercial use for both alternating and direct current. Various photomicrographs and radiographs were shown dealing with the internal examination of metals and welded joints. A discussion followed, and an inspection of different examples of electrically-welded joints.

Belfast Association of Engineers.—At the meeting of the Association, on February 17th, a paper, entitled "Costing in a Small Engineering Works," was read by Mr. James A. Hind, A.M.I.Mech.E. The paper was illustrated by means of lantern slides.

Paisley Association of Electrical Engineers.—On February 2nd Mr. David M'Kay read a paper on "Wireless Telegraphy and Telephony." The speaker gave a detailed history of the subject, and described a large number of instruments. A short discussion followed the reading of the paper.

Institute of Metals.—The annual general meeting of the Institute of Metals will be held at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W. 1, on March 9th and 10th, 1921. The meeting will commence at 10.30 a.m. each day. On March 9th the annual dinner of the Institute will be held, and on March 10th there will be a visit to the National Physical Laboratory. For permission to make this visit the Council is indebted to the director, Sir Joseph Petavel, K.B.E., D.Sc. A special Council meeting will be held in London, on February 23rd, for the express purpose of considering applications for membership. All applications that are found to be in order will be included in a ballot list to be issued to members on February 24th.

S.A. Institute of Electrical Engineers.—The *S.A. Mining and Engineering Journal* states that Mr. L. B. Woodworth is the new President of the S.A. Institute in succession to Mr. A. E. du Pasquier, who is now director of the Metropolitan-Vickers Export Co.

Royal Aeronautical Society.—Meteorology and Aviation.—In discussing the subject of meteorology in the service of aviation, before the above Society, on February 3rd, Major G. Dobson considered various methods of observing weather conditions with a view to gathering such information as would make it possible to produce an accurate weather forecast, and recommended the use of unmanned kite balloons carrying recording instruments. He explained that observation stations could be located along the flying routes, to telegraph (probably by means of wireless) data to a central station. There would be great advantage in employing wireless telegraphy for the transmission of the information, for not only would time be thereby saved, but also any large aerodromes could have their own wireless apparatus and receive not only the information transmitted by the central station, but also that sent by such of the observation stations as were within its range could be intercepted direct, and the delay of circulation through the central station avoided. The lecturer also outlined various methods by which fog might be dissipated over an area sufficiently large to enable an aeroplane to land in safety—namely, by artificially warming or drying the air, and by the electrical discharge method. With regard to the latter, he pointed out that if a pointed rod be introduced into a jar containing artificial fog or smoke, and be charged electrically till a brush discharge takes place from the point, the fog is quickly cleared in a remarkable manner. Methods of this type have frequently been suggested, but it seems certain that all the imaginable effects of an electric discharge (which easily account for the clearing in a jar) would be enormously too small to cause any appreciable clearing on a large scale. Major Dobson has not been able to find any positive results where experiments have been made in the open with this method.

Nottingham Society of Engineers.—On February 21st, Mr. W. Haddock is to give a lecture on "Grinding Machines and Wheels." The Society and other scientific and technical societies of the district have a joint library from which members may borrow volumes. The general public is allowed access to the library for reference purposes.

Society of Engineers (Inc.)—A paper on the "Physical Properties of Clay" which was read recently by Mr. A. S. E. Ackermann, dealt with the results of 107 experiments, and is a continuation of the author's previous paper on "Experiments with Clay in its Relation to Piles" (which was read before the Society in March, 1919, and which was awarded the president's gold medal), wherein the results of the first 102 experiments are recorded. Some of the experiments now recorded are similar to those dealt with in the first paper, and they extend the range of the conditions which held during the earlier experiments; others are new. As a result of the last year's work, the following modifications of the conclusions given in the first paper become necessary: The effect of temperature on the supporting capacity appears to be limited to stresses below the pressure of fluidity, and the sides of a hole appear to crush in before the statical head is equal to the pressure of fluidity. All other conclusions are confirmed, and further ones, which appear to be justified as a result of the new work, are that the tensile strength of clay increases as its water content decreases, and the contraction of clay on drying increases as the original water content increases.

Manchester Wireless Society.—At the meeting held on Feb. 9th, the chairman, Mr. McKernan, announced that arrangements were being made with a view to establishing the headquarters of the Society at the Albion Hotel, Piccadilly, and that an aerial would be erected on the roof, and facilities given by the management to allow of reception of signals by members of the Society at stated times. Mr. J. C. A. Reid then read a paper on "Searchlights, and their Work during the War." Mr. Reid gave a very clear account of the work carried out by this section of the Army and Navy, and the many difficulties that were experienced, especially during the early stages of the war.

Birmingham and District Electric Club.—A meeting was held on February 12th, at which a paper was read by Mr. C. G. A. Macdonald, entitled "Reminiscences of the Test Bed." The paper was much more elaborate than was implied by its title. It gave an interesting and detailed account of the technique, methods and instruments used in testing motors, single phase transformers and rotary converters. The paper was illustrated by mathematical formulæ and diagrams, and gave rise to a lively discussion.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

MR. ARTHUR W. FITHIAN, M.I.E.E., who for nearly 20 years has acted as engineer and branch manager for the North of England of the Tudor Accumulator Co., Ltd., has now joined Messrs. E. G. Lind & Co., 48A, Buckingham Palace Road, S.W., who have been appointed sole agents for Great Britain and Colonies for the "A.F.A." accumulators

The directors of the Notting Hill Electric Lighting Co., Ltd., have elected MR. R. G. RAWKINS (who has been secretary of the company for 28 years) to a seat on the Board, in the place of the late Sir William Crookes, O.M., F.R.S.

MR. W. J. McDONALD, traffic superintendent of the Yorkshire (W.R.) Electric Tramways, has resigned his position to join the firm of Messrs. Tate, who handle the distribution of the well-known Ford motor vehicles in the district. The staff and employés at the Wakefield tramway depôt last week presented him with a barometer.

MR. A. G. F. HEATHER, A.M.Inst.C.E., is shortly leaving the Metropolitan-Vickers Electrical Export Co., to take up a position as electrical engineer under the Federated Malay States Government.

The L.C.C. Highways Committee recommends that CAPT. G. D. MEYNELL, A.M.Inst.C.E., at present engineer in the London office of the Victoria Falls and Transvaal Power Co., Ltd., be appointed assistant electrical engineer in the tramways department at £600 a year, rising to £800 (based on pre-war conditions), and that as from January 1st, 1921, MR. H. UNDERWOOD, boiler house charge engineer, at Greenwich power station, be promoted to be boiler house superintendent at a commencing salary of £300 a year, rising to £400 per annum (based on pre-war conditions).

According to the *Daily News*, SIR JAMES CURRIE, who has been Controller of the Industrial Training Department of the Ministry of Labour since 1918, and has given his services voluntarily, is about to retire.

Middlesbrough Gas and Electricity Committee has recommended that the salary of MR. SCOTSON, the electrical engineer, be increased by £100 per annum, as from April 1st.

Wrexham Corporation electricity works staff has presented a leather suit case to MR. ARTHUR HOLT, mains foreman, who is leaving, after 12 years' service, to take up an appointment under the Malvern Urban District Council.

MR. ARTHUR HUTCHINGS has severed his connection with the Acme Electric Traction Co., Ltd., Seven Sisters Road, N., and has opened an office at 15, Penton Place, King's Cross, W.C. 1, as consulting electrical engineer, manufacturers' agent, &c.

Obituary.—MR. W. KING WOOD.—We regret to hear of the death which occurred suddenly on January 27th, at Teheran, Persia, of Mr. W. King Wood, C.I.E., C.B.E., Director, Persian Section, Indo-European Telegraph Department, at the age of 53 years.

MR. G. R. PEERS.—We regret to record the death, which occurred suddenly on February 10th, of Mr. George R. Peers, A.M.I.E.E., at the age of 54 years.

The many friends of MR. V. DELEBECQUE, of the Walsall Electrical Co., Ltd., will join with us in expressing sincere sympathy on the death of Mrs. Delebecque, as the result of an accident.

MR. S. J. BESSANT.—The death has taken place, at the age of 22 years, of Mr. Stanley James Bessant, B.Sc., who was an electrical engineer with the British Thomson-Houston Co., Ltd., at Rugby. During the war he held a commission in the Hampshire Regiment, and served in Palestine. He was mentioned in despatches.

MR. G. NICHOLSON.—The death has taken place suddenly of Mr. George Nicholson, formerly of Messrs. Nicholson & Waddeley, electrical engineers, North Street, and Great Market, Newcastle-on-Tyne. He was a native of Berwick, and for many years acted as electrician at Alnwick Castle, the seat of the Duke of Northumberland. He was an authority on engineering subjects, and during the war was engaged as an Army electrician at Newcastle-on-Tyne.

NEW COMPANIES REGISTERED.

Lighting, Heating and Power Installations Co., Ltd. (172,989).—Private company. Registered February 4th. Capital, £5,000 in £1 shares. To take over the lighting, heating and power installation business carried on by W. Smith at 16, Atkinson Street, Deansgate, Manchester, and elsewhere, as the Lighting, Heating and Power Installations Co. The first directors are: J. Lytheer, 13, Councillor Lane, Cheadle Hulme, Cheshire; G. A. T. Jesson, Endsley, Swinton, Lancs.; J. H. Langford, Stafford House, 6, Mauldeth Road, Heaton Mersey, Cheshire; W. Smith, 22, Bankhall Road, Heaton Mersey, Cheshire. Qualification, £100. Remuneration as fixed by the company. Secretary: J. Lytheer. Registered office: 16, Atkinson Street, Deansgate, Manchester.

Fyfe Wilson & Co., Ltd. (172,959).—Private company. Registered February 3rd. Capital, £10,000 in £1 shares (8,000 8 per cent. cumulative preference). To take over the business carried on at 31, Budge Row, E.C., and Harlow, Essex, as "Fyfe Wilson & Co.," and to carry on the business of mechanical and electrical engineers, manufacturers of and dealers in electrical apparatus and machinery, &c. The first directors are: H. F. K. Dearlove (permanent managing director), Hill House, Burnt Mill, Essex; A. Hall, Barkway House, near Royston; H. A. May, St. Olaves, Bury Road, Harlow. Registered office: 31, Budge Row, Cannon Street, E.C.

Alklum Electrics, Ltd. (172,950).—Private company. Registered February 3rd. Capital, £1,000 in £1 shares. To carry on the business of general electrical engineers, manufacturers of all kinds of electric apparatus, machines, instruments and accumulators, &c. The first directors are: R. Maude, 20, Hyde Park, Halifax (director, Worsnop & Co., Ltd.); C. H. Worsnop (managing director), Rockville, Halifax (director, Worsnop & Co., Ltd.); H. E. Hodgson, 34, Ashgrove, Bradford; A. Worsnop, 25, Union Street, Halifax; A. Parker, 7, Hyde Park Gardens, Halifax. Registered office: Waterside Works, Waterside, Halifax, Yorks.

Nickeloid Electrotype (an Eyre & Spottiswoode Subsidiary).—The Nickeloid Electrotype Co., Ltd., has been registered as a "private" company, with a nominal capital of £40,000 in £1 shares. The objects are: to adopt an agreement with Eyre & Spottiswoode, Ltd., and to develop the business of electro-deposition, electro-typing, stereotyping and engraving formerly carried on by the said company. The first directors are: G. E. Briscoe Eyre, 18, Redcliffe Square, S.W.; Nigel de Mundeville Bond, Springfield House, Hatfield Peverel; G. O. Smith, 24, St. John's Wood Park, N.W.; A. T. Atkinson, The Old Bells, Bramley, Hants. So long as Eyre & Spottiswoode, Ltd., or their nominees hold 20,000 of the shares allotted to them pursuant to purchase agreement, they may appoint the permanent directors. Secretary: J. S. Crosthwaite. Registered office: 6, Middle New Street, Fetter Lane, E.C.

British Brazing Co., Ltd. (172,903).—Private company. Registered February 1st. Capital, £10,000 in £1 shares. To carry on the business of brazers and welders of metals, engineers, pattern makers, boilermakers, ship, boat and aeroplane builders, &c., and to adopt an agreement with the Marine and Mechanical Electric Welding Co., Ltd. The first directors are: W. Pollock, M.I.Mech.E., 3, Lloyd's Avenue, E.C.3 (chairman of James Pollock, Sons & Co., Ltd., and other companies); T. Ballantine, 34, Queen's Gate, Dowanhill, Glasgow (director, Marine and Mechanical Electric Welding Co., Ltd.); J. McAuslan, Gilchrist, Aytoun, Sydenham Road, Dowanhill, Glasgow (director, Marine and Mechanical Electric Welding Co., Ltd.); J. M. Scott, 139, Hamlet Gardens, Ravenscourt Park, W.C. (director, James Pollock, Sons & Co., Ltd.). Qualification, £250. Registered office, 3, Lloyd's Avenue, E.C.3.

J. H. McBean, Ltd. (173,034).—Private company. Registered February 8th. Capital, £5,000 in £1 shares. To take over the business of an electrical engineer, &c., carried on by J. H. McBean at Clarence Mills, Bradford Road, Batley. The first directors are: J. H. McBean (chairman and permanent managing director), 34, Whitaker Street, Batley; A. W. Blackburn, Waynville, Reservoir Street, Dewsbury. Registered office: Clarenca Mills, Bradford Road, Batley.

Whitworth Electric Lamp Co., Ltd. (173,062).—Private company. Registered February 9th. Capital, £5,000 in £1 shares. To carry on the business of an electrical engineer and factor carried on by H. Harrison at 195, North End Road, West Kensington, W. 14. The first directors are: H. Harrison, 78, Woodstock Road, Bedford Park, W. 4; W. C. Hands, 33, School Road, Moseley, Birmingham (both permanent subject to holding 2,000 shares each). Registered office: 195, North End Road, West Kensington, W.14.

Norwest Electrical Manufacturing Co., Ltd. (11,604).—Private company. Registered in Edinburgh January 29th. Capital, £5,000 in £1 shares. Electrical engineers, electrical machine makers, machinists, metal workers, brass and iron founders, electricians, &c., in the works to be erected by the company at Motherwell, Lanark. The subscribers (each with 100 shares) are: A. N. Penman, 85, Kirk Road, Wishaw, electrical engineer; D. Smith, 5, Cecilia Terrace, Glasgow Road, Wishaw, engineer. The first directors are: A. N. Penman and D. Smith. Solicitors: Logan, Sloan and Rae, Wishaw.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Banbury and District Electric Supply Co., Ltd.—Satisfaction in full on December 31st, 1920, of debenture dated March 26th, 1913, securing £100.

Northampton Electric Light and Power Co., Ltd.—Particulars of £60,000 debenture stock, authorised November 22nd, 1920, and covered by trust deed dated January 5th, 1921, present issue £18,425, charged on the company's undertaking and property, present and future, including uncalled capital, subject to prior deed securing £50,000 first debenture stock. Trustees: C. C. Fisher, C.B.E., Chipston House, Market Harborough; J. Pendered, "Redwell," Wellingborough; and P. H. Page, 33, Billing Road, Northampton. Satisfaction in full on January 1st, 1921, of debentures dated November 12th and December 3rd, 1915, October 31st, 1916, and January 17th, 1917, securing £18,600.

Hexham and District Electric Supply Co., Ltd.—Satisfaction in full on January 24th, 1921, of debentures dated January 20th, 1908, and April 26th, 1909, securing £3,350 and prior lien debentures dated May 24th, 1917, securing £4,300.

Sheerness and District Electric Power and Traction Co., Ltd.—Satisfaction in full on January 1st, 1921, of debentures dated February 12th, 1915, securing £200.

Park Royal Engineering Works, Ltd.—Particulars of £9,000 debentures authorised December 23rd, 1920, whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital, subject to prior charges.

West India and Panama Telegraph Co., Ltd.—Particulars of £100,000 first mortgage debentures authorised by resolutions of May 13th, 1891, and December 15th, 1920; present issue £20,000; charged on company's undertaking and property, present and future,

Vulcan Arc Welding and Transport Co., Ltd.—Mortgage dated January 11th, 1921, to secure £5,000 charged on certain land and premises in Wigan. Holder: J. A. Fairhurst, Arlington Manor, Newbury, Berks.

Stearn Electric Lamps Co., Ltd.—Debenture dated January 17th, 1921, to secure £10,000; charged on real estate, plant machinery, undertaking and assets. Holder: Sir Maxwell Hicks, Kt., 20, Copthall Avenue, E.C.

Hackbridge Cable Co., Ltd.—Particulars of £40,000 debentures authorised January 11th, 1921; whole amount issued; charged on company's undertaking and property, present and future, including uncalled capital.

Ilford Dry Battery Co., Ltd.—Satisfaction in full on June 19th, 1919, of debentures dated August 23rd, 1916, securing £1,250.

Ingleton Electric Lighting and Power Co., Ltd.—Issue on February 1st, 1921, of £500 debentures, part of a series already registered.

English Electric Co., Ltd.—Particulars of £1,250,000 debentures (being 12,500 Notes of £100 each carrying interest of 8 per cent. per annum), authorised by resolution of November 22nd, 1920, and covered by trust deed dated January 1st, 1921, whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: Anglo-American Debenture Corporation, Ltd.

Brownlee & Green, Ltd.—Deed of assignment dated January 14th, 1921, to secure £2,460 19s. 3d. charged on certain payments due to the company. Holder: Clay Cross Co., Ltd.

F. L. Mitchell & Co., Ltd.—Particulars of £650 debentures authorised January 26th, 1921; whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital.

Automatic Telephone Manufacturing Co., Ltd.—Particulars of £350,000 debentures authorised December 9th, 1920, and covered by trust deed dated January 17th, 1921; whole amount issued; charged on company's undertaking and property, present and future, including uncalled capital, freehold hereditaments, buildings, plant, machinery, &c. Trustees: London County, Westminster and Parr's Bank, Ltd.

East Anglian Electricity, Ltd.—Mortgage dated February 1st, 1921, to secure £1,000, charged on certain freehold land and buildings at The Quay, Sudbury, Suffolk. Holder: F. R. Francis, Sudbury, Suffolk.

CITY NOTES.

Westminster Electric Supply Corporation, Ltd.

The total connections increased during 1920 from 52,457 kW to 56,652 kW. After referring to the new Bill which is likely to be introduced, the directors say:—

> The Electricity Commissioners, acting under the Electricity (Supply) Act, 1919, have provisionally determined a London District and have asked for schemes to establish an Electricity Authority for the district.
>
> A majority of the London companies, including this company, in association with the L.C.C. and the Conference of Local Authorities, have in preparation a technical scheme which they propose to submit for consideration by the Commissioners.
>
> The extremely important administrative and financial conditions which should govern the creation and powers of a Joint Electricity Authority are at present having the careful consideration of the associated companies in view, especially, of the necessity for safeguarding the interests of their shareholders.
>
> It is hoped that the scheme ultimately put forward will be such as to secure the best use of existing resources and experience, with the object of producing and selling electricity as widely and cheaply as possible.

After allowing for depreciation, sinking fund, and other charges, and paying the preference dividend, the total distribution on the ordinary for the year, less income tax, is 10 per cent., leaving £12,698 to carry forward. Units generated, 28,890,889; units sold, 25,659,191.

St. James' and Pall Mall Electric Light Co., Ltd.

The connections increased from 18,902 kW to 19,904 kW during 1920, and 13,510,297 units were supplied to consumers. Net profit £28,310, plus £8,577 brought forward. Preference dividend (7 per cent.), £7,000; ordinary dividend total for the year 12 per cent., £24,000; carried forward £5,887. The Electricity (Supply) (No. 2) Bill, which is likely to be proceeded with in the forthcoming session, appears to need amendment in certain particulars in the interests of the existing undertakers, and the directors are taking steps to get amendments moved. The report contains the same references to this matter as are given in the Westminster report above.

The death is recorded of Mr. Marlborough R. Pryor, a director, and Messrs. M. Gluckstein and R. H. Benson have been elected to the board.

Units generated by steam plant, 482,051; purchased, 17,128,333.

London Electric Supply Corporation, Ltd.

Profit for 1920, £99,487, against £95,240 in 1919. Add brought forward £11,500. Interest on temporary loan, &c., £1,379; debenture interest and sinking fund, £40,074; preference dividend (6 per cent.), £26,952; dividend of 2½ per cent. on the ordinary shares, £8,325; reserve, £15,000; contingencies, £5,000; carry forward, £14,257. Sinking fund for redemption of debenture stock in 1931 is now £150,226, in addition to £55,918 shown in the capital statement under the agreement with the St. James' and Westminster companies. Units sold 47,366,351, against 42,907,637 in 1919. Total costs per unit sold 1.38d., against 1.17d. Average receipt per unit sold (lighting and power) 1.81d., against 1.60d. Mr. G. W. Partridge has been appointed managing director in place of the late Mr. R. Stewart Bain. In regard to electricity legislation, the directors say it is hoped that the scheme ultimately adopted will be such as to secure the best use of existing resources and experience, with the object of producing and selling electricity as widely and as cheaply as possible. Meeting: February 21st.

South Metropolitan Electric Light & Power Co., Ltd. Credit balance for 1920, £82,821 plus £12,323 brought forward; also 10 per cent. on holding in West Kent Electric Co., Ltd., £1,002; total £96,146. Debenture and other interest £15,861; 7 per cent. dividend on cumulative first preference shares and 6 per cent. on the second; £23,000 to depreciation; £10,000 to reserve; 8 per cent. dividend on the ordinary shares, less income tax, £13,200; to be carried forward £18,260. Despite the unfavourable conditions which prevailed during the year, the business of the company shows a satisfactory improvement. Meeting, Winchester House, February 23rd.

Lanarkshire Tramways Co., Ltd. Revenue during 1920 £229,546; expenses £197,967; leaving £31,579. Contributions to local authorities absorb £2,011; income tax £1,809; interest on debentures £643; interest accounts £4,053; depreciation reserve £9,000. Balance £14,062, plus £5,280 brought forward; total £19,342. After paying 5 per cent. for the year on the shares (£18,211), £1,131 is carried forward. The revenue shows an increase of £29,678 and the expenses an increase of £49,907, and there is also an increase on deferred repairs of £7,763; the increase in expenses was caused by the additional charges for electrical energy, wages, and extensive repairs. A provisional order was granted in December last authorising the company to abolish halfpenny fare stages, and to run motor omnibuses within the county borough of Lanark. As the Lanark County Council did not accept the terms upon which the company was prepared to dispose of the undertaking, the company has acquired the lines constructed by the County Council at cost price (£60,981). Passengers carried 1920, 35,584,191, as against 31,521,049 for 1919. Meeting, Cannon Street, February 28th.

Metropolitan Railway Co. At the ordinary general meeting, held on February 10th, Lord Aberconway (chairman), in presenting the directors' report, said that only the last four months of the period covered by the accounts showed any benefit from increased fares, while the increased expenses prevailed for the whole of the 12 months. With a current consumption increase of only 1 per cent., a mileage increase of 11 per cent., or 2½ million miles, was obtained. Lord Aberconway expressed the opinion that the cost of fuel and most other items of expenditure had reached its highest point, and that substantial reductions could be looked for in the present year. The company did not view the prospect of decontrol in August next, or at a later date, with any apprehension. The increased dividend was made possible by the receipts from that part of the undertaking remaining free from Government control. The effect of continued wages increases had been to raise the wages bill to a permanent figure three times the pre-war amount, and shorter hours made the position worse for the company. During the period covered by the accounts twelve new electric coaches had been delivered, as well as seven steam stock trains. The improvement in the design of the electric locomotives to increase their haulage capacity by 50 per cent. and to raise their speed had proceeded satisfactorily. Commenting upon the additions, the speaker said that the new design of car was, in the opinion of their experts, the best suited to this type of traffic, comparing favourably with any in this country for comfort and convenience. Arrangements had been made to increase the capacity of the generating plant at Neasden by the addition of a 12,000-kW turbo-generator, with the necessary steam plant. Referring to the proposed grouping of railways, Lord Aberconway thought that the Metropolitan would be put into a group with the District, the "Tubes," the East London Railways, and what might be called the General Metropolitan group.

Yorkshire Electric Power Co. In presenting the directors' report and accounts at the annual meeting, held on February 15th, the chairman (Mr. A. G. Lupton) said that although many of their customers were working short time, new consumers had brought the demand for power up to a higher level. The company now had in operation 446 miles of mains conveying electricity to 164 sub-stations supplying in the areas of 84 local authorities in the West Riding. In addition to direct supply to steel works, tramways, shipyards, collieries, factories, &c., the company was giving bulk supplies for distribution to the holders of 40 provisional orders. Working agreements were now in operation with Bradford, Sheffield, Rotherham, Dewsbury, and Batley. Their mains were on the point of being coupled up with those of Sheffield at the southern extremity of their area, and supplies were being given already to Otley on the northern boundary, Todmorden in the west, and Pontefract in the east. This had been accomplished in less than 20 years, and in spite of the scattered nature of the population served, their prices were as low as those in the densely populated cities of the West Riding. It had been in the minds of some of the company that another 20 years would see an unbroken supply, through other undertakings, through Yorkshire to Birmingham and Rugby, and stretching out to Lancashire and Lincolnshire, not only for factories and householders but ultimately to the railways. Unfortunately, at the present time, the company was prevented from going forward with the large station at Ferrybridge. This was urgently needed, and if the proposals for nationalisation had not intervened it would have been in hand. The expenditure of the million pounds involved would have provided work for men and British engineering shops, and would have been of some value in solving the problem of unemployment. The speaker deprecated the action of the Government and local authorities in holding up the development of useful schemes such as the company's, while road and other schemes of little practical value were proceeded with. The provisions of the Electricity (Supply) Act would not deal satisfactorily with the question of electricity supply on a great scale. The distribution of electricity to wide areas could not be carried out by such parochial schemes which did not realise the possibilities of the future.

Underground Electric Railway Companies. A summary of the results of working of the four railway companies and the London General Omnibus Co. for the year ended December 31st, 1920, is given below.

	1920.	Increase + or Decrease −
	£	£
Traffic Receipts	10,895,881	+ 1,785,411
Government Compensation to Sept. 26th, 1920 (after providing for adjustments)	705,347	+ 138,977
Total	11,601,228	+ 1,924,388
Operating Expenses	10,378,847	+ 2,199,249
Net Receipts	1,222,381	− 274,861
Miscellaneous Receipts (Net)	693,998	+ 130,369
Net Income	1,916,379	− 144,492
Interest, Rentals and other Fixed Charges	825,910	− 2,597
Balance	1,090,469	− 141,895
Reserve for Contingencies and Renewals	420,000	—
Balance	670,469	− 141,895
Dividends on Guaranteed and Preference Stocks, excluding M.D.R. Second Preference Stock	315,977	—
Surplus Paid into or *Deficit* met out of Common Fund	354,492	− 141,895
Amount Received from Common Fund	354,492	− 141,895
Per cent.	100 %	—
Add Balances from last year's Accounts	134,278	− 13,640
Total amount available for Dividends and further Reserves	488,770	− 155,535

Further statistics are also given which show a large increase in the number of car miles run and in the number of passengers carried, although the latter is not so great as the previous year's increase.

Passengers carried—

Ordinary	1,041,750,266	+85,053,376
Workmen	73,832,349	+ 5,329,061
Season	56,119,253	+ 7,926,883
Total ...	1,171,701,868	+98,309,320
Average fare per passenger ...	2.18	+ .19
Number of car miles run ...	148,728,900	+17,751,663

The reports of individual members of the group are given below.

Central London Railway Co.—The total net income amounted to £166,569, a decrease of £20,347. This, with a balance of £11,762 brought forward, made a total of £178,331. From this were deducted interest, rentals, and other fixed charges, £54,071; appropriation to reserve £20,000, and dividend on preference stock £21,600, leaving an available balance of £82,660. After payment of final dividends the sum of £15,160 is carried forward.

Metropolitan District Railway Co.—Total net income £539,840, a decrease of £25,771, this, with the balance brought forward, amounts to £561,938. Interest, rentals, and other fixed charges £327,371, appropriation to reserve £45,000, dividends on guaranteed and first preference stocks £124,930, leaving a balance of £64,637 available for distribution. Of this a dividend at the rate of 3 per cent. per annum on the second preference stock absorbs £44,100, and a balance of £20,537 is carried forward.

London Electric Railway Co.—Total net income £564,561, a decrease of £47,041, this, with a balance of £20,942 brought forward, amounts to £585,503. Of this total interest, rentals, and other fixed charges absorb £286,266, appropriation to reserve £45,000, and dividend on preference stock £126,947, leaving an available balance of £127,290. This is allotted as follows: Dividend on ordinary shares fully paid at the rate of 1½ per cent. per annum £104,940, balance carried forward to next year's account £22,350.

City & South London Railway Co.—Total net income £138,389, a decrease of £6,098; balance brought forward £19,750; total, £158,139. Interest, rentals, and other fixed charges £49,619, appropriation to reserve £25,000, dividends on preference stock £42,500, leaving a disposable surplus of £41,020. Of this balance, £3,700 is absorbed by the payment of an interim dividend of ¼ per cent., and £18,500 by a final dividend of 1¼ per cent. on the consolidated ordinary stock, leaving £18,820 to be carried forward. The directors of this company regret that owing to financial stringency they have been unable to proceed with the reconstruction and re-equipment of the railway, although the other three companies report the delivery of new rolling stock.

Bruce Peebles & Co., Ltd. Profit for 1920, including interest on investments and transfer fees, and after deducting income tax, administration expenses, and the amount required for debenture service £74,714, plus £5,462 brought forward. To reserve for E.P.D. and corporation profits tax £35,000; depreciation reserve £8,000; general reserve £10,000; 7½ per cent. per annum on the preference shares, and a further 2½ per cent. making 10 per cent., less tax, £5,107; 10 per cent. on the ordinary, less tax, £16,246; carried forward £5,823. The works were fully employed during the year, and the result is satisfactory; prospects for 1921 are good. It is proposed to issue the balance of the authorised share capital, 36,469 in ordinary shares, and the ordinary shareholders will be invited to subscribe for these at par, less a commission of 10 per cent., or 18s. net. The shareholders will have the right to subscribe for two new ordinary shares for each nine ordinary shares now held. Conditional allotment letters will be issued with the dividend warrants. In June last the directors appointed Mr. S. E. Bastow, formerly one of the joint managers of the company, and subsequently chief engineer to The British Dyestuffs Corporation, Ltd., to be managing director of the company. His appointment will be submitted for confirmation at the annual general meeting. Mr. James Watt has agreed to join the board if appointed.

Meeting: Edinburgh, February 21st.

Dublin United (Electric) Tramways Co., Ltd. Presiding at the annual meeting, the Rt. Hon. Laurence A. Waldron, P.C., chairman, stated that the total revenue was £43,254 over that of 1919, in which year they had the highest revenue previously attained by their operations. The result in the year just closed was achieved in spite of the unsettled conditions in the working area, which was accountable for recurring interruptions, and had resulted in loss of traffic. From this cause and the extension of the curfew to 10 p.m., in the Metropolitan area, under the military regulation, they had lost at least £200 a day in gross receipts, while owing to the 10 o'clock curfew he estimated a loss of about 2,000,000 passengers since October. There was some fear at the moment that a further extension of curfew would be made. In that case he did not know what would happen, but his opinion was that the effect in regard to themselves would be to paralyse the business of the company, and no doubt other great undertakings would also be most seriously affected. Labour and material this year showed a total of £109,047, being £32,120 in respect of material, £76,927 in respect of wages, and an increase in general charges, bringing the total increased working and general expenses up to £124,487 for the year. The loss in passengers was offset to some extent by the increased fares which they were permitted to institute a few months ago. On the whole, the chairman thought the shareholders were to be congratulated on their position. The stock of cars had been inproved, and added to, and rebuilding had been done at their own works at Inchicore. The condition of permanent way and rolling stock compared favourably with other tramways in the United Kingdom; indeed, they had exceeded the programme of renewals he set before them last year.

A resolution was passed declaring a 6 per cent. dividend for the half-year on preference stock and a final dividend of 7 per cent. on the ordinary stock, which, with the interim dividend, made 5½ per cent. for the year.

French Companies. At the meeting on December 17th of the *Société Industrielle des Téléphones* the report was approved and a dividend of 35 fr. per share voted.

The results of the year's working of the *Energie Electrique du Nord de la France* showed a net profit of 1,213,778 fr., allowing of a distribution of 30 fr. per share.

The report of the board of the *Compagnie Générale d'Electricité*, read at the meeting on December 20th, indicated the progress of the many undertakings the company has in hand. The net profits had risen to 7,370,815 fr., being 885,463 fr. above those of the foregoing year. The kWh sold by the branches totalled 95,089,000, against 82,764,000 in 1919 and 47,494,000 in 1914. A dividend of 60 fr. per share was declared.

The accounts for the working year of the *Sud Electrique*, submitted for the approval of the meeting of December 22nd, showed a profit balance of 1,888,668 fr., allowing of the payment of a dividend of 6 per cent. The network worked by the company now extends to 1,744 kilometres of high and low-pressure mains. The dividends distributed by the company's two offshoots were: Société Avignonnaise d'Electricité, 9 per cent.; and the Société Nimoise d'Electricité, 10 per cent. The company is also interested in the Electro Culture and the Société Générale Agricole—undertakings concerned with adapting electricity to agriculture.

The meeting on December 23rd of the *Exploitations Electriques* voted the distribution, as from April 1st, 1921, of a dividend of 17.50 fr. per share and 15 to 16 per cent. per part, the profits amounting to 1,007,207 fr. Favourable accounts were given of the working of the many traction, distribution and construction companies with which the company is concerned.

The rise in the Swiss rates of exchange has not permitted the *Société des Applications Industrielles* (which has big interests in Switzerland) to make the distribution of a dividend, notwithstanding that 1,518,502 fr. profit was realised during the year's working. The reserve against the risks of exchange was advanced to 3,500,000 fr.

The accounts submitted to the meeting on December 30th of the *Société Alsacienne et Lorraine d'Electricité* disclosed a deficit of 38,561 fr. The company is an offshoot of the Thomson-Houston company, and recently increased its capital from 1,000,000 fr. to 12,000,000 fr.

At the recent ordinary meeting of the shareholders of the *Compagnie Electrique de La Loire et du Centre* it was reported that the steps taken to obtain an increase in the tariff both from clients and the municipalities to cover the increased cost of working owing to the dearness of coal and prime materials had been temporarily successful, pending the fixing of a definite tariff by the experts. The energy consumed by the company's customers had sensibly declined in the year 1918-19, owing to the stoppage of business caused by the war; but the industrial revival was clearly shown in the year 1919-20 by the progressive increase in the call for electric current, to the extent that at the end of the latter period consumption was 31 per cent. in excess of the former. The total receipts were 19,215,738 fr. against 15,732,863 fr. in the year before. The outgoings, including bond interest, and loss on exchange totalled 19,215,738 fr. The profit balance was consequently 4,516,097 fr. The company has carried out the repairs to the generating groups and transformers which could not be effected during the war. At the end of May a group of 6,000-kW generators at the Montaud à St. Etienne station was the seat of a short circuit which caused a fire in the stator. The insurance covered almost the whole loss. The output of energy was 148,401,377 kWh, against 146,445,471 in 1918-19. Important new works were under way on several sectors of the company—St. Etienne, Roanne, Montluçon. The council proposed to devote 1,207,525 fr. to various sinking funds and to fix the dividend on the numbered shares at 20 fr. gross per share. The distribution was approved.

National Gas Engine Co., Ltd.—Net profit for 1920, after providing for depreciation of buildings, plant, tools, &c., and allowing for management salaries, corporation profits tax, and income tax, £92,062. Final dividend of 5 per cent. on the preference shares; also final dividend of 7½ per cent. per annum on the ordinary shares, less income tax (in addition to interim of 7½ per cent. already paid), on the ordinary, together with a bonus of 9d. per share. Balance forward £57,332.

Electrical Distribution of Yorkshire, Ltd.—The directors' report for the year ended December 31st last shows a net profit of £5,426 as against £4,354 for the previous year. This, with the balance brought forward, makes a total of £6,579 for distribution. £3,883 is allocated to a dividend at the rate of 6 per cent. per annum (free of income tax) on the ordinary shares, £1,000 is put to reserve, and £1,696 is carried forward.

Cambridge Electric Supply Co., Ltd.—The accounts for 1920 show a profit of £9,584, which with £2,382 brought forward totals £11,966. Debenture and other interest absorbs £2,096, depreciation fund £3,000; 5 per cent. dividend is to be paid (£4,758) and £2,111 is carried forward. Owing to the growth of the company's business £10,000 7½ per cent. "C" debentures were offered by the directors to the members in April last; of these £8,000 have been taken up, leaving a further £2,000 still on offer.

Tyneside Tramways & Tramroads Co.—Surplus of receipts over expenses £3,341 for the December, 1920, half-year, plus £1,011 brought forward. After deducting interest on mortgages, loans, &c., 5 per cent. per annum (less tax) is to be paid on the preference shares and 3 per cent. (less tax) on the ordinary (making 4 per cent. for the year); £488 is to be carried forward. Increase in traffic receipts £2,051, as compared with the corresponding half of 1919. For the whole year the increase was £6,580, but the increased costs of operation have exceeded this advance.

W. T. Henley's Telegraph Works Co., Ltd.—Final dividend on the ordinary shares issued prior to January 1st, 1921, of 2s. per share less income tax, making, with the interim dividend of 1s. per share, 3s. per share for the year.

South Metropolitan Electric Light & Power Co., Ltd.—The transfer books are closed until February 28th for the preparation of warrants for dividends payable on and after 28th inst. on the preference and the ordinary shares.

Stock Exchange Notice.—The Committee has ordered the undermentioned to be officially quoted:—

Crompton & Co.—250,000 ordinary shares of £1 each, fully paid (Nos. 79,540 to 329,539).

Clontarf and Hill of Howth Tramway Co.—A dividend at the rate of 3 per cent. per annum, less tax, has been declared.

Parsons Marine Steam Turbine Co., Ltd.—Interim dividend of 7½ per cent., free of tax.

Rushden and District Electric Supply Co., Ltd.—Final dividend of 4 per cent., making 6½ per cent. for the year.

Montreal Light, Heat & Power Co.—Gross revenue for 1920, $12,748,409; expenses and taxes absorbed $6,810,286, depreciation and renewal reserve $1,055,166, leaving net revenue $4,882,956, less fixed charges $1,078,449, leaving net income $3,804,506; dividends paid absorbed $2,683,443, dividend accrued (not declared) $537,295; surplus $583,767, less appropriated for pensions $20,000; transferred to general surplus, subject to tax, $563,767.—*Financial Times.*

New Issue.—The issue of 30,000 eight per cent. cumulative preference shares in the Melbourne Electric Supply Co., Ltd., was over-subscribed, and the lists were closed on Monday.

Northampton Electric Light and Power Co., Ltd.—Final dividend on the ordinary shares at the rate of 5½ per cent., making 8 per cent. for the year, as against 7 per cent. last year.

Central Electric Supply Co., Ltd.—During 1920 energy was supplied to the Westminster, St. James' & Pall Mall, and Chelsea companies to an amount of 38,246,260 units.

Smithfield Markets Electric Supply Co., Ltd.—Dividend 5 per cent. on the ordinary shares for 1920.

Fife Tramways, Light and Power Co.—Dividend 8 per cent. for 1920.

STOCKS AND SHARES.

TUESDAY EVENING.

THE general conditions of Stock Exchange markets are not unsatisfactory, although it cannot be said that they call for any particular enthusiasm on the part of members of the House. There is not enough business to go round the four thousand odd men who make up the membership of the Stock Exchange. Clients are not anxious to do much one way or the other at the present time. The tide of investment sets strongly towards gilt-edged issues. Banks, insurance companies and other financial institutions are buying heavily. The boom in life assurance contributes to the remarkably big sums that are being utilised in gilt-edged issues. On the other hand, Home Railway stocks, debenture, preference, guaranteed and ordinary are flat, in consequence of the pessimistic utterances of various chairmen at the meetings last week. Talk of a fall in the Bank Rate has retired into the background, and the hopes of an early alteration are no longer urgent.

The reports of the Underground Electric railway companies have their points of theoretical interest, although for all practical purposes the figures published in this column last week deserve greater attention. It is very obvious that the decreased dividends which we set out have come as a result of enormously increased charges. The railway companies unite in a common cry of the impossibility of making profits with wages and materials at their present level. Precisely the same wail comes from America, where it is held that fares and charges have already reached limits beyond which it is practically impossible to go without serious risk of losing traffic. The only other way in which net earnings can be increased is through economies in working, reduction of staffs, lower wages, cheaper coal, &c. The same conditions apply to our railways over here, and the opening of Parliament on Tuesday was never awaited with more anxiety by railway shareholders, who look to the present session to produce legislation that shall give railway stockholders a reasonable hope for profit upon their investments.

Movements in the cable stocks have been mostly upward. Eastern ordinary has risen to 160½. Globe ordinary and preference are harder, and Eastern Extensions remain at 15¼. Western Telegraphs at 16. There is scarcely enough difference between the various prices to make it worth while for the holder of Eastern ordinary stock to sell this and re-invest the money in Eastern Extensions or Globes, though the movements in the prices of the quartette will be closely watched with a view to making this kind of straddle if the opportunity offers. Marconis went back to 1⅞ and rallied to 38s. 9d. Radio preference touched 12s., to ease off to 11s. 6d. The common shares keep about 9s.

Chili Telephones are ⅛ down at 5⅝, and the American group holds its prices. Most of the stocks and shares of the dollar issues are better on the week, owing, of course, to the movements in the New York exchange. Brazilian Tractions are 38, showing a point advance, but they have been up to 39. Rio Tramways first mortgage bonds eased off to 87.

The possibility of a railway strike has combined with other fears to produce pronounced flatness amongst Home Railway stocks. Underground Incomes are better at 68½, but Metropolitans, Districts and practically the whole list of the steam stocks are lower, the steam stocks substantially so. There is no confidence felt in the market, and prices are shrinking away under the incessant pressure to sell in a market where buyers become increasingly rare. East London ordinary has dropped to 3. City and South London 4 per cent. debenture is lower at 42½.. Numbers of prior-charge stocks show falls of one or two points on the week.

County of London Preference improved to 7⅞, and Charing Cross preference at 2¾ recovered the 2s. 3d. per share dividend deducted last week. Westminsters sagged to 5⅛. Apart from these, there are no changes worth mentioning in the list of electricity supply shares. In the new session of Parliament it is expected that the Government will proceed with its ambitious Electricity Bill.

Newcastle-on-Tyne ordinary gave way to 14s. 6d. Yorkshire (West Riding) ordinary weakened to 17s. 6d. In the foreign list, Para 6 per cent. preference at 10s. and the ordinary at 8s. 9d. are both easier.

A reader writes from India to ask for the inclusion in our price-lists of English Electric quotations. It is a pleasure to comply with a request so reasonable. The manufacturing shares are heavy in tone. Edisons have fallen 1s. 3d. to 10s. 9d. British Aluminiums are 1s. down at 17s. 6d. General Electrics at 1 7/32 have recovered the small fraction lost last week. Babcock & Wilcox hold their improvement at 2¼. The armament group is lower, Vickers dropping sharply and taking Armstrongs in their train. Iron, coal and steel shares have given way because of the prevailing trade depression. But the public are not buyers of any industrial shares just now.

Rubber has gone up a penny or two without, however, arousing any particular interest. Share values are therefore limp, and business is stagnant. Reorganisation of capital account is regarded as almost inevitable in the case of certain of the financially weaker companies. Indeed, there are evident signs that the inordinate inflation of capital by many trading companies during the war period must bring nemesis in its train, and that the pruning-knife will have to be applied drastically to some accounts in order to bring capital into closer relation with assets that have shrunk with even greater rapidity than they previously expanded.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend		Price Feb. 15, 1921.	Rise or fall.	Yield p.c.
	1918.	1919.			
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary..	8	12	5⅞	—	£10 4 4
Charing Cross Ordinary	4	7	4	—	8 15 0
do. do. do. 4½ Pref. ..	4½	4½	2¾ xd.	—	8 8 8
Chelsea..	8	4	8¼	—	8 8 0
City of London	8	10	24/3	—	8 5 4
do. do. 6 per cent. Pref. ..	6	6	17/6	—	6 17 2
County of London	7	8	7½	—	10 13 4
do. do. 6 per cent. Pref.	6	6	7⅞	+ ⅛	7 12 4
Kensington Ordinary	8	7	8¾	—	9 0 6
London Electric	Nil	2½	½	—	10 0 0
do. do. 6 per cent. Pref...	6	6	2¾	—	10 18 2
Metropolitan..	5	6	2⅞	—	10 8 8
do. 4½ per cent. Pref. ..	4½	4½	2 9/16	—	8 15 8
St. James' and Pall Mall	10	12	6¼	—	9 12 0
South London	5	8	2⅝	—	9 9 10
South Metropolitan Pref.	7	7	13/9	—	10 8 8
Westminster Ordinary	8	10	5⅛	− ⅛	9 15 2
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	81½	—	7 7 6
do. Def.	33/6	1½	16½	—	9 6 8
Chile Telephone	6	6	5⅝	− ⅛	*5 6 8
Cuba Sub. Ord.	7	7	6½	—	*10 15 4
Eastern Extension		10	15¼	—	*6 9 0
Eastern Tel. Ord.	8	10	160½	+1	*6 4 5
Globe Tel. and T. Ord.	6	10	15⅝	+ ⅛	*6 8 0
do. do. Pref.	6	6	9	+ ½	6 13 4
Great Northern Tel.	22	22	22	—	10 0 0
Indo-European	13	10	30	—	8 6 8
Marconi	25	25	1 15/16	—	—
Oriental Telephone Ord.	10	12	9 5/16	—	*6 4 0
United R. Plate Tel.	8	8	6½	—	*6 8 0
West India and Panama	1/3	Nil	9/16	—	Nil
Western Telegraph..	8	10	16	—	*6 5 0
HOME RAILS.					
Central London Ord. Assented ..	4	4	43½	—	9 4 6
Metropolitan	1	1½	20½	− 1	7 6 4
do. District	Nil	Nil	15	−1	Nil
Underground Electric Ordinary	Nil	Nil	1⅞	− ⅛	Nil
do. do. "A" ..	Nil	Nil	5/6	—	Nil
do. do. Income ..	5	4	68½	+1	2 18 3
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams, First Pref. ..	Nil	5½	2⅝	− ⅛	10 9 6
do. do. 2nd Pref. ..	Nil	Nil	3½	—	Nil
do. do. 5 % Deb. ..	5	5	59½	—	8 8 0
Brazil Tractions	Nil	Nil	38	+1	Nil
British Columbia Elec. Rly. Pfce.	5	5	56	—	8 18 6
do. do. Preferred	2½	5	53½	—	*8 16 0
do. do. Deferred	Nil	3	51½	—	*12 2 8
do. do. Deb. ..	4½	4½	55½	+1	7 13 2
Mexico Trams 5 per cent. Bonds..	Nil	Nil	40½	—	Nil
do. 6 per cent. Bonds..	Nil	Nil	25½	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	21½	—	Nil
do. 1st Bonds	Nil	Nil	63½	—	Nil
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	2¼	—	6 13 8
British Aluminium Ord.	10	10	17/6	— 1/-	11 8 6
British Insulated Ord.	12½	15	1⅝	—	9 5 10
Callenders	25	15	1⅜	—	10 18 2
" 6½ Pref.	6½	6½	17/6	—	7 8 7
Castner-Kellner	20	17	2⅞	—	7 12 9
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	10	10/9	−1/3	—
do. do. 5 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	⅞	—	11 8 6
English Electric	—	8	14/6	—	10 19 2
Do. Pref.	—	6	14/-	—	8 11 5
Gen. Elec. Pref.	6½	6½	18/6	—	7 2 6
do. Ord.	10	10	1 7/32	+ 1/32	*8 4 0
Henley	25	15	1 7/16	—	10 5 0
do. 4½ Pref..	4½	4½	6½	—	6 18 6
India-Rubber..	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	1 13/16	—	8 16 4
Siemens Ord...	10	10	1 1/32	—	*9 13 8
Telegraph Con.	20	20	21½	—	*5 11 8

* Dividends paid free of Income Tax.

THE BROWN-BOVERI MERCURY ARC RECTIFIER FOR LARGE OUTPUTS.

By R. L. MORRISON, A.M.I.E.E.

Introduction.—It has been said the ideal is impossible of attainment. We can, however, approach very close to it, whether in ethics or machinery matters not, and the operation of the plant described in this article is acknowledged, by those competent to judge, as being of that order.

For many years there has been a widespread demand for some simple form of direct current converting plant that could be compared in simplicity and reliability with the ordinary transformer. At the present time the position is an acute one on account of high attendance charges that must in most cases be provided for with direct current sub-stations using running machinery, though to some extent the position has eased by the introduction of the automatically operated rotary converter. This, however, does not eliminate the running machine, and many of those responsible for the generation and distribution of electrical energy have considered the advisability of eliminating as far as possible direct current from their systems in favour of alternating current, where this could be conveniently done without too great expenditure, though it should not be forgotten that for the average municipal undertaking direct current stands pre-eminent as the most suitable all-round supply.

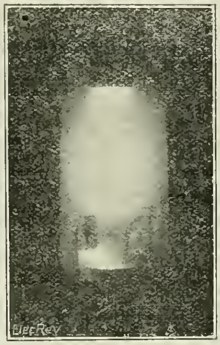


Fig. 1.—The Mercury Arc.

It is now possible to have stationary direct current sub-station plant, and this fact has given a new lease of life to this form of supply. These conditions are fulfilled by the introduction of the large mercury arc rectifier. The success that has attended, in so comparatively short a time, the efforts of those responsible for its development is very encouraging, and judging by the eminently satisfactory results obtained, and by the considered opinion of those having operating experience of such plant, the future can be looked forward to with every confidence, and it is not premature to say that before long the rectifier will become a formidable rival to the existing forms of rotating converters.

Fundamental Considerations.—The mercury arc rectifier is a converter for transforming alternating current into direct current. The mercury arc when operating in a vacuum has the peculiar property of permitting the passage of a current in practically one direction only, this having been demonstrated for many years in the small glass bulb rectifiers introduced by Mr. Cooper-Hewitt, to whom must be given the credit for the discovery that this valve action was possible.

Of the molecular or physical nature of the arc very little is definitely known. The study of the subject is an extremely difficult one, and no tangible explanations can be given for many of the phenomena connected with it. When dealing with large currents the difficulty is increased, due to the necessity of confining the arc to well-defined paths by means of cylindrical steel guides, and hence direct observation is almost impossible.

An interesting photograph is shown in fig. 1 of the mercury arc in a small glass tube rectifier. The arc raises the temperature of the anode evenly over its whole surface to that of red heat, giving it the appearance of having a halo around it. At the cathode it centres in one spot, the crater, the temperature of which is raised to 2,000 deg. C. or over, corresponding to that of white heat. This cathode spot travels irregularly at high speed over the surface of the mercury, and gives off an intense metallic vapour, a portion of which forms the conducting medium for the current. The major portion of the space between the electrodes is occupied by a luminous column starting close up to the anode and extending downwards to within a short distance of the cathode, where it stops abruptly, leaving a dark space. With very high vacua it is noticed that a large negative flame rises from above the cathode, and this is one of the undesirable features in rectifiers.

To account for the above phenomena the following explanation has been adduced *:—

In gases, electricity travels in charges called ions. There are positive ions which are combined with the chemical atom, and negative charges or electrons which have no weighable mass. On the other hand, there are neutral molecules possessing charges of both kinds. To bring these different elements into action a point on the cathode surface is brought to white heat by suitable means, which produces electrons. These electrons under the influence of the electric field, travel with acclerating speed towards the anode, and after accumulating sufficient kinetic energy come into violent contact with the neutral molecules. The impact separates these molecules into their constituent positive and negative charges (termed "ionisation by shock"), at the same time raising the conductance of the vapour path. The newly formed positive ions, together with the existing ones, move with great speed towards the cathode, and heavily bombard it on a very small surface, which is thereby brought to white heat, and so the discharge is maintained. It should be emphasised that in accordance with this theory the formation of an arc depends mainly on the existence of electrons such as are produced at the cathode when brought to white heat and when under the influence of an electric field. To prove this, the following test can be made:—

The upper portion of fig. 2 shows an exhausted glass tube having one iron or graphite electrode A, and two mercury electrodes B and C. It is desired to produce an arc between A and B. By tilting the tube contact can be made between B and C by the mercury running from one to the other. On the tube being brought back to its original position an arc will be started at the point of rupture with B as the cathode, and thus the first necessary condition has been fulfilled, that is to say, a spot on the cathode surface has been brought to a white heat. From a consideration of the connections it is apparent that B can be either anode or cathode, depending upon the way the connections are made. It will, however, be found that if A is negative and B positive an arc cannot be started between them even though the pressure be raised to thousands of volts, whereas if the polarity is reversed only 20 to 30 volts is necessary to start the arc. It is only under these circumstances that the electrons can ionise the space between A and B. Referring to the ignition circuit, it should be stated that an arc cannot be produced between the main electrodes if when the ignition arc was started B was positive and C negative. The production of an arc between the electrodes A and B is therefore only possible if the main mercury electrode is a cathode, because it is only at the cathode that the electrons can be produced.

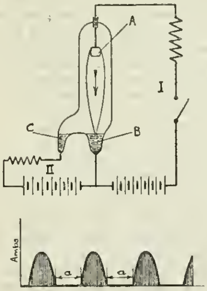


Fig. 2.

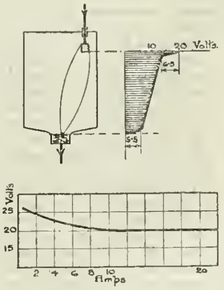


Fig. 3.

From the foregoing it will be gathered that the mercury arc operating in the manner described constitutes an electric valve, that is to say, it only permits the passage of a current in one direction. Electrons cannot be produced on a cold electrode, and it was shown with regard to fig. 2 that current would only flow provided the highly heated electrode was a cathode. To prove this—replace circuit I by an alternating current supply, and it will be found that an arc is only formed if A is positive and B negative, the result being a current wave similar to that in the lower portion of fig. 2. It should not be assumed that the spaces *a* without half-waves represent a loss of energy, because during these periods the valve passes no current, and therefore no energy is lost. It has, however, been ascertained by special measurements that a very minute current amounting to a few milli-amperes does actually pass in the reverse direction, but this has no detrimental effect on the operation of the rectifier.

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* See *B.B.C. Review* No. 5, 1919.

The temperature of iron anodes can be allowed to reach red heat without the valve action being endangered, though it is essential that the vacuum be kept as high as possible, for only then will the arc form as a halo round the anode without over-heating or vaporisation taking place on its surface.

Losses in the Arc.—To arrive at the losses occurring in a rectifier it is necessary to know the pressure drop in the arc. This is the sum of three separate drops due to the anode, the cathode, and the arc itself. The drop in the electrodes is practically constant, and is independent of their composition, the current density, or the vacuum. For iron anodes it is 6.5 volts, and for a mercury cathode 5.5 volts, making a total of about 12 volts.* The drop in the arc, however, is very variable, and depends upon the vacuum, the current density, and the section of the arc. It is directly proportional to the vacuum and inversely so to the current density and arc section. If we take a long tube of small section with a vacuum of 1 to 2 mm. Hg through which 3 to 5 amps. is passing, the drop would amount to 0.8 to 1.2 volts per cm. of arc length, but in large rectifiers where the vacuum is very much higher, the section of the arc greater and the current density amounts to several hundred amperes, the drop is reduced to 0.1 volt per cm. and below.

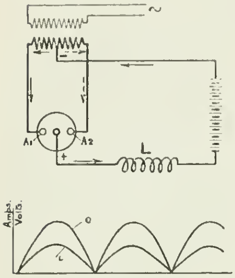

Fig. 4.

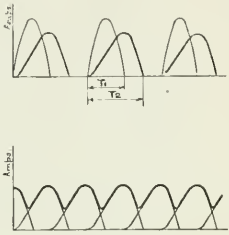

Fig. 5.

Assuming an arc 80 cm. long, which is that applicable to the largest rectifiers, the drop would be that due to the electrodes—12 volts, and that due to 80 cm. of arc at 0.1 volt per cm.—8 volts—or a total of 20 volts. This is the pressure required to maintain the arc, and is shown graphically in the upper half of fig. 3, the almost horizontal portions of the curve relating to the anode and cathode, while the steep portion joining the two refers to the arc. For ignition purposes a higher pressure must be used to overcome the high initial resistance due to the conductance of the vapour path being very low at first. In the lower half of fig. 3 is shown a curve of current plotted against pressure drop with approximately constant vacuum, from which it will be seen that the curve falls very rapidly at first as the conductance increases with the increasing production of vapour, and then onwards remains constant, so that for all practical purposes it can be said that the drop is constant for all loads.

The efficiency of a rectifier, therefore, remains constant at all loads, the losses being the product of the current and the drop across the arc. Consequently, increasing the pressure does not increase the losses, so that the higher this pressure is the better will be the efficiency—at 220 volts this is about 91.6 per cent., at 550 volts 96.5 per cent., and at 1,500 volts 98.5 per cent. In the first two cases the drop is taken as a maximum of 20 volts and in the last at 22 volts, the latter figure being a little higher to allow for the increased distance between the anodes and cathode in high-pressure rectifiers.

Single-phase Rectifiers.—The commercial application of the single-phase rectifier is very limited in consequence of the highly pulsating direct current wave form produced. A consideration of the simplified connections and wave forms applicable to such rectifiers is, however, of importance, as the general principles are the same for both single and polyphase rectifiers.

The usual connections will be those given in fig. 4, from which it will be seen that the rectifier is provided with two anodes, while the secondary winding of the transformer is divided into two with its neutral point brought out to form the negative pole of the direct-current system. The cathode forms the positive pole of the system. The path of the current is from the transformer secondary to the anodes, thence by way of the arc to the cathode, and finally through the external circuit back to the neutral point of the transformer.

There would appear to be some doubt in the minds of many as to whether both halves of the alternating waves are fully utilised. The matter is very simply explained as follows:—

It has already been shown that the rectifier will only permit the current to pass in one direction. The transformer secondary windings are connected in such a manner that the current can only flow in that portion having an e.m.f. urging it through the external circuit to the neutral point, the rectifier being the only circuit through which it can pass, that is to say, with each half-wave the sense of the current is positive, and hence it can only flow from the neutral point towards the anodes. During the first half-wave the flow would be along the left half winding in the direction of the arrow towards the anode A_1, the right half winding during this period having no current flowing through it, while the anode A_2 would naturally be negative. With the second half-wave the polarity is reversed, due, as already explained, to the windings being arranged to always give a positive direction to the current, A_2 then becomes positive with the current flowing towards it through the right half winding, and A_1 becomes negative. It will thus be seen that both halves of the current waves are fully utilised.

This results in a unidirectional pulsating current similar to the pressure and current waves of fig. 4, the load being assumed to be non-conductive. It will be noticed that the current drops to zero at each half-period, which means that the arc would be extinguished and the supply interrupted because it only requires a cessation of the current for 1/100,000 of a second for the hot spot on the cathode to cool sufficiently to stop the formation of the necessary electrons. Some means, therefore, must be provided to prevent this occurring, the usual method being to have separate excitation in the form of an auxiliary arc supplied from an external source, though the desired condition can be obtained by the use of suitable choking coils (L in fig. 4). The part played by these choking coils is illustrated in fig. 5, from which it will be seen that the waves are flatter and prolonged from T_1 to T_2. If the current waves for the two anodes are added graphically, we obtain the result shown in the lower portion of fig. 5, in which the resultant current is always well above zero, and hence the supply is maintained. It will be easily understood that a direct-current supply of this nature could only be utilised for motors provided the momentary value of the rectified pressure is higher than the back e.m.f. of the circuit, which can be ensured by making the choker large enough.*

It is not proposed to deal at this stage in detail with the relative values of the current and pressure in single-phase rectifiers—suffice it to say that the transformer must on an average be designed for an output about 1.75 times the d.c. output. The matter will be dealt with in greater detail for the six-phase rectifier.

Polyphase Rectifiers.—When it is desired to transform two or three-phase current into direct current for lighting, general power, and traction purposes, the six-phase rectifier comes into consideration. In general appearance it is similar to the single-phase rectifier already described except that the number of anodes increases with the number of phases, whereas the cathode remains the same.

The simplest connections are represented by the diagram in fig. 6 which shows a six-phase rectifier fed from a three-phase supply through a six-phase transformer. When the source of supply is two-phase two transformers in Scott connection would be used. The same arrangement of the windings is followed for the transformer secondary, as has already been explained for the single-phase case, so that the current is always flowing from the neutral point towards the anodes. The use of a six-phase rectifier is decidedly satisfactory with regard to the resulting direct-current wave form, which is represented in fig. 7 by the heavy line joining the points of intersection of the half-waves, the load in this case being non-inductive. As indicated by the shaded portion, the individual anodes only carry current so long as the momentary value of the corresponding phase pressure exceeds that of the adjacent phases, that is to say, during one-sixth of a cycle. By the use of suitably designed choking coils, however, two or even three anodes can be made to carry current from different phases at the same instant, which results in a reduction of the peak currents and the prolongation of the

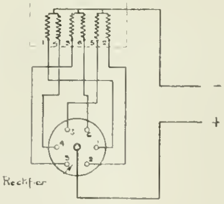

Fig. 6.

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* See *B.B.C. Review* No. 5, 1919.

* See *B.B.C. Review* No. 5, 1919.

half-waves as was shown in the case of the single-phase rectifier. We therefore find that the amplitude of the undulation of the rectified wave form as compared with the alternating-current wave amounts to about 8 per cent., as against 60 per cent. in the single-phase rectifier.*

Relationship of Current and Pressure in Polyphase Rectifiers.†—A fairly definite relationship exists between the direct current pressure and the transformer secondary phase pressure, this being given for a six-phase rectifier by the simplified equation :—

$$\text{R.M.S. phase pressure, } e_p = \frac{V + \epsilon + (c \,.\, e_a)}{1{\cdot}35\; k}$$

where V is the desired d.c. pressure, ϵ the drop in the arc, e_a the drop in the anode chokers, and c and k correction factors depending upon the connections adopted, while 1.35 is a constant giving the mean value of the pressure fluctuations above the points of intersection of the individual half-waves.

Taking a typical case in which it is desired to give direct current at 250 volts, we obtain :—

$$e_p = \frac{250+20+(1.2\times 30)}{1.35\times 0.97} = 234 \text{ volts.}$$

The drop in the anode chokers is taken at 30 volts, and that in the arc as 20 volts. The values 1.2 and 0.97 given to c and k have been obtained by experience. The transformer must therefore give 234 volts between the neutral point and its terminals to produce 250 volts on the direct-current side at normal load. Allowing for the regulation of the transformer, which is generally taken as double that obtaining with an ordinary alternating current having a 90 per cent. power factor, we arrive at an open circuit pressure that is considerably higher. If, for example, we assume the regulation to be increased to 6 per cent., the transformer open circuit voltage will be 248 volts. The corresponding rectifier pressure will be :—

$$V_o = (1.35\times 0.97\times 248) - 20 = 305 \text{ volts.}$$

There is a total drop, therefore, of 305 − 250 = 55 volts, giving an inherent regulation from no load to full load of 18 per cent. If such coarse regulation is inadmissible it can be considerably improved by interconnecting the windings of the anode chokers, which has the effect of changing the factor c in the equation from 1.2 to 0.2, resulting in a corresponding decrease of the overall regulation. Many forms of connections can be utilised, all giving different results to suit varying conditions.

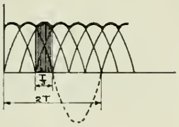

Fig. 7.

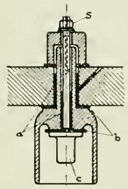

Fig. 8.—Mercury Seal, in Section.

Dealing now with the relationship existing between the two currents, we have the interesting result that for a polyphase rectifier the theoretical R.M.S. value of the phase current is equivalent to the total direct current divided by the square root of the number of phases or $I \text{ eff} = C/\sqrt{n}$; n being 6 for a six-phase case, $\sqrt{6}$ is therefore equal to 2.45. Taking a 1,000-ampere rectifier, the phase current would be 1,000/2.45 = 408 amperes. In practice this theoretical value would be somewhat reduced due to the over-lapping effect produced by the anode and regulation coils which enables 2.8 to 3.5 to be taken instead of 2.45.

From the foregoing it is evident that the kVA rating of rectifier transformers must be higher than the corresponding direct current output. On an average the primary is designed for an input 20 per cent. greater to allow for efficiency and power factor, and the secondary an output 70 to 80 per cent. greater, making an increase for the whole transformer of about 1.5 times the direct current output.

To prevent confusion, it should be pointed out that though a larger transformer must be used it does not mean there is a corresponding loss of energy. The secondary windings may be said to be unfavourably utilised because of the larger section of copper that is required on account of the effective value of the phase current being high as compared with the direct current. This is due to each phase only dealing with half-waves. Hence it follows that the transformer must be a good deal bigger than one designed for normal purposes.

The transformer primary windings are invariably delta connected, though the star connection can be used when a regulation choker is connected in the neutral point. The explanation for this lies in the fact that without the choker alluded to the slight ripples in the direct current would react on the primary supply if the transformer were star connected, but by adopting the delta connection with its closed circuit the effect is largely damped out. The regulation choker still further smooths out the ripples and enables either form of connection to be used. For very high primary pressures, however, the transformers are always star connected.

The Construction of Large Rectifiers.—In the early stages of the development of the large steel rectifier many serious and almost insuperable difficulties were encountered, and the present production is the result of many years of patient experimenting, and the experience gained in actual practice with a number of installations on the Continent. The serious nature of these difficulties may be gauged by the fact that one well-known concern, after working for some time with little success, abandoned its manufacture, considering such rectifiers to be too unreliable and costly to compete with the usual rotating converters. To those endeavouring to reach a solution, the results obtained with the glass bulb rectifier were of little assistance, because when dealing with heavy currents the whole aspect of the subject changes. Broadly speaking, the difficulties that had to be overcome can be summarised as follows :—

(*a*) The manufacture of large cylinders that would be absolutely gastight.

(*b*) The electrodes had to operate satisfactorily at high temperatures without deterioration of the insulation.

(*c*) The possibility of internal short-circuits occurring had to be eliminated as far as possible.

*Sealing**.—When dealing with large cylinders consisting of a number of component parts, the difficulties of sealing are considerable, especially as a high degree of vacuum is essential to satisfactory operation. After trying many methods, the best results were found to be obtained by the use of asbestos packing and mercury, which together form a perfect seal. This form of seal has contributed very largely to the success of the Brown, Boveri rectifier, and is illustrated diagrammatically in fig. 8. It will be seen that the anode c is securely clamped against the asbestos washers *b* by the bolt *s*, while the mercury is poured into the spaces *a* surrounding the bolt and the anode insulator. The mercury completely fills up any irregularities in the surface of the materials with which it is in contact, and if the bearing surfaces for the asbestos are properly prepared and the washers well bedded, it is impossible for any air to percolate through. In justification of this it may be stated that the necessity for running the vacuum pumps after the cylinders have been completely exhausted is in general not because of any air that might leak inwards, but because of the gases that are given off at the anodes when well loaded. In fact, so satisfactory is the design that it is possible to maintain quite easily a vacuum equal to 0.01 mm. Hg.

(*To be continued.*)

THE ELECTRIFICATION OF A YORKSHIRE WOOLLEN MILL.

An interesting conversion from mechanical to electrical drive has recently been completed at Messrs. Rouse Bros'. Vale Mills, Oakworth, situated in an isolated and interesting part of the West Riding of Yorkshire.

These mills have utilised water power for driving their spinning and weaving machinery for upwards of 60 years.

The electrical equipment is unique, inasmuch as induction alternators are used to generate electricity from power supplied by the turbines. The use of generators of this type does away with complicated synchronising switchgear and the skilled attention which it demands. A glance at the main switchboard shown in fig. 2 will supply evidence of the simplicity for operation purposes.

The building containing the water wheel was completely dried out and made suitable for electrical machinery.

The new turbine plant (fig. 1) consists of three turbines, made by Messrs. Gilbert Gilkes, of Kendal, two taking water from the lower level supply and one from the higher. The lower level turbines are of the single discharge spiral-casing type, and develop 125 and 64 h.p. respectively on a head of 36 ft. when using 2,300 and 1,200 cu. ft. of water per minute, the speed being 428 and 600 r.p.m. The turbines are carried on cast iron combination bedplates and direct-coupled to the generators. The high fall turbine is of the double discharge twin runner type, and is arranged so that in periods of drought the water may be shut off from one runner, thereby enabling the other to be operated at a much higher efficiency. This turbine is also mounted on a cast iron bed and coupled direct to the generator. It is designed to develop 150 h.p. at a working head of 50 ft., using 2,000 cu. ft. of water per minute and running at 600 r.p.m.

It is interesting to note that there is no governor gear required, as the generators are run in parallel with the supply taken from the Keighley Corporation, and as a natural consequence, the speed is maintained constant. The simple manner in which these machines are put on circuit calls for special attention. First, the distributor vanes on the turbine are opened to allow sufficient water to pass to run the turbine up to approximately synchronous speed. Secondly, the generator is switched direct on to the line, the vanes being opened fully out in order to allow the necessary amount of water to pass for the generator to develop its full output. This completes the operation.

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* See *B.B.C. Review* No. 6, 1919.

† See *B.B.C. Review* No. 6, 1919.

* See *B.B.C. Review* No. 6, 1919.

Considerable difficulty was experienced in arranging the turbines in suitable positions without entailing excessive cost in altering masonry and pen troughs. This accounts for the peculiar angles at which the pipes run. Each turbine drives an induction type alternator, the outputs of which are 81 kW and 43 kW for the low level turbines, and 103 kW for the higher level machine.

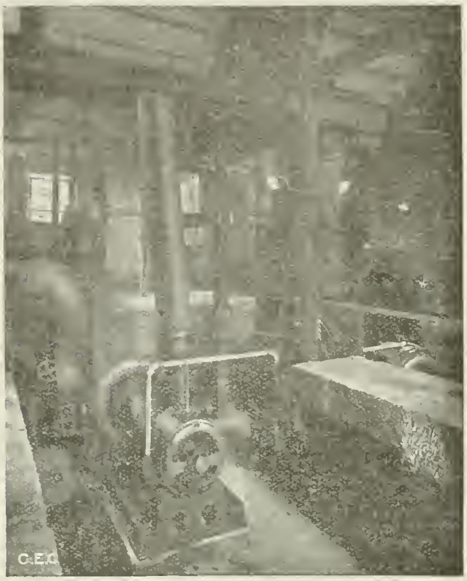

Fig. 1.—View of Hydraulic Turbo-alternators.

In addition to the electrical power derived from hydraulic power, a certain amount is taken from the mains of the Keighley Corporation, this being stepped down from 6,600 volts to 400 volts, by three 250-kVA transformers, at which pressure it is distributed from the main switchboard (fig. 2) which controls the alternators. It comprises three alternator, two transformer, and four feeder panels. Each is equipped with an oil switch, energy meter, and so forth.

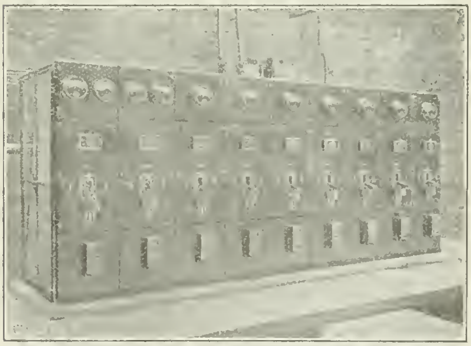

Fig. 2.—Main Switchboard.

All the motors up to and including 60 h.p. are of the squirrel cage enclosed ventilated pattern running at 580 r.p.m.; above this size they are of the slip ring pattern. All the 60 h.p., 80 h.p., and 100 h.p. machines are fitted with third bearing shaft extension and are mounted on substantial cast iron bedplates.

The large weaving shed contains upwards of 100 looms. Six 25 h.p. motors situated in the roof drive two shafts each, while another shaft is driven by a 100-h.p. machine, the auto-transformer starters for these and the other motors in the mill being manufactured by Messrs. George Ellison, of Birmingham.

The contract for the electrification of this mill was carried out by the General Electric Co., Ltd., through its Leeds branch.

In conclusion, thanks are due to Messrs. Rouse Bros. for permission to take the photographs reproduced in this article, and to publish the particulars.

THERMAL CHARACTERISTICS OF ELECTRIC OVENS AND HOT-PLATES.

By EZER GRIFFITHS, D.Sc., and F. H. SCHOFIELD, B.A., B.Sc.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

The British Engineering Standards Association recently issued Standard Specification No. 106, 1920,* for electrically-heated cooking ranges. Among other requirements, certain thermal tests are prescribed which are based on experimental work carried out at the National Physical Laboratory in 1918. The present paper reviews the prescribed tests so that the reason for their selection may be understood. It is concerned with hot-plates and cooking stoves solely from the thermal point of view, and does not touch on other factors also dealt with in the specification.

For toasting or grilling, a high proportion of radiant energy is required, involving the use of bare resister elements at a red heat; for intermittent operations the lightly constructed plate or oven embodying a minimum amount of metal has obvious advantages, while for continuous operation the heavy plate or well-lagged oven is probably most suitable. The cooking appliances sent to the N.P.L. included 15 makes of hot-plates and eight makes of ovens, and seem to have been a representative selection of the various types.

Hot-Plates.

In testing hot-plates, conditions should correspond closely to those prevailing in practice. Ordinary cooking utensils are not sufficiently standardised to be used for quantitative tests; therefore, metallic disks of the same order of cross-section and thermal capacity were used for the purpose, and attempts were made to determine the effect of various surface conditions in the heat-receiving face. Experiments were also made with special cast-iron vessels containing oil.

Except where otherwise stated, the copper disk used was supported off the plate by steel pegs, and the surface of the disk was oxidised. The following results were obtained during the heating up of the plate:—

Temperature distribution was quite uniform for both the open and enclosed types of plate, except where the disk was larger than the heat-emitting area. In the latter case the outer edge of the disk lagged behind the centre. Copper disks of the same thickness but of different diameters were placed over an enclosed hot-plate of larger diameter. The watts supplied were approximately the same for the two experiments, and there is only a very slight difference between the rate of temperature rise in the two cases. This implies that the disk only absorbs the energy emitted from the area actually covered. The uncovered area radiates the heat into space, and there is but little transverse conduction across the top of the plate.

When supported off the hot-plate by the steel pegs the copper disk is heated primarily by radiation and by air conduction through an air layer. Convection in such a narrow horizontal layer would probably be of negligible magnitude. Hence the degree of oxidation of the receiving surface would exercise a considerable influence on the heat transfer by radiation.

Actually the coefficient of emission of an oxidised cast-iron plate is about 70 per cent. of that of a black body, while for oxidised copper the value 50 per cent. would be of the right order, but if the copper surface were cleaned up with emery paper its coefficient would probably be less than 10 per cent. So that the heat transfer for a given difference of temperature would only be one fifth that obtained with the oxidised surface. If account is taken of multiple reflections of energy between the two surfaces, the effect is to increase considerably the heat transfer by radiation.

Assuming the standard case of both surfaces being oxidised, and assuming an air-gap between them, then the heat transmitted by thermal conduction is greater than that by pure radiation. It has been repeatedly observed that the surface of the hot-plate was at a red heat (about 600 deg. C.) when the copper disk was in the neighbourhood of 300 deg. C. Radiation is the more important factor in the heat transmission under these conditions.

In the case of the open spiral types of hot-plates the conditions are somewhat different; the spirals are running at a steady bright red heat and the fireclay grooves are also at a fairly high temperature and, since the air-gap is considerably increased, it is probable that some convection occurs. Under these circumstances it would be expected that thermal conduction would be relatively unimportant compared with radiation and convection transfer.

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* Elec. Rev., Aug. 13th, p. 212, and 27th, p. 263, 1920.

Experiments were made with a closed-type plate to illustrate the influence of the surface condition of the receiving copper disk, and it was found that the effect of polishing the surface is to reduce considerably the rate at which the disk absorbs heat. Regarding the effect of metal contact between hot-plate and disk, oxidisation does not affect the rate of rise of temperature, and consequently it may be presumed that the two surfaces were in sufficiently intimate contact to prevent oxidation of the receiving face of the disk. For other experiments the copper disk was raised with the three steel pegs; the time required to heat up to 200 deg. C. was reduced from about 13 to 6 minutes, by placing the surfaces in close contact.

Some typical results obtained with the copper disk are set out in Table I. "Efficiencies" give the ratio of the heat absorbed by the disk, *i.e.*, the heat capacity of the disk multiplied by the temperature-rise of 100 or 200 deg. C., to the energy supplied to the hot-plate during the time interval taken by the disk to rise 100 or 200 deg. C.

The results of these experiments bring out two important points. First, while the interposition of an air-gap by means of pegs makes the contact conditions reproducible, it has the disadvantage that the conditions are of a different character from those in actual practice, and this may operate unfairly against the hot-plates with machined surfaces compared with the radiant types.

Secondly, the disk has a very small thermal capacity, being equivalent to only 0.18 pint of water.

TABLE I.

	Open type	Closed type
Mean watts	1,085 to 1,400	910 to 1,150
Time to rise 100° C., min. ...	4.2 to 5.6	9.0 to 11.1
Efficiency, per cent.	10.0 to 12.1	4.8 to 6.4

Further experiments were made with thick mild steel disks, and it was ascertained that the uniformity of the temperature over a plane of the disk was quite satisfactory and that, therefore, the mean temperature could be obtained by observations with a thermometer, which is probably more convenient for general use than a thermo-couple.

The heat capacity of this disk was equal to 1.6 pints of water, while a similar copper disk had a rather larger capacity. Some typical results obtained with these disks are given in Table II. As before, the "efficiencies" are taken to be the ratio of the heat absorbed by the disk to the energy supplied to the hot-plate. The efficiency for the complete run to the maximum temperature attained by the disk after the energy is switched off is greater than the efficiency during heating since, for some time after switching off, heat will continue to flow into the disk.

TABLE II.

	Open type	Closed type
Mean watts	1,420 to 1,550	730 to 2,570
Time to rise to 200° C., min. ...	24.75 to 25.58	15.33 to 25.92
Efficiency during heating, per cent.	27.6 to 30.3	26.8 to 60.2

Experiments were made with two cast-iron vessels supplied by the British Engineering Standards Association. The bottom surfaces had been machined up, but were not quite true, and cotton-seed oil was used as the liquid. The time-temperature curves for repeat experiments were not as concordant as those with the disks. This may be due to variable thermal contact between the bowl and the surface of the hot-plate, and to some extent to inefficient stirring. Calculations of the efficiencies of the hot-plates have been made on the basis of the above experiments, and are given in Table III. It is assumed that the bowl is at a uniform temperature throughout, and that the specific heat of the oil is 0.5.

TABLE III.

	100° C. rise	Full run
Efficiency open type, per cent. ...	27.4 to 29.8	31.8 to 33.4
Efficiency closed type, per cent.	35.5 to 42.7	45.2 to 53.4

Cooking Stoves.

The efficiency of an oven should consist in the determination of (1) the number of electrical units required to bring the temperature of the interior to the maximum within a certain period, (2) the energy required to keep it at the minimum temperature necessary for cooking operations. In the first instance thermo-elements of iron-constantan were employed with the hot junction formed of very thin sheets of oxidised copper foil; the thermometric lag of this form of pyrometer is practically negligible.

In the case of an oven which took 12 minutes to reach a temperature of 200 deg. C. from cold, the mercury thermometer lagged about 20 deg. C. behind the thermo-element, and for an oven taking 40 minutes to reach 200 deg. C. the lag was only 5 deg. C.

To obtain the average temperature of the volume in the centre of the oven experiments were made using a hollow copper sphere with the two wires of the couple soldered to the top and bottom hemispheres respectively. The results of a comparison with a disk thermo-element showed that the sphere lags behind the disk by about 25 deg. C. in the case of an oven taking about 16 minutes to reach a temperature of 200 deg. C. This lag could be reduced by making the sphere of thinner metal; the indications of the spherical form are independent of the orientation. Further experiments were made with special mercury thermometers of the nitrogen-filled type. It was found that the differences obtained for the various sized thermometers commercially obtainable were almost negligible compared with the lack of uniformity in the oven. However, to ensure reproducibility the size of the thermometer is specified.

The distribution of temperature differs considerably in the different types of ovens according to the distribution of the heating units.

No general rules can be laid down for the distribution of temperature, and it would be impracticable to attempt an integration to obtain the true mean temperature. It will probably suffice for comparative tests to take the readings given by a single thermometer projecting into the centre of the oven.

TABLE IV.

Light ovens, air-gap insulation: 570 to 785 watts; kWh per cubic foot to raise to 200° C., 0.319 to 0.350.
Light ovens, air-gap insulation: 1,210 to 1,990 watts; kWh per cubic foot to raise to 200° C., 0.222 to 0.585.
Heavy ovens, lagged: 2,065 to 2,590 watts; kWh per cubic foot to raise to 200° C., 0.389 to 0.696.

The procedure in making a test was to run the oven at "full heat" to the temperature desired and then to reduce to the medium or low heat by means of the switches provided with the oven. This corresponds more closely to what occurs in practice than the determination of the energy necessary for a series of equilibrium temperatures. The data obtained are summarised in Table IV. The lagged ovens, usually of heavy construction, require from 1 to 1½ units to raise the temperature to 200 deg. C., but are very efficient when working at a steady temperature if account is taken of the cubic capacity in relation to watt supply. Most of the ovens tend to remain at a very steady temperature when switched on to medium heat.

Thermal Insulation of Ovens.

The thermal efficiency of an oven depends largely on the provision of suitable insulation. Taking a freely exposed vertical surface as being, on the whole, most typical of oven walls, the curves connecting convection loss and temperature difference illustrate the importance of employing surfaces of low radiating and absorbing power. Thus for a temperature excess of 100 deg. C. above the surroundings, the heat loss of a surface with a 10 per cent. coefficient will be only about one-half of that of a black body. To give some idea of the range of coefficients for common materials the following rough values may be given. Paints * of all colours and surfaces (from matt to enamel) 80 to 90 per cent., oxidised metal surfaces 50 to 90 per cent., dull metal surfaces 20 to 40 per cent., polished metal surfaces 3 to 10 per cent. It is out of the question to use highly polished metal surfaces in oven construction, but the use of clean unoxidisable surfaces often adds considerably to the efficiency. In the case of ovens with thin solid walls (generally metal), the heat loss will be governed entirely by the surface "resistance," but in the case of an oven with a double metal wall with air-gap the heat loss can be shown to be rather less than one-half of that of the single wall, for the convection loss between two parallel faces "boxed in" at the top and bottom is considerably smaller than for a plate with free access of air and the same temperature difference.

Regarding ovens with two metal walls and insulating material between them, x being the thickness of the insulating material, if $x=2$ cm. the heat loss will be about the same as for the double-walled oven with air-gap. If, however, $x=5$ cm., it will be a little more than one-half of that of the double-walled oven with air-gap.

The above illustrations give some idea of the factors affecting the transference of heat through oven walls when the steady state has been reached, such as in an oven run continuously. But this is not often the case in practice. It is more common for an oven to be switched on when cold, used for some cooking operation, and then allowed to cool again. In these circumstances the heavily lagged oven, although more efficient in continuous running, may be at a disadvantage. Its greater heat capacity will cause energy to be wasted in heating up the mass, and it will take a longer time to reach its maximum temperature. Temperature curves for the air in the oven, and for the interior and exterior walls show that while the air and internal wall reach their maxima in less than 50 minutes, the exterior wall took over 100 minutes to reach its steady condition. This means that, for the last-mentioned period, energy is still being absorbed in heating the walls of the oven. The curve obtained when heating up the oven and determining the watts required to keep it steady at a series of ascending temperatures, and the curve obtained for a series of descending temperatures differ, because for the ascending part of the cycle, heat is flowing into the walls when the air in the oven is kept constant, and *vice versa* for the descending part.

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* A metallic paint such as aluminium paint is an exception, having a coefficient of about 50 per cent.

Discussion in London.

Mr. J. W. **Beauchamp**, who opened the discussion, which was not intended to be confined to the subject dealt with in the paper, but to cover electrical appliances for domestic purposes generally, thought the paper would be a very useful one for reference purposes. The efficiencies of the various types of appliances did not differ very materially; efficiency really depended upon the operator, that was, on the size of cooking utensil used and on the art with which the switches were manipulated. Under present conditions the switches provided were not used to anything like the extent or manner in which they were intended to be used. The need for demonstration was, therefore, very evident, and until users had been taught how to use electrical appliances properly the best results would not be achieved. It should also be remembered that the use of the oven for roasting and baking was a small fraction of the total cooking operation which was carried out by means of hot-plates, &c. In that connection, the speaker did not think the last had been heard of immersion heaters. Such heaters when constructed of the proper shape to be easily cleaned would be found to be exceedingly useful and efficient devices. The paper had proved to be very useful to him, and he was sure it would be equally useful to manufacturers of electric heating and cooking apparatus.

Mr. H. H. **Berry** characterised the excellent work described by the authors as unique; the paper was a record of facts. Nevertheless there were other equally important facts to be considered which he regretted had been omitted. He then proceeded to outline his well-known system of maintaining a constant temperaure (equally applicable to the heating of rooms, water, ovens, hot-plates, &c.) by means of one fire burning a cheap fuel, and "topping up" by means of electricity to any higher temperature as and when required. The complaint that central heating caused houses to become "stuffy" and oppressive was justified, because the constant temperature maintained by such systems was usually much higher than was necessary.

Mr. W. A. **Gillott** criticised the tests outlined by the authors on the ground that they did not represent the true conditions obtaining in the domestic use of the appliances. He thought their first aim should be to standardise nomenclature; for example, a "hot-plate" was really a boiling plate, and what was termed a "cooking range" was no more than an oven. The tests had been carried out from a laboratory standpoint, and they had no commercial value. Why could not the tests have been made under ordinary domestic conditions? In his opinion a better line on which to work would be to show that a device could be relied upon to do a certain amount of work in a definite time. Special utensils were now obtainable for use with electrical cooking devices, and it should be remembered that the object was not to heat a surface uniformly or otherwise, but to cook the contents of the vessel. With regard to ovens, no indication was given in the paper of which was the best type of heating element to use; his opinion was that the elements should be placed on the sides of the oven, they should be very robust, and unaffected by extreme temperatures. In designing an oven the first consideration should be rapidity of heating up to cooking temperature.

Mr. W. R. **Cooper** confessed that he had failed to understand the true meaning of the figures for efficiency which the authors had given. The methods adopted for the tests were condemned by the results which had been obtained, which contradicted each other. He was not in favour of the use of disks standing on pegs because the layer of air thus introduced between the disk and the hot-plate would alter the conditions. It would be preferable to place the disk in direct contact with the hot plate, but it was of very little use attempting to work to any great accuracy in such tests. The use of oil would alter the conditions because it would result in too high a temperature being reached, and the best method to adopt would probably be to use an ordinary cooking vessel and boil in it a definite quantity of water.

Mr. H. T. **Harrison** protested against the criticism which had been made as he thought the paper contained useful data and would be a valuable one for reference purposes. At the same time the authors had made several assumptions which they had no right to make. For instance, the shape of the ordinary vertical oven, which took as its model the gas-heated oven, was quite wrong; the correct shape was one in which the breadth and width were large compared with the height. Moreover, why were ovens always constructed of a material which conducted the heat away and then lagged in order to retain a portion of the heat? He had used for many years an oven in the construction of which no metal whatever had been used. Another point to be remembered was that in many establishments the same cooking vessels were used for cooking by coal fire, gas, or electricity, and such utensils were usually not merely oxidised, but actually coated with a thick deposit of carbon. The need for instruction in the proper use of electrical domestic devices was apparent; and it should always be remembered that the electrical method should not be advocated on economical grounds, but on account of its cleanliness and convenience.

Mr. P. **Good** criticised the use of the word "efficiency" by the authors, and thought that a better idea of their meaning would have been conveyed if they had used some other term. It was a matter of the greatest difficulty to devise tests which could be repeated with accuracy; he had seen much of the work in progress at the N.P.L., and many of the results which had been "boiled down" into the paper, and he congratulated the authors on their achievement. The future development of the application of electricity to domestic purposes would depend largely on standardisation; interchangeability of such things as wall plugs, &c., although small in themselves, would exercise considerable influence and their standardisation would be very helpful. What they wanted was apparatus, together with accessories and component parts, which was interchangeable and capable of being moved from room to room, or house to house, as was the case with gas-heated devices.

Prof. E. W. **Marchant** said that some of the points he had intended to raise had been covered by Mr. Cooper's remarks. He criticised the use of the word "efficiency," and described the tests as unfavourable ones, but thought the apparatus was not actually as bad as would appear from the authors' results. He had caused some tests to be made by his students by boiling an ordinary kettle on an electric hot-plate, and they had found that with a kettle having a clean bottom and one-quarter full of water, the efficiency was 40 per cent., and when full 52 per cent. When the bottom of the kettle was candle blacked the efficiencies were respectively 32 and 40 per cent. Surely they could devise tests and present the results in such a manner as would give a clearer indication of what the apparatus was really capable of doing than had been done in the paper?

Mr. C. G. **Nobbs**, speaking as a manufacturer, explained that most tests relating to heating and cooking devices were very indefinite, but the authors had given them figures which could be trusted, because they knew exactly how those results had been obtained. Immersion heaters were the best means of heating water electrically; the air temperature within an oven was very variable, and he thought that if during the tests a bulk equal to the object to be cooked had been placed inside the ovens the results obtained would have been very different.

Mr. A. F. **Berry** pointed out that it was very difficult to determine what the efficiency of a particular oven was; the objects to be cooked in an oven varied greatly, and there were a whole lot of cross elements that had to be considered. Considering the complexity of the subject he thought the authors had tackled it valiantly.

Prof. J. T. **MacGregor-Morris** pleaded for instruction to be given on the proper use of domestic electrical appliances; printed instructions were of little use, they were rarely read and still more rarely remembered. Turned cast-iron utensils were undesirable because they soon got into bad condition, and an essential point about electric cooking was reliability. He had used electricity for that purpose for 15 years, and had found that the cost of element renewals was a serious item; if he had not been an electrical engineer he would have abandoned electric cooking long ago. Little details which might appear of no consequence to an electrician were really very serious in the eyes of the user who knew nothing about electricity, and it was just those details that needed improvement and on which the future of the whole subject would depend.

Mr. E. T. **Williams** was of the opinion that the problem had been considered too much from the engineer's point of view; on the other hand, the housewife looked at the bill. It was of little use to rely on cooks and housemaids to manipulate the switches properly, and the only remedy would be the incorporation of a simple form of thermal switch in the oven. Such a device would go a long way towards satisfying the housewife's point of view. Undoubtedly the best form of propaganda was to install the device in the house, and after demonstrating how it should be used, the housewife should be allowed to use it herself for a period. If that method were tried he was sure the device would be retained in every case. He favoured some form of central heating by which the temperature could be "topped up" as outlined by Mr. Berry. During the spring and autumn some artificial heating was often required in the morning and evening, but not during the day time, and under those conditions electric radiators were most suitable and cheaper than coal fires.

A speaker, whose name was missed, explained that in an "all electric home" three-quarters of the electricity consumed would be used in heating water. Under those conditions the cost would be prohibitive, and the whole problem, therefore, rested upon the development of some form of cheap and efficient water heater.

Dr. E. **Griffiths**, in briefly replying to the discussion, pointed out that the disks used in the experiments had a thermal capacity equal to a certain quantity of water; the conditions, therefore, were easily comparable. Immersion heaters were excellent for heating water and other liquids, but they had been set a definite task, and the results obtained were set out in the paper. They always did what they were asked to do to the best of their ability, and if they were asked to elaborate the investigation they would have much pleasure in rendering assistance.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A British Washing Machine.

Electric washing machines that have hitherto come to our notice depend upon the effect obtained by enclosing the articles to be washed either in a cylindrical container which rotates in water, or in a circular container fitted with a revolving or oscillating dolly which rubs the clothes.

Messrs. Napier-Kimber, Ltd., 109, Great Portland Street, W. 1, have produced a washer (fig. 1) in which the washing effect is obtained by enclosing the articles to be washed in a container to which a vertical reciprocating motion is imparted with a frequency of 30 to 50 complete oscillations per minute, the sides of the container being so designed as to ensure a rapid and forcible flow of water in and out of the container, and therefore through the articles at each oscillation.

The container, which is rectangular in shape, is suspended at the ends of two arms which are attached at their other ends to a rocking shaft. This shaft is mounted near the top, and at one side of the rectangular tank projects two inches. A lever is attached to one end of the overhang, and at the other end to a connecting rod which runs on a crank pin attached through a dog clutch to the low speed shaft of an electrically-driven worm gear. A wringer is mounted on one side of the tank and driven from the same shaft as the washing mechanism. A dog clutch is provided here also so that it is possible either to run the washer or the wringer separately or both together, as may be desired.

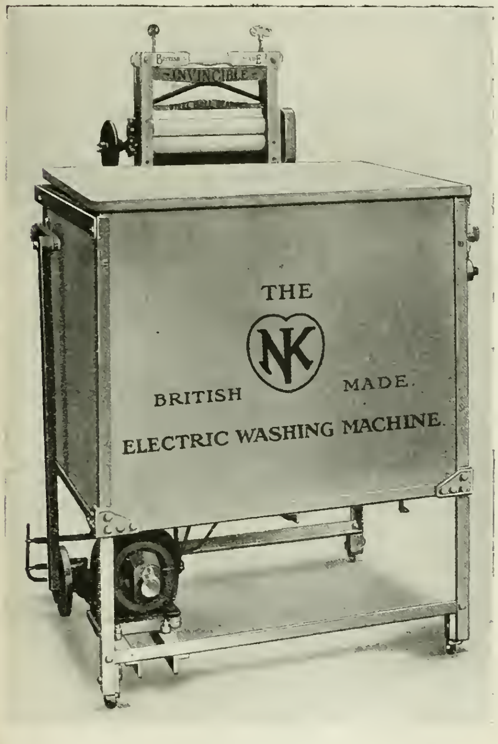

Fig. 1.—The Napier-Kimber Electric Washer.

The wringer is driven by means of a round belt, the tension of which can be adjusted so that it will slip at a load below that which involves an overload on the motor, and the belt tightening arrangement consists of a pair of jockey pulleys mounted on the end of a pivoted arm, the pivot end of which is capable of revolution about the same axis as the driving pulley on the main low-speed shaft. It is thus possible to obtain a vertical belt drive to the wringer, while at the same time keeping the whole of the vital portions of the mechanism underneath the tank, and thus avoiding the risk of splashing.

Apart from a main double-pole switch and fuse controlling the motor itself the control of the machine is effected by Bowden wire mechanisms operating on the washer and wringer clutches respectively. The machine is of British manufacture throughout.

A Novel Bowl Clip.

The usual method of suspending bowl fittings in lighting installations is by means of a ring into which the bowl drops. This, of course, necessitates a stock of rings of various sizes, and probably a different size for each bowl. An extremely simple but at the same time efficient device to supplant this method of suspension has been produced by Messrs. Henry G. Richardson & Sons, flint glass manufacturers, Wordsley, near Stourbridge. This is the small combined hook and clip illustrated in fig. 2. The "Levahook," as it is aptly named, consists of a bent lever of cast brass, the top part of which is hooked for the reception of a chain while the other end fits against the inside of the bowl. The rim of the bowl is then held by the pivoted hook seen in the illustration, and the weight of the bowl keeps the fitting closed. It will be seen that the greater the weight of the bowl, the more effectively is it held by the fitting. Any size or shape of bowl can be fitted with this clip. A patent is being applied for. Fig. 3 shows the fitting applied to a suspended bowl.

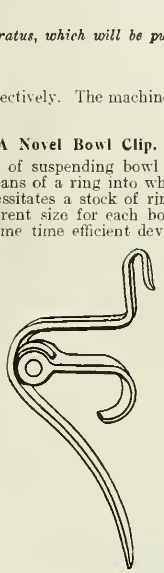

Fig. 2.—The "Levahook" Clip.

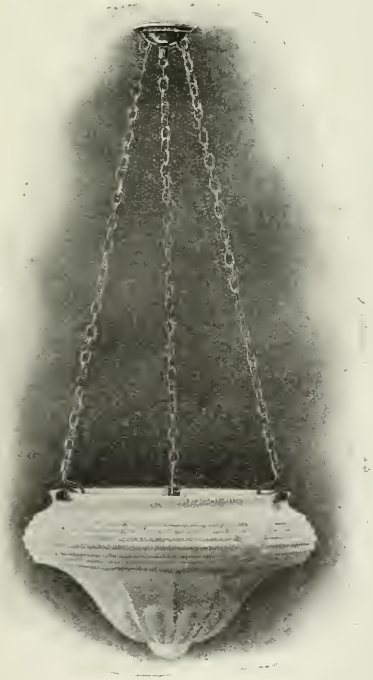

Fig. 3.—Application of Clips.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

3,467. "Electric switches." C. Hyland. January 28th.

3,470. "Adaptors for electric lighting, &c., circuits." F. Young. January 28th.

3,473. "Blocks for securing ceiling-roses, electric light switches, gas brackets, &c., to walls and ceilings." G. H. Easter. January 28th.

3,474. "Electrical heaters." J. R. Quain. January 28th.

3,480. "Method of cleaning sparking plugs." J. Chabrolle. January 28th. (France, January 29th, 1920.)

3,482. "Joints for electric conductors." W. C. Bailey and London Electric Supply Corporation, Ltd. January 28th.

3,483. "Sound receivers." Signal Ges. January 28th. (Germany, October 16th, 1920.)

3,489. "Electrical instantaneous water-heater." E. Caselli and E. C. R. Marks (Caselli). January 28th.

3,492. "Arrangement for doubling number of periods in electro-dynamo vibrating devices for sound transmitters, &c." W. Kunze. January 28th.

3,527. "Delay-action devices employing thermionic valves." N. Lea and Radio Communication Co., Ltd. January 29th.

3,528. "Electro-plating barrels, dipping baskets, &c." F. R. Tubbs. January 29th.

3,534. "Electric head-lights for vehicles." R. Bosch Akt.-Ges. January 29th. (Germany, November 26th, 1920.)

3,535. "Relay for amplification of electrical energy." D. H. Fehr. January 29th.

3,540. "Apparatus for recording telephone calls." A. D. Ickringill. January 29th.

3,576. "Automatic variable resistance with single rheostat for printing kinematographic negatives." L. Lobel. January 29th. (France, February 3rd, 1920.)

3,577. "Incandescent electric lamps, and methods of manufacturing same." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 29th.

3,578. "Means for making and breaking electric circuits." F. M. Brown and A. E. Davies. January 29th.

3,596/7. "Motor vehicle lamps." W. H. Eggington & H. Lucas. January 29th.

3,610. "Automatic variable resistance with single rheostat for printing kinematographic negatives." L. Lobel. January 29th. (France, September 27th, 1920.)

3,266. "Illuminating systems for vehicles." S. V. Gramlich. January 26th.

3,268. "Sound amplifier." W. F. Smith. January 26th.

3,275. "Brakes for cableways." S. A. Rogers. January 26th.

3,618. "Combined electric starting, lighting, ignition, and warming system for motor cars, &c." R. H. Playfoot. January 31st.

3,626. "Electric rectifying device." A. Day and J. C. Robertson. January 31st.

3,647. "Instrument for conveying sound to the deaf." A. L. J. Belasco. January 31st.

3,648. "Adjustable anti-vibrator for electric lamps." H. Clayton. January 31st.

3,665. "Brush-holders for dynamo electric machines." E. H. H. Hassler. January 31st.

3,677. "Automatic electric switches." H. W. F. Ireland, H. Lucas, and O. Lucas. January 31st.

3,678. "Sparking plugs." T. J. Puplett. January 31st.

3,683. "Magneto-ignition apparatus for internal combustion engines." Scintilla. January 31st. (Switzerland, February 4th, 1920.)

3,685. "Electric furnace regulators." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 31st.

3,693. "Telegraph and telephone systems." I. Hortix. January 31st.

3,699. "Means for recording telephone calls." A. W. Wood. January 31st.

3,704. "Process of carrying out to the limit incompletely proceeding reactions." H. Arnold and T. Goldschmidt Akt.-Ges. January 31st. (Germany, February 7th, 1920.)

3,709. "Wireless telegraph calling or alarm devices." T. D. Parkin. January 31st.

3,718. "Spark plugs." P. J. Donavan. January 31st.

3,720. "Electric fly switches." A. J. Bonella. January 31st.

3,733. "Machine for taking soundings from submarines, &c." C. I. Cockin. February 1st.

3,734. "Device for testing sparking plugs." F. Greenhalgh and J. J. Jennison. February 1st.

3,739. "Means for coupling electric cables, &c." G. Andrew and F. H. Wilkinson. February 1st.

3,744. "Gripping device for electric lamp holders, &c." J. Ashworth. February 1st.

3,774. "Apparatus for indicating and recording speed and number of movements of mechanism, applicable also as distance indicator for road vehicles." G. J. Gibbs. February 1st.

3,777. "Automatic, &c., telephone systems." W. Aitken. February 1st.

3,802. "Manufacture of commutators of dynamo electric machinery, &c." L. Neal. February 1st.

3,805. "Head lamps for vehicles, &c." H. C. Gibson. February 1st.

3,809. "Electric generating plants or systems." Cutler-Hammer Manufacturing Co. and Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). February 1st.

3,810. "Alternating current commutator motors." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. February 1st.

3,820. "Electrical heating of buildings, &c." J. R. Bayley, K. G. Maxwell and Metropolitan-Vickers Electrical Co., Ltd. February 1st.

3,829. "Electric starters, for internal combustion engines." E. R. Elliston. February 1st.

3,831. "Means for obtaining electricity from the atmosphere." H. Gough-Turner. February 1st.

3,834. "Terminal plate for electrical and engineering purposes." J. Laird. February 1st.

3,855. "Sparking plug." C. A. West. February 2nd.

3,861. "Burglar alarms." N. Reeves. February 2nd.

3,863. "Cab signal for railway trains." L. W. Madge. February 2nd.

3,867. "Controlling, starting, &c., apparatus for electric generators and/or motors." T. H. M. Swinburne. February 2nd.

3,884. "Electrically operated machines for riveting, pressing, stamping, &c." R. M. Taylor. February 2nd.

3,892. "Combined electric plugs or holders and circuit breaking devices." L. Poncet. February 2nd.

3,906. "Submersible electrical machinery." E. L. W. Byrne. February 2nd.

3,907. "Travelling platform for termini of electric tramway systems." C. R. Thompson. February 2nd.

3,909. "Telephone repeaters." Western Electric Co., Ltd. (Western Electric Co., (Inc.). February 2nd.

3,916. "Electric switches." A. H. Cornish, Petters, Ltd. and H. S. Saunders. February 2nd.

3,919. "Electric liquid heaters." Festa Akt.-Ges. February 2nd. (Germany, February 11th, 1920.)

3,927. "Electro-mechanically controlled telephone system." F. Aldendorff and H. Baron (Aldendorff). February 2nd.

3,928. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. February 2nd.

3,932. "Electric arc welding." International Welding Engineering Corporation, A. E. White (International Welding Engineering Corporation). February 2nd.

3,946. "Sparking plugs." J. C. Milne. February 2nd.

3,962. "Portable electric hand lamps." G. W. Richards. February 2nd.

4,019. "Magnetically operated device for indicating or controlling changes of level, &c." R. H. Barbour and Electrical Apparatus Co., Ltd. February 3rd.

4,044. "Arc lamp carbon holders." W. van den Broeck. February 3rd,

4,045. "Means for indicating direction to aircraft during fog." J. T. Babington. February 3rd.

4,055. "Portable accumulators." J. W. Cook. February 3rd.

4,057. "Electric switches." C. L. Arnold and C. R. Belling. February 3rd.

4,058. "Relays, amplifiers, and high-frequency signalling receiving apparatus, &c." P. R. Coursey and H. S. Pocock. February 3rd.

4,062. "Electric motors, &c." J. V. Brittain and F. E. Harris. February 3rd.

4,068. "Semi-direct electric light fittings." S. D. White and F. Winstanley. February 3rd.

4,089. "Sparking plugs." A. H. Fynn. February 3rd.

4,091. "Electron discharge apparatus. General Electric Co., Ltd., and C. F. Trippe. February 3rd.

4,093. "Charging hoppers for electric furnaces." E. E. D. Edlundh, E. C. Beck-Friis, and C. I. Thorssell. February 3rd.

4,118/9. "Electric transformers." O. Imray (Pittsburgh Transformer Co.) and Pittsburgh Transformer Co. February 3rd.

4,120. "Electric plug switches, switch fuses, &c." H. F. Shanahan. February 3rd.

4,121. "Thermionic valves for wireless telegraphy and telephony." B. Hodgson,, S. R. Mallard, L. G. Preston, and G. Shearing. February 3rd.

4,131. "Anti-dazzle device for electric motor lamps." N. Kemp and W. H. Kemp. February 4th.

4,156. "Electric thermostats." E. P. Barfield and L. W. Wild. February 4th.

4,157. "Signalling." W.. H. Crabb. February 4th.

4,169. "Dead cable indicator." H. McCrudden. February 4th.

4,177. "Motor head-lights, and electric lamps therefor." A. B. Gibbons. February 4th.

4,178. "Registering telephone calls." E. H. Kinnard. February 4th.

4,179. "Talking machines, &c." C. J. Barnett. February 4th.

4,180. "Telephonic apparatus." H. Edmunds. February 4th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1914.

8,327. "Control apparatus for multiple-speed gear." Payne and Bristol Tramways & Carriage Co., Ltd. April 2nd, 1914.

17,036. "Electric gasfilled glow discharge lamps." Lederer. July 19th, 1913.

17,646. "Electric gasfilled glow discharge lamps." Lederer. July 25th, 1913. (Addition to 17,036, 1914.)

1916.

16,609. "Speed regulation of electric induction motors." British Thomson-Houston Co., Ltd. (General Electric Co.). November 20th, 1916. (156,813.)

1917.

16,855. "Automatic and distant control of aircraft or other dirigible bodies." J. H. Hammond. November 15th, 1917. (156,818.)

1919.

14,327. "Railway signalling and collision prevention apparatus." W. Wright, B. Weiss, P. A. Connolly, W. O. J. Philips, and L. Langford. June 5th, 1919. (156,830.)

14,476. "Thermostats." J. E. Gee. June 6th, 1919. (156,831.)

16,232. "Electric welding." L. J. Steele, H. Martin, and A. E. McCarthy. June 27th, 1919. (156,836.)

17,821. "Method for the heating of material or the performance of chemical processes in electrical furnaces, together with apparatus intended therefor." Aktiebolaget Kvafveindustri. April 12th, 1919. (141,656.)

22,725. "Electric heating device applicable for use in connection with cooking utensils and the like." S. L. R. Price. September 16th, 1919. (156,862.)

24,105. "Alternating current dynamo electric machines." British Thomson-Houston Co., Ltd., and H. W. Taylor. October 2nd, 1919. (156,868.)

24,405. "Transmitting apparatus for use in wireless telegraphy and telephony." J. B. Bolitho. October 6th, 1919. (156,876.)

24,724. "Electrical seam welding machines." E. Schroder. May 30th, 1918. (133,700.)

26,126. "Lift-gate switches and locks." Igranic Electric Co., Ltd., and A. H. Mackley. October 24th, 1919. (156,936.)

26,542. "Portable magneto meter." T. L. Galloway. October 29th, 1919. (156,944.)

26,611. "Electric meters." G. A. Cheetham and Metropolitan-Vickers Electrical Co., Ltd. October 29th, 1919. (156,945.)

27,086. "Electric bells." J. C. Wrighton and Edison Swan Electric Co., Ltd. November 4th, 1919. (156,954.)

27,930. "Mine exploding devices." R. Barthelemy. May 19th, 1919. (143,488.)

28,088. "Devices for exploding mines." R. Barthelemy. November 12th, 1919. (Addition to 143,188.) (156,961.)

1920.

2,304. "Process and apparatus for the electrical transference of designs in the textile arts." E. C. R. Marks (Oesterreichische Siemens-Schuckertwerke and Regal-Patente Ges. January 24th, 1920. ((156,995.)

4,676. "Electric lamp mountings." L. T. Dixon. February 16th, 1920. (157,000.)

7,542. "Switch and fuse contacts." J. F. Watson and Callender's Cable and Construction Co., Ltd. March 13th, 1920. (157,011.)

9,651. "Process of improving the magnetic qualities of magnetisable material." Metropolitan-Vickers Electrical Co., Ltd. April 4th, 1919. (141,348.)

9,686. "Electric furnaces." E. Assie. August 9th, 1917. (141,352.)

12,053. "Telephone systems." Western Electric Co., Ltd. May 21st, 1919. (143,498.)

12,137. "Stiffeners or strengthenings for wooden posts, poles, and similar objects which are buried in the ground and liable to become defective." E. Schultz. October 10th, 1919. (152,629.)

14,672. "Rectification of high-tension generating currents." Soc. Anon. des Etablissements H. Pilon. April 9th, 1919. (143,929.)

15,727. "Telephone transmitter." Western Electric Co., Ltd. June 22nd, 1914. (144,698.)

19,849. "Electric arc lamps for searchlights or projectors." Siemens-Schuckertwerke Ges. April 3rd, 1917. (147,804.)

23,552. "Arc lamps." P. R. Jackson (Sperry Gyroscope Co.). July 11th, 1919. (Divided application on 152,411.) (157,039.)

24,546. "Electric incandescent arc devices." British Thomson-Houston Co., Ltd. (General Electric Co.). March 4th, 1916. (Divided application on 152,694.) (157,041.)

25,248. "Electric contact devices." C. C. Farmer. December 10th, 1919. (155,230.)

28,085. "Electrical regulator systems." Metropolitan-Vickers Electrical Co., Ltd October 2nd, 1919. (151,893.)

THE

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COSTS—CAPITAL AND LABOUR.

DURING the past few years an increasing amount of attention has been given to the question of costing in engineering works. It may not seem a very profound remark to suggest that this is an important matter, yet it is an astonishing fact that many firms have not regarded it altogether in that way. Too often was the costing department, so-called, left to the tender mercies of a clerk, whose sole qualification for the post was that he was good at figures. The circumstances of the past six years have opened our eyes to our shortcomings in this respect, and the establishment a few years ago of the Institute of Cost and Works Accountants was an important step in the direction of creating a new branch of skilled persons known as works accountants, whose function is a quite separate one from that of the accountant who comes in once or twice a year and audits the books.

The works accountant, as a moment's reflection will suggest, should come next in importance to the managing director and the works manager, and should be in daily consultation with them. Only in that way can the management keep a check on its costs, and endeavour to hold its own with its competitors. It is necessary at the same time that the works accountant should have a thorough training in costing accountancy, and one of the first steps taken by the Institute of Cost and Works Accountants was to institute an examination scheme. Thus membership of the Institute can be relied upon by employers as signifying that such a man applying for a post has at least some qualification.

Such detailed attention has been given to costing generally now that a stage has been reached when the question of standardisation of systems of costing is being seriously discussed. As a matter of fact, in the printing trade, a standard system has been evolved which, it is said, can be adapted to a firm employing 2,000 workmen, or to one employing 20 workmen. However that may be, it is highly probable that greater difficulty would be experienced in the engineering trades, although there does not seem to be any reason why standardised methods should not be worked out for special branches. The accurate allocation of overhead charges seems to be the main difficulty, and here, of course, the particular conditions in the firm, including the up-to-dateness of the equipment or otherwise, have an important bearing. For ordinary rough works purposes, it is perhaps accurate enough to cost with a flat percentage for overhead charges, but it must, of course, be elaborated when questions of improved methods of working are under consideration. Indeed, the possible ramifications of a costing system become greater and greater the more they are considered, but a word of caution is necessary against over-elaboration, because a point can be reached when the cost of a costing system will outweigh the supposed advantages. Nevertheless, in a works of any magnitude, some detail is necessary, but the amount depends upon circumstances, and this brings out the importance of common sense on the part of the works accountant. Thus it is apparent that the cost accountant should be not a mere supervisor of clerks, but a man of initiative, who can place before his employers figures and logic which, among other things, have a direct bearing on the relations between the employer and the workmen.

Indeed, this aspect of the importance of costing is by no means its least. A case in point is that in which a firm found itself undercut by a competitor. The piece-work rates were reduced as the result of a close investigation of the costs, and in order to convince the workers of the facts, not only were the firm's own costs placed before the workers, but also invoices for similar goods actually bought from other makers at lower prices. The result was that the reduction in piece rates was agreed to.

It will thus be seen how a competent cost accountant is really the pivot of the whole scheme of management, although it is not at all certain even now that when he can show the works manager he is wrong, his advice is always taken. Then there is the question of the relations between the costing and selling departments, which must be of the closest possible character. In many of our large engineering works, of course, the significance of all these matters is recognised, but there are far too many instances where old-fashioned methods are still in vogue. These are having the effect not only of causing prices to remain high in some instances, because with a judicious rearrangement of costing the price could perhaps be lowered, but also this policy may easily, and in fact has been known to, act in the opposite direction. Particular items have been sold actually at a loss, and the fact has only been found out when an accurate costing system has been introduced.

A discussion of this aspect of works management serves to throw a special light upon the real importance of the administrative staffs, which has been rather overshadowed in the many controversies between what is called capital and labour. The fact is that the administrative staff is a vital link between the employers and the wage-earning staff, yet it has been seriously neglected in the consideration given to it under the changed conditions of the present time. How essential is the administrative staff was well shown when the Italian workmen, who seized the engineering works last year, found themselves helpless because the technical and administrative staffs did not fall into line with them. This all goes to prove that the psychology of industry is not merely an adjustment of the differences between employers and the rank and file of the workmen, because both would, so to speak, be lost without the connecting link formed by the administrative staff.

Industrial Reorganisation in Individual Works.

The necessity for new methods to meet our present new industrial era is admitted on all sides, and chief amongst these is the question of increasing co-operation between labour and capital. The precise problem for most industries is to get some effective machinery inside individual works to attain this end.

We have received a very interesting communication from the Commonwealth Edison Co. which bears on this subject. It appears that this company is solving the problem by establishing an "Industrial Relations Department," with a duly appointed manager at the head of affairs. This department is charged with everything which deals with the well-being of the employés, and especially with the harmonious relations between employés and the management. One of the first matters which this department has taken in hand is the "employés' representation plan." This "plan" is practically an analogue of a Works Committee, being composed of two sides, one representative of the employés, and the other of the employers. The fact that the president of the Edison Co., Mr. Samuel Insull, is adopting an industrial method of this kind for his own company should carry with it a very strong recommendation for the establishment of works committees in the electricity supply industry in this country. Up to the present, works committees are the only part of the Whitley scheme not yet adopted, but the National Council is dealing with this matter at the present moment, and it is hoped that it will shortly issue very strong recommendations that works committees should be set up in all the undertakings in the country.

In this connection it is interesting to note the very strong recommendation which Sir Lynden Macassey expressed in his recent address on "Present-Day Industrial Psychology." He contended that it was vital for the future of industry to recreate the interest of the individual workman in his work, an interest which had languished due to mass production; that the only remedy for this decay of interest was for capital to ensure that both the administrative staff and the wages staff could acquire a wider interest in the prosperity of the works in which they were employed and of the industry of which the works formed part; that works councils, provided they had adequate powers, were infallible means to the creation of such a stimulus. The foregoing is, of course, only one of the many identical recommendations from leaders in industry on the employers' side (among the most sagacious of whom there seems to be a unanimous opinion) as to the pressing need for the universal establishment of works committees.

The Paris Lighting Concession.

As we recently mentioned, a new agreement is to be entered into between the Paris Municipal Council and the Compagnie Parisienne de Distribution d'Electricité, modifying the terms of the convention which was concluded between the two parties on September 5th, 1907, concerning the supply of electricity in Paris. According to the latter, the company's concession would expire on June 30th, 1940, but it is now proposed to extend it for five years to the end of June, 1945. It appears from a report presented to the Municipal Council that the Council was compelled to sanction an increase in the selling prices for electricity last May, the receipts from the higher charges having been carried to a special account for future settlement. The proposed new agreement will regulate four main problems and all secondary questions which in practice have shown the defects of the convention of 1907. In the first place, the fixed tariff is to be replaced by a variable tariff which, taking into account ministerial orders, applies an economic index according to the variations in the price of coal and in the rates of wages. Secondly, the question of the *personnel* has been settled by placing entirely at the charge of the company the responsibility for the payment of the officials, staff, and workmen of all classes. In the third place, the cost of supplementary works is to be defrayed with the aid of a special fund fed by a levy on the gross proceeds of the sales, and the concession rental payable to the City of Paris has been materially increased. It is further provided that for complementary works of first establishment, temporary treasury advances, redeemable by the City, can be made by the company by means of short-term loans or banking credits, the conditions of which will require the approval of the City.

The agreement further states that the company has undertaken to discontinue the legal proceedings in progress having reference to claims raised either from the fact of the economic circumstances resulting from the war or with regard to the difficulties in interpreting the original convention. On its part the City of Paris has undertaken to abandon the legal action relating to the execution of complementary works, and renounces the recovery from the company of the credits voted by the Municipal Council prior to the signature of the new agreement, and the company also renounces the recovery of the sums expended by it previously in excess of the 1,700,000 fr. annually fixed for new works. It is suggested that under the new agreement the company's dividend will increase in proportion as the cost of producing electricity declines, that is to say, in proportion as the coal and wages indices fall, which regulate the cost price and consequently the selling price of energy.

It's All Wrong! We are daily—and oftener—told that half a million admirals and generals and people of every sort have studied Pelmanism, and we understand that this study is based upon a knowledge of some of the laws and principles of psychology. Moreover, there are books galore on the subject, and professors and exponents of the science can be met, like the party leaders under King Goodheart's regime in the song in "The Gondoliers,' in twos and threes in every street. May it not, then, be confidently assumed that some of those concerned in the administration of London's traffic have some nodding acquaintance with it?

Whether that be so or not, we see few signs of an intelligent understanding of the British temperament in some of the methods adopted in the desperate hope that they will accomplish results that can only be produced by adequate service. Notices telling the passenger to "keep to the left" at one station, and neutralised by peremptory injunctions to "keep to the right" in another, are not conducive to efficiency. Bawling youths, calling upon passengers to "pass down" a car already rammed full to the roof, produce nothing save soreness of their own throats. The "Stentorphone" at Oxford Circus would tempt a medieval warrior to get to work on it with a battleaxe. The new pattern of railway coach recently described in our columns is a considerable improvement, but all that we have seen have been for first-class service, whereas the remedy is more urgently needed by the third-class passengers.

Turning from the Underground, we find that conditions on the suburban lines during the rush hours are indescribably bad. The slightest fog, and everything is disorganised completely. Goods trains lumber slowly through stations upon the platforms of which the crowd steadily increases. When the long-expected suburban train arrives, a hydraulic press is needed to get any more passengers into it. The ensuing struggle at the doors is entirely vain.

Then the omnibuses seem careful to avoid stopping at the right places, so that if there is any semblance of a queue—which isn't often—it rapidly dissolves into a scrambling, trotting mass, and those who have waited longest, or prefer not to struggle, may go on waiting. The Paris system of numbered tickets works well, and passengers would soon get accustomed to it.

The average passenger is a peaceable individual, only anxious to proceed on his or her journey, causing, and being caused, the minimum of trouble. Pushing, and bawling (human or mechanical), and uncodified directions, and lifts in which the first enterer is the last to leave, and ill-considered expedients of every sort, are irritating and ridiculous, and we believe that it would be possible to do better without them.

The Telephone "Ramp." By persistent and vociferous agitation, culminating in a debate in the House of Commons, the opponents of the Postmaster-General have gained their immediate end—the appointment of a Select Committee of Inquiry into the administration and conduct of the telephone service. Whether they will achieve their ultimate object—the withdrawal or modification of the new tariff, and the retention of the flat rate—is open to question; the new rates are to come into force on the appointed day, and apparently no reimbursement of payments is contemplated by the Government, in the event of an adverse report. Chopping and changing is fatal to the efficient conduct of any business, and we do not wonder at the reluctance of the Government to give any pledge in that sense.

That the report of the Select Committee will in the main bear out that of the committee which has already endorsed the Postmaster-General's proposals we have no doubt: facts are stubborn things, and that the continuance of the flat rate simply means that the big flat-rate subscribers will be generously subsidised by the smaller users—assisted by the ordinary taxpayer—is certain. unless the rental is put up to £30 or £40, an unlikely event. Much has been said with regard to the inefficiency of the service, and much of it is justified; but what would you? It was well known to those who understood the matter that inefficiency would be the inevitable result of nationalisation. The only gleam of hope—and it is a faint one—is the possibility that the Committee will recommend the removal of the service from the control of the Post Office. But that, we fear, is a Utopian idea.

The N. Wales & Chester Inquiry. The protracted inquiry into the schemes proposed for the North Wales and Chester District which the Electricity Commissioners have been holding at Llandudno affords further evidence of the regrettable absence of the co-operative spirit which is essential to the success of the proposed authorities. As in the case of the Liverpool inquiry, the representatives of many of the local authorities concerned were openly out to crab the scheme; it was noteworthy that the majority of the authorities, like the Chester Corporation itself, relied upon their own permanent officials rather than upon counsel, and apparently this practice is not conducive to geniality and goodwill. The Connah's Quay U.D.C. had already described the Chester scheme as "repulsive," and Rhyl expressed a desire to cultivate its own allotment in its own way.

The case for setting up a Joint Electricity Authority, and for the scheme of the Chester Corporation in which it is embodied, was very ably presented by Mr. J. H. Dickson, the town clerk, who was complimented by the chairman on his performance. As the acoustic properties of the Town Hall are far from perfect, and caused much inconvenience to all parties, all the more credit is due to him for his achievement. His task was not facilitated by the introduction of amendments to the scheme at the last moment, with a view to meeting various objections.

Both the Chester Corporation scheme and that of the North Wales Power Co. have been outlined in our pages. Summarised, the former proposes a Joint Electricity Authority for the whole area, based on a system of representation calculated on the rateable values of areas and the capital expenditure of authorised distributors. The engineering scheme consists in leaving the North Wales Power Co. to develop the North-Western area, in the development of a series of low-fall water-power stations on the river Dee, about 20 miles above Chester, coupled together on the Thury system, and in building a steam station on the lower Dee, to act as a stand-by and supplementary plant. It is proposed to deal in the early years with an extension into the salt area of Mid-Cheshire, and later to couple up via the North Wales coast route with the North Wales Power Company. At the outset, pending the completion of works, a bulk supply has been arranged for, from the Government factory at Queen's Ferry.

The constitution of the Joint Authority bristles with points which may cause lively opposition, but it must be said that the scheme appears to be well thought out, and is the result of numerous conferences with interested authorities. It is, we believe, in great part the work of Mr. S. E. Britton, electrical engineer to Chester Corporation, who for years past has minutely studied the subject and investigated the resources and requirements of the area. The success of his hydro-electric plant on the Dee is well known to our readers. We must not, however, detract from the credit due to Mr. E. N. Humphreys, the first witness, who was until recently chairman of the Chester Electricity Committee, and who has been largely responsible for the scheme. His examination-in-chief showed him to be a thorough master of every detail of the subject, and it must be said that he deserves and has the gratitude of all those who support the scheme.

At the time of writing the inquiry is still in progress. We commence a report of the proceedings elsewhere in this issue.

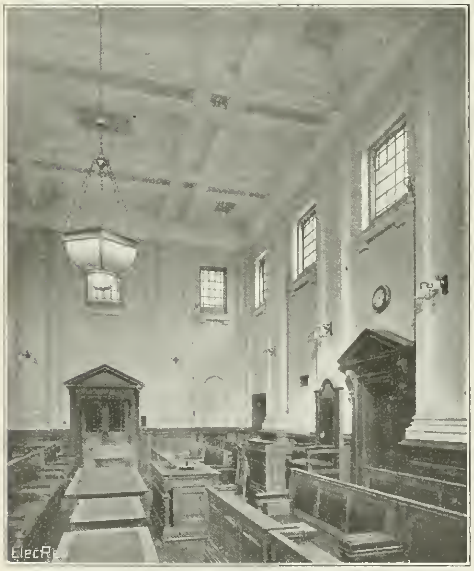
THE NEW SESSIONS HOUSE, LONDON COUNTY COUNCIL.

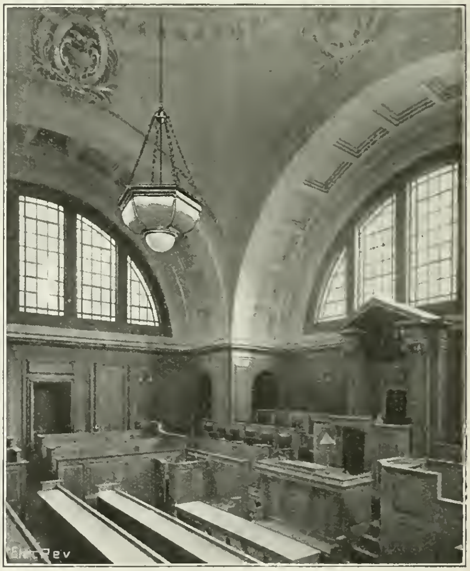
Early this year the new Sessions House, which has been built by the London County Council in Newington Causeway, London, S.E., was completed and brought into occupation. This fine building, which provides for the accommodation of the Metropolitan Courts engaged upon the trial of civil cases, and is therefore on a par with the Central Criminal Courts in the Old Bailey, was commenced in 1912, and had been carried a long way towards completion when the outbreak of war necessitated the suspension of building operations; it is of very substantial construction, and its internal finish and equipment will compare favourably with those of any other courthouse in the country. The building consists of three floors and a basement, and covers an area of some 43,500 sq. ft.; on the ground floor there are three courts and a public hall, and ample accommodation is provided for the Bench and the Bar, officials, police, domestics, the general public, and, of course, the prisoners.

Photo by] [*London News Agency.*

The Public Hall.

Simplex Foot-warmers.





Views of the Courts, showing the Electric Lighting Fittings and Clocks.

For a public building of so much importance, it was desirable that the lighting, lifts, heating, and ventilating arrangements should be of the first order, and a recent inspection of the equipment has satisfied us that nothing has been left undone to secure this end. The work has been carried out to the specifications of the engineer to the London County Council, Mr. G. W. Humphreys, M.Inst.C.E., the electrical engineer to the Council, Mr. C. A. Baker, M.I.E.E., and his assistant, Mr. H. M. Harding, being responsible for the design of the whole installation and supervising the work.

The principle followed by Mr. Baker in preparing the lighting scheme was generally that of semi-direct illumination, supplemented by a certain proportion of direct lighting; he is not, however, a slave to any particular system, but uses whatever device he regards as most appropriate for the purpose in view. The contractors for the lighting equipment were the Alpha Manufacturing Co. Electricity is supplied from two sources: The London Electric Supply Corporation, a.c. at 220 volts, 85 cycles; and the Metropolitan Borough of Southwark, d.c., 3-wire, at 220 and 440 volts. The a.c. supply is the main source for the lighting system, and the d.c. for the pilot circuits and for a stand-by to the a.c. supply, as well as for all the motors and heating appliances. The meters and main switchboards are installed in a room in the basement, and there are 28 lighting and seven power distribution boards in the building; the distribution boards are let in flush with the wall surface, and provided with wooden doors matching the surrounding decorations. Most of the wiring is protected with screwed steel conduit, into which the cables were drawn after the pipe-work had been finished; no joints were allowed, looping-in being generally adopted, with connector boxes where this was not practicable. At certain points surface wiring with flexible cords carried in insulated eyelets is employed, and in the corridors on the ground floor, and in some other situations, metal-sheathed twin conductors are used. Draw-in boxes under parquet floors are fixed flush with the floor level, the covers being filled with the material used for the surrounding floor; in plaster work they are encased in wood with a polished wood flush cover. The covers of switches in the Courts and other principal rooms are of bronze.

The public hall is exceptionally well lighted, with 100-watt gasfilled lamps in globes, which are carried by eight handsome bronze bracket fittings, each supporting two globes; in addition a number of smaller lamps are provided for local illumination. The Courts are lighted by large ornamental pendant bronze bowl fittings, which are suspended under the domed roofs from winches; there are two circuits in each fitting, and the connections are made with four concentric rings, the raising gear being that supplied by the London Electric Co., which takes the strain off the hoisting rope when the fitting is in place. Courts Nos. 1 and 2 each have one of these fittings, containing one 1,000-watt and three 500-watt gasfilled lamps; Court No. 3 is provided with a similar fitting containing lamps of smaller candle-power. The glass bowls used for these fittings were specially chosen and tested, permitting the transmission of about 45 per cent. of the light, the remainder being reflected on the ceiling. In each Court additional local lighting is provided by wall brackets carrying vacuum tungsten lamps in globes. An excellent effect is produced, the light being agreeably mellow, but amply sufficient for all purposes. Illumination tests show that in the courts there is an intensity of 3.8 to 4.2 foot-candles, and in the public hall 4.0 to 5.1; in the Deputy Chairman's room, the Justices' common room, and the Bar mess, the illumination is between 3.1 and 4.0 foot-candles, and in the Standing Joint Committee room it is 5.7. These results justify the accuracy of the formulæ on which Mr. Baker calculated the whole of the illumination figures in designing the installation. The prison cells, at a height of 3 ft., receive 0.89 foot-candle. The Committee room, which is a very handsome apartment, is lighted with two bowl fittings, each containing three 300-watt lamps, together with wall brackets; the Justices' common room is provided with three fittings each containing three 150-watt lamps, and eight 60-watt metallic filament lamps in two-light brackets.

Bowl Fitting for Committee Rooms (Strode and Co.).

In the corridors flat fittings are fixed to the ceilings, and fed from special circuits, a certain proportion of the lighting supply being derived from each of the two sources. In the Records Store Room portable lamps with connections to wall plugs are provided. Special attention has been given to the lighting of the staircases, the fittings being so disposed that the lighting is approximately uniform at all points; holophane globes are used, centrally suspended.

The fittings suspended in the Courts, which weigh about 1¼ cwt. each, were made by Messrs. Simplex Conduits, Ltd., who also supplied the large brackets for the Public Hall and the brackets in the Courts, and 60-watt foot-warmers for the use of the judges, magistrates, and clerks in the Courts; the bronze fittings in the committee rooms, jury rooms, vestibule, and corridors were made by Messrs. Strode & Co., Ltd.—all to designs approved by the County Council.

The building is provided with a hot-water central heating system, with Verity 5-h.p. duplicate motor circulating pumps. Special attention has been given to the ventilating system, which was carried out by the Buffalo Forge Co., Ltd. Two main ventilating installations, electrically driven, have been put down in the basement, in which the air is washed and filtered, and warmed by steam if necessary; the air is distributed by large steel trunks, of excellent workmanship, and is also removed by exhaust fans, a combined plenum and vacuum system being adopted. The kitchen being equipped with gas cooking apparatus, special fans have been installed to remove the fumes, by the Keith & Blackman Co., with Veritys' motors. The motor starters were made by Messrs. Brook, Hirst & Co.

The ninety prison cells in the basement are provided with separate ventilating equipment, and with electric bells. The pushes for the latter, which were made by the Alpha Manufacturing Co., are fixed near the doors, and fitted with mechanical indicators; when a push is pressed, an electric indicator informs the warder in which block it is situated, and an arm falls to a horizontal position at the door of the cell, so that the warder, looking down the corridor, can see at once where the call has been made.

There are two Waygood-Otis electric passenger lifts, one for the use of the public, and one for the justices. Each of these lifts is arranged to take a load of seven persons, at a speed of 200 ft. per minute, and is fitted with a worm gearing and sheave drive, fixed overhead, and driven by a motor specially designed for lift service, rated at 10 h.p. The makers' standard electrical controller is provided, giving smooth and gradual starting and stopping, and operated by a switch in the car with a self-centring handle. The cars are of English oak, and are fitted with safety gear which is operated by a special governor, designed to come into operation in the event of the car attaining an excessive speed on the downward journey from any reason. The guides for the car and counterbalance weight are of round turned steel. Patent electrical and mechanical locking gear is fitted to the landing gates, designed to prevent the lift from being started unless the gates are shut, and to prevent the gates from being opened unless the car is opposite them.

A flash-light position indicator is provided on each floor, with a series of lamps and special controlling gear, so as to show in the indicator on each floor the position of the car in the well-hole at any moment.

Messrs. Waygood-Otis, Ltd., also fitted two electric coal and service lifts, to take a load of 3 cwt. at a speed of 110 ft. per minute. The cars are of angle-iron frames filled in with oak. These lifts are operated on the automatic system, with a set of push-buttons on each floor, so that the car can be sent from any floor to any other floor, stopping automatically on reaching the desired level. An electric flash-light indicator is provided at each opening to show the position of the car.

Another interesting feature of the electrical equipment is the installation of some 60 electric clocks, supplied by The Silent Electric Clock Co. The master clock is the company's well-known standard pattern short-pendulum control clock, and is fixed in the electrical plant room in the basement; the electrical impulse to the pendulum is provided by a modern application of the well-known "Hipp" principle, which is noiseless in action. The 55 receiving clocks, arranged in two circuits, are all of the company's patent silent rotary-armature pattern, and have been provided with handsome oak cases, in harmony with the oak panelling of the interior of the building. The installation is energised by a battery of Fuller "Block" accumulators at 10 volts, which is charged off the 220-volt circuit through a resistance. Each of the clock circuits takes a momentary current of ¼ A at half-minute intervals. The wiring for the clocks and bells was done by the Alpha Co., with v.i.r. cable in steel conduit.

Telephonic communication throughout the building is provided for by a Post Office private branch exchange.

The whole of the electrical equipment has been designed and carried out on the most up-to-date lines, with first-class materials and workmanship, and is in every way worthy of the important building in which it is installed. Our thanks are due to Mr. C. A. Baker for enabling us to inspect the installation and for explaining the features which we have described in this article.

THE BRITISH INDUSTRIES FAIR.

The British Industries Fair, which may be termed "Britain's shop-window," opened in London and Birmingham on Monday last; the Glasgow Section is, this year, a week behind the other two. Although the Fair of 1920 was an eminent success, and in spite of the dullness prevailing in industry, the organisers are looking forward to even better results. As in the previous year, it is at Birmingham that the engineering exhibits are to be found; the London section is devoted principally to fancy goods, toys, office appliances, &c., while Glasgow is to exhibit textile goods, food products, and chemicals. We intend to deal with some of the individual exhibits at Birmingham more fully in subsequent issues; at present, for the most part, we merely give the names of exhibitors of articles of interest to the electrical profession, trade, and industry, with an indication of the nature of their displays.

LONDON SECTION.

The London section of the Fair, which has again increased in size, and promises to surpass its predecessor even as that in its turn added to the roll of success since the Fair's inception in 1915, was opened at the White City, Shepherd's Bush, W. 12, on the 21st inst., and will remain open until March 4th. Producing trades are grouped for convenience of inspection, and the groups are again divided into sections and so housed as to facilitate a rapid survey of British products in any given line, a wise provision, since the space occupied by exhibitors' stands has grown in seven years from 80,000 to 240,000 sq. ft.

At the White City there are some 3½ miles of stand frontage, and the electric lighting of this temporary market town must have been a big undertaking in itself. In addition to 15 miles of "flex" and 6 miles of straining wire, some 20 miles of electric cable have been laid to supply the 6,000 lamps on exhibitors' stands. The Post Office has installed nearly 300 special telephones for individual exhibitors, in addition to the numerous call boxes and a number of post and telegraph offices distributed throughout the buildings.

An aggregate of 1,150 firms are exhibiting in the London section of the Fair, which is sectionalised into seven divisions broadly classified as follows: I, china, glass, and earthenware; II, fancy goods; III, paper, &c.; IV, drugs and scientific instruments; V, jewellery, silver, cutlery, clocks; VI, sports and toys; VII, furniture, basketware, and musical instruments.

On the whole the display is an imposing one, but there are few stands of direct electrical interest. In Division I the manufactures of the Deal Potteries, Ltd., include electrical porous pots, and Messrs. Doulton & Co., Ltd., show a selection of porcelain insulators of various types and sizes for l.p. and h.p. work. Glass bulbs and tubing as used in the manufacture of electric lamps are displayed on the stand of the Sheraton Glass Manufacturing Co., Ltd., while the Vauxhall Glass Manufacturing Co., Ltd., has on view flint and fancy glassware, shades, and both upright and inverted globes.

In Division II some new and unique designs in lamp shades and standards may be seen on the stand of the Artistic Shade Co., Ltd., the shades being made of silk, linen, or parchment; a speciality is made of hand painting, and the colour schemes are carried out in good artistic taste. Other stands on which similar exhibits are also shown are those of Miss M. Bruce Low; Messrs. S. L. Miller & Co., who specislise in hand-painted shades to match vases adapted for table lamps; Messrs. Charles Selz, and Messrs. Henry Wolff & Co.

In addition to fancy goods, Messrs. T. de la Rue & Co., Ltd., exhibit "Telenduron" insulators, and the Improved Solidite Co., Ltd., claims that its product can be moulded into any shape or form; it is produced in qualities suitable for machining, is supplied in nearly all colours, and can be used as a substitute for other insulating materials. Messrs. Siemens Bros. & Co., Ltd., have on view specimens of their dry-battery electric lighting equipments for bicycles and motor cycles, and a complete range of cells and batteries as manufactured at their Woolwich works. The Ever-Ready Co. (Great Britain), Ltd., besides batteries, is showing a variety of portable lamps and torches and electrical fancy articles; a number of the exhibits of the Semaphore Engineering Co., Ltd., are of a similar nature to those mentioned above.

In Division IV the laboratory apparatus shown on Messrs. Brown & Son's stand included electrically-heated muffles, while Messrs. S. G. Brown, Ltd., show a "Brown" gyroscopic compass, electrical relays, wireless telephone receivers, telegraph instruments, &c., and also the "Cyclux" cycle-lighting generating set. Amongst the photographic apparatus on Messrs. W. Butcher & Sons, Ltd., stand, kinematograph projectors, arc lamps, and resistances may be seen, and Messrs. A. Graham & Co. exhibit a selection of high-grade permanent magnets and loud-speaking telephones. As regards medical instruments, Messrs. W. Gowland (1916), Ltd., show, amongst many other things, electrical dental sets, and several types of electrical inspection lamp. The use of ozone for medical purposes is too well known to need description, and neither does it require any extra nasal sensitiveness to detect the stand of Messrs. Ozonair, Ltd. An interesting exhibit is provided by Messrs. J. Pilkin & Co., Ltd., in the form of an instrument for measuring the velocity of a bullet or projectile by electrical means. The firm includes in its manufactures electrical indicating and recording instruments and spiralising and other machines as used in electric lamp factories.

Division V includes only one stand of electrical interest, *i.e.*, that of the Magneta Time Co., Ltd., on which are shown electric clocks and synchronised time systems which do not employ batteries or contacts; also electrically-operated turret clocks and bell signalling apparatus.

In Division VI Messrs. A. Chase & Co., Ltd., exhibit a selection of their manufactures, such as small electric motors for driving toys, tapping keys, buzzers, signalling lamps, &c., and all kinds of electrical novelties and toys.

BIRMINGHAM SECTION.

The Castle Bromwich Aerodrome is again the site of the important Birmingham section of the Fair; although the number of exhibitors is practically the same as last year, the floor space taken up is considerably larger, and the fully representative character of the exhibits has been assured. The arrangement of the stands has been improved to a great extent, so that it is almost impossible for visitors to miss any section of the exhibits. Requisites for all classes of engineering are on view, and the domestic exhibits cover a wide range. Copper and bronze wares constitute a larger section of this year's display, indicating the determination of British manufacturers to maintain their supremacy in the face of foreign competition.

The catalogue issued by the organisers (Birmingham City Council and the Chamber of Commerce) is a marvel of compactness, considering the amount of information it contains. The alphabetical index of goods, indicating the stands on which they are to be found, is printed in English, French, and Spanish. Each of the six hundred-odd stands is given sufficient space in the catalogue to indicate thoroughly its nature.

The following is a list of firms exhibiting electrical goods or wares closely connected with the electrical industry. The stand number is given in each case.

BUILDING A.

Excelsior Shade Manufacturing Co., "Betterway" shades and electric lighting fittings	1
Donovan & Co., ironclad switchgear, factory and domestic apparatus, electrical accessories, insulators, &c.	6
David Shanks & Co., Ltd., electric light fittings	7
Wm. McGeoch & Co., Ltd., switchboards and fittings for ships, lamps for navigation and signalling, electric door locks, &c.	8
Improved Solidite Co., Ltd., "Solidite" moulded insulation	9
The Semaphore Engineering Co., Ltd., dry batteries for telephones and alt purposes, complete lighting sets for cars and cycles	10
Berry's Electric Ltd., open type and ironclad switchgear for domestic, manufacturing, and colliery purposes, electric fires, instruments, &c.	12
Siemens Bros. & Co., Ltd., automatic telephones, signalling apparatus for mines, cables and wires, primary cells, car lighting equipments, and other electrical appliances	13
British Brass Fittings, Ltd., electric light fittings, switches, electric fires, tramway and railway fittings, &c.	14
Ingram & Kemp, Ltd., ditto.	15
Player & Mitchell, ditto	16
Sperryn & Co., Ltd., ditto	17
J. H. Tucker & Co., Ltd., electric lighting and power accessories, tumbler switches, lamp holders, wall sockets and plugs, switchboards, fuses, distribution boards, &c.	20
Gent & Co., Ltd., electric clocks, signalling apparatus, industrial telephones, bells, indicators, &c.	21
Sutcliffe (of Crumpsall), Ltd., vulcanised fibre tubes, rods, sheets, &c.	22
Electrical Conduits, Ltd., heavy and light gauge tubes, junction boxes, &c.	23
The Telephone Manufacturing Co. (1920), Ltd., automatic inter-communication telephones, "Laryngaphones, bells, terminals, junction boxes, and other accessories	24
Best & Lloyd, Ltd., ornamental fittings and shades for electric lighting	25
F. & C. Osler, Ltd., metal electric light fittings, crystal glass, and alabaster	26
Faraday & Son, Ltd., electric light fittings of various descriptions	27
The Etna Lighting & Heating Co., Ltd., electric lighting installations	28
Simplex Conduits, Ltd., conduit fittings and accessories, electric light fittings, ironclad distribution boards, ships' fittings, electric heating and cooking appliances, &c.	29
Premier Electric Heaters, Ltd., electrical domestic appliances for heating, cooking, &c.	31
Ebonestos Insulators, Ltd., moulded insulation	32
C. H. Parsons, Ltd., lamp holders, tumbler switches, and ironclad switches and fuses	35
Edward J. Shaw & Co., electrical fittings, lanterns, and cut glassware	39
Samuel Heath & Sons, Ltd., electrical fittings and accessories	42
The Vincent Switchgear Manufacturing Co., ironclad switch and fuse-gear, distribution boards, &c.	46
May & Padmore, Ltd., brass fittings, electric fires, irons, and cooking apparatus	49
T. Saveker, electroliers, pendants, table standards, &c.	50
The Rawlplug Co., Ltd., patent wall plugs for screws	52
Crofts & Assinder, Ltd., electrical fittings	59
Edgar A. J. Hooper, Ltd., electric light fittings	62
Wm. Soutter & Sons, Ltd., electric lighting and heating	63
John A. Harry Hunt, electric light fittings	65
Stoves, Ltd., electric stoves	66
Thomas R. Carpenter, Ltd., electric lighting pendants, bowl fittings, standards, &c.	67
The B.E. Co. (of London and Birmingham), Ltd., all classes of lighting fittings and accessories, heating apparatus, irons, lamps, bells, and batteries	69
Wm. Sanders & Co., ironclad switchgear, distribution boards, battery switchboards, &c.	74
The Thermal Syndicate, Ltd., electric lighting pendants, bowl fittings, shades, &c.	76
Mark Webber, Ltd., small electric lighting, pumping, &c., sets	80
The National Gas Engine Co., Ltd., suction gas plants	80A
The General Electric Co., Ltd., electric light fittings and accessories, switchgear, flexible wires and cables, telephones, bells, medical apparatus, lamps, vacuum cleaners, cooking, heating, and ventilating apparatus	81
The Austin Motor Co., Ltd., small electric lighting sets	82
Fuller's United Electric Works, Ltd., storage batteries for lighting and general purposes—plate and block types—miners' lamps and equipment	83
The "Perfacta" Engineering Co., Ltd., "Perfecta" and "Super" boiler circulators	84
Townshends, Ltd., electric cooking and heating appliances	86
Falkirk Iron Co., Ltd., electric cookers and irons	90
Watertight Fittings, Ltd., electric light fittings, conduit boxes, switches, and fuses	93
Springs, Ltd., springs for all purposes	95
Crisp, Francis & Co., Ltd., electrical fittings	97
Parker, Winder & Achurch, Ltd., dynamos, electric lighting outfits, electric floor polisher, &c.	100 and 529
Imperial Contractors Machinery Co., concrete mixers	102
The Birmingham Mica Co., Ltd., mica and micanite insulation	104
Wm. Whitehouse, Ltd., electric light fittings	105
Accles & Shelvoke, Ltd., fractional h.p. motors, patent dynamotor, lighting dynamos for cars, &c.	106
Electric Heating & Hardware, Ltd., "Komet" electrical products	107
Gath Electrical Engineering Co., electric light and bell accessories	108
Watts, Williams & Co., Ltd., electric lighting sets for cycles and motor cycles	115
Singleton & Rome, electric light fittings, pendants, brackets, standards, accumulators, heaters, &c.	118
The Central Gear Co., Ltd., applications of heliocentric reduction gears to electric motors, fans, &c.	130
Metallurgical Co., Ltd., ingots of non-ferrous metals	134
Parc, Ltd., jigs and fixtures for repetition work and mass production	493
John Slater, Ltd., paraffin engine suitable for small lighting set	494
Factory Equipment Co., machine tools, jigs, gauges, &c.	496
John Rigby & Sons, Ltd., iron, steel, and brass wires and bars	501
Wm. Beardmore & Co., Ltd., pumps for petrol, oil, water, &c.	510
Coleman & Appleby, Ltd., electro-plating plant and chemicals	520
G. Jones & Co., electro-plating plants, dynamos, &c.	526
E. Camelinat & Co., Ltd., electric lighting sets for cars and cycles	527
Clayton-Wright Bros., "Pedlite" lighting sets	528
British Cellulose & Chemical Manufacturing Co., Ltd., non-inflammable celluloid, glass substitute, &c.	530
Apollo Plug Manufacturing Co., Ltd., electric horns and sparking plugs	539
H. Miller & Co., Ltd., dynamo lighting sets for motor cycles	543
Reavell & Co., Ltd., totally-enclosed air compressors	548
Scarab Oil Burning Co., Ltd., patent oil burners for boilers, &c.	548A
Ransomes, Sims & Jeffries, Ltd., electric truck with electric elevating platform	549
F. H. Adams, Ltd., aluminium die castings for motor-car magnetos, dynamos, starting motors, &c.	550
New British Electric Supply Co., Ltd., totally enclosed motors	552
The Hockley Chemical Co., Ltd., electro-plating chemicals and accessories	555
Motor Trading & Garage Supply Co., Ltd., accumulator and dynamo car and cycle lighting sets	560
Birmingham Small Arms Co., Ltd., machine tool accessories, cycle lighting sets, &c.	571-6
Thomas Howse, Ltd., insulating varnishes and compounds	583
The Frederick Crane Chemical Co., Ltd., colouring and frosting preparations for electric lamps	589
Nightingale & Co., lubricating oils and greases	600
Pinchin, Johnson & Co., Ltd., insulating varnishes, compounds, &c.	605

BUILDING B.

Henry Wiggin & Co., Ltd., nickel products, anodes, salts, resistance wire and tape, &c.	137
T. J. Priestman, non-ferrous alloys	143
McKechnie Bros., Ltd., extruded brass and brnoze rods in all sections	145
Galloways, Ltd., super-heaters, boiler tubes, boiler accessories, &c.	148
London Simplex Engineering Co., Ltd., boiler water circulators	150
Brass & Copper Tube Association, seamless tubes for boilers, &c.	151-221
Brass Wire Association, brass, phosphor bronze, bronze, &c., wires	151-221
Brazed Brass Tube Association	151-221
Cold Rolled Brass & Copper Association, all sizes of brass, copper, and brass alloy strip, sheets, tapes, &c.	151-221
Nickel Silver Association	151-221
Association of Drop Forgers and Stampers, boiler fittings, electrical fittings, &c.	222
Bloxwich Lock & Stamping Co., electrical fittings	225
Lancashire Ordnance Accessories Co., Ltd., electrical fittings	237
The Aston Chain & Hook Co., Ltd., turbine blading, &c.	246
Brooks & Adams, Ltd., brass die pressings and stampings for the electrical trades	253
British Electric Vehicles, Ltd., 4-ton electric locomotive and electric industrial truck	254
Thomas Piggott & Co., Ltd., pressed steel tanks, &c.	258
Mansill, Booth & Co., Ltd., brass, white metal, and phosphor bronze stampings for the electrical trades	267
A. E. Lefever, light-gauge, solid-drawn brass and copper tubes for the electrical trades	276
The New Rotoplunge Pump Co., Ltd., electrically-driven pumps	422
J. H. Fenner & Co., Ltd., belting of various types	425
The Midland Supply Co., electric monorail and friction hoists, winches, and pulley blocks	430
William Robinson, electric hoists, telephers, winches, &c.	431
Rayner & Heald, Ltd., two- and three-phase motors	432

The "M. & P." Electric Welding Machine Co., lifting magnets and resistance welding machines	433
The Consolidated Pneumatic Tool Co., Ltd., electric drills and grinders	435
John Hill & Sons, electric pulley blocks, &c.	440
Hollings & Guest, Ltd., insulating press with hot plates ...	441
H. C. Slingsby, electric carrying and lifting trucks ...	448
R. & J. Dick, Ltd., "Balata" belting	458
W. Goodyear & Sons, Ltd., 2-ton "Greenbat" electric truck	467
The Pneulec Machine Co., electrically-operated jar ram moulding machine	472
BUILDING C.	
The Springvale Engineering Co., Ltd., official electrical contractors to the Fair	283
The Hoover Suction Sweeper Co., Ltd., electric suction sweepers	333
The "Daisy" Vacuum Cleaner Co., Ltd., electric vacuum cleaners	345
Thomas Pemberton & Sons, Ltd., brass-foundry work for electrical purposes, &c.	373
Evered & Co., Ltd., electrical fittings, alabaster bowls, &c.	376
Simmons Holloware Co., Ltd., electric lamps and reflectors	380
Scholey & Co., Ltd., electric suction cleaners and electric drills	391
The Electric Appliances Co., Ltd., electric vacuum cleaners	395
James Smellie, Ltd., electrical fittings, &c.	407

THE EFFICIENCY EXHIBITION.

(*Concluded from p.* 199.)

The exhibits of the University of London are intended to illustrate the teaching and research work of the University as carried out at the incorporated colleges and its schools. The exhibit of the Electrical Engineering Department of University College, London (Prof. J. A. Fleming, F.R.S.), includes several items of practical and historical interest, such as samples of the original instruments of research which led Prof. Fleming to the important invention of the thermionic valve; he also exhibits the original oscillation valves which he first employed in 1904 as detectors of electric waves in wireless telegraphy, and also many of the later developments, such as the three-electrode valves, &c. Other apparatus exhibited comprises phonoscopes, or instruments for photographing the wave form of sounds, which were made at University College, London, during researches which assisted the Admiralty in the anti-submarine warfare.

The King's College Department of Geology exhibit illustrates teaching and research work as carried on in the department by Prof. W. T. Gordon, Mr. A. K. Wells, and Mr. L. D. Stamp. A process in the examination of minerals by means of converging polarised light on definitely orientated slices of crystals is included. In commerce such a method is employed in selecting and differentiating mica fo rinsulating purposes in electrical machinery, and for other uses.

The Wheatstone Laboratory's exhibit of historical apparatus from the George III Museum, King's College, is of great interest as illustrating the history of discovery in electrical science. The Wheatstone Laboratory is the oldest physical laboratory in the country open to students. The professors at King's College have included such men as Maxwell, Wheatstone, Hopkinson, H. A. Wilson, Barkla, and O. W. Richardson, all of whom have been or are well-known leaders in electrical progress. Some of the apparatus devised by them and by other distinguished scientists working in the laboratory is shown in the exhibit.

The Metallurgical Department of the University of Sheffield illustrates its wartime activity in the production of cupro-nickel; the Department of Glass Technology shows, amongst other things, an electrically pre-heated blowpipe burner, while the Electrical Engineering Research Department demonstrates Dr. T. F. Wall's method for producing sparkless operation of inductive electrical circuits and its practical applications.

Armstrong College, Newcastle-on-Tyne, exhibits Dr. Benson's apparatus for determining the liability to explosion of coal dust and the inhibitory power of inert dust. The apparatus consists of a glass bulb within which are placed a few grains of the dust to be examined; by means of a puff of air the dust is blown against a source of heat, such as a red-hot platinum wire, and if the dust is capable of producing a colliery explosion, a small flash of light is seen in the globe, and the amount of energy developed is registered on a pressure gauge attached to the bulb.

The whole of the articles exhibited by the Loughborough College, including electrical fittings, are the work of students, who include a large number of ex-officers and disabled ex-service men.

The Dominion Machinery Co., Ltd., demonstrates a number of electrically-driven wood-working machines, showing that complicated operations can be carried out with the same facility as simple ones.

Messrs. Ozonair, Ltd., show various types of portable and stationary apparatus for the electrical production of pure ozone. On this stand may also be seen a Wild-Barfield electric furnace which is flat in contrast to the more usual cylindrical shape.

The British Thomson-Houston Co., Ltd., has a handsome stand on which is assembled some of its more novel and recent apparatus; for example, an automatic d.c. arc welder is demonstrated, the operation of which is started and stopped by means of a push-button switch; butt welds can be made at speeds varying from 4 to 20 in. per minute, and metal deposited at rates varying from 1 to 4½ lb. per hour. The welding head consists of a steel body carrying feed rolls and adjusting and straightening rolls, which draw the electrode wire from the reel, straighten it, and feed it to the work, while provision is made for such hand adjustment as may occasionally be necessary. The feed rolls are driven by a d.c. motor, the fields of which are excited from a separate source of d.c., the armature being connected across the arc between the electrode and the work. Therefore, as the arc tends to lengthen, the speed of the motor will increase and feed the electrode wire more rapidly; this brings the arc length and arc voltage back to their normal values. The reverse operation occurs if the arc length tends to shorten. Control is automatic through the medium of relays and contactors for regulating the feed,motor, together with rheostats for adjusting the speed to suit various sizes of electrode wire. The moment contact is made the potential between electrode and work falls to zero, which causes a contactor on the control panel to operate, thereby reversing the feed motor and withdrawing the electrode wire from the work a distance sufficient to establish the proper arc length. The motor thereafter continues to feed the electrode wire to the arc at the correct speed. The equipment may be held stationary and the work travelled past the arc, or the welding head may be movable and the work held stationary; a lathe, planer, or boring mill may be used for the purpose, thus a spiral of metal can be laid so that each succeeding layer will fuse into the previous one. If desired, the operation of the welder can be made entirely automatic by means of interlocks on the control panel. The welder has been operated continuously for 16 hours without breaking the arc. Other articles shown by the firm include motors, control gear, a Tirrill regulator panel, flow meters for measuring the flow of liquids and gases in pipes, an electric rivet heater, a portable wireless telegraph receiving set weighing 20 lb. which needs an aerial, a portable Coolidge X-ray outfit which can be operated at the bedside of the patient, a "Tungar" battery-charger, and Mazda lamps and fittings.

The Marconi Companies have a large exhibit of modern wireless telegraph and telephone apparatus, embracing valve transmitters and receivers; also complete ships' installations and field sets for military and surveying or other similar purposes.

The Eastern Associated Telegraph Companies show a demonstration circuit comprising a keyboard perforator and Wheatstone transmitter at the sending end, and an electrolytic magnifier, "Jockey" and intermediate relays, perforators, and a printer at the receiving end, the apparatus being a duplicate set of that used on the London-Alexandria circuit. Other exhibits include the original model of the siphon recorder by Sir W. Thomson (Lord Kelvin), specimens of cable and "faults," marine growths, fish bites, &c.; repairing tools and gear, and models of the s.s. *Lady Denison Pender* and the bed of the Atlantic Ocean showing the positions of cables. Messages can be accepted at the company's stand for direct transmission to places abroad at the usual rates.

Messrs. Creed & Co., Ltd., have arranged a somewhat similar exhibit to that described above, but illustrating a 1920 pattern Creed high-speed automatic printing telegraph circuit. The messages are prepared in punched slip form at one end of the stand, and received at the other in printed Roman characters, the working speed being 175 words per minute. Musical selections are also rendered at intervals on the "Stentorphone," an instrument of the gramophone type, but possessing great power.

Messrs. Barr & Stroud, Ltd., demonstrate the practical utility of the optophone, an instrument for enabling the totally blind to read ordinary print by using the sense of hearing instead of that of sight. How each letter of the alphabet is represented by different combinations of five, or less, musical notes, was fully described in our pages a week or two ago. Miss Mary Jameson can be seen at the exhibition reading ordinary printed matter selected by members of the public. Miss Jameson has been blind from birth, and can testify to the facility with which a person can learn to use the instrument, of the capabilities of which we have personal knowledge.

Messrs. Belling & Co. show many examples of their various designs of electric radiators and convectors for heating purposes, as well as water boilers and hot plates, &c.

The Hobart Manufacturing Co., Ltd., has a stand on which is displayed a number of electrical machines that will appeal to those interested in the preparation of food in any manner. They include such devices as cake and dough mixers, loaf moulders and rounders, coffee mills, sausage and mincing machines, and many other electrical labour-saving machines.

The Durolite Manufacturing Co., Ltd., exhibits specimens of "Klydo" animated signs adapted for electrical and other means of illumination. Only one light is used in each sign which gives a moving rainbow effect with good diffusion.

The Beck Kinematograph Manufacturing Co., Ltd., show two portable kinematograph projectors designed for lecture. educational, or home entertainment purposes. The firm is also responsible for the complete installation in the Minor Hall of the Exhibition, where trade and commercial films are shown daily.

Three firms have on view self-contained petrol-electric generating plant suitable for lighting country houses, farms, &c. The "Dayton" automatic set is shown by the T.B.S. Electrical Construction Co., Ltd., and the "Ballot" 1-kW, 50/70-volt set by Messrs. Hick-Diesel Oil Engines, Ltd. The latter firm's plant includes a wall-type marble switchboard and a 28-cell, 75-Ah Fuller battery on a wooden stand. The single-cylinder, four-stroke engine is cooled in a novel way by means of a mechanical water cooler forming part of the set, so that no water tanks are needed.

Messrs. Mark Webber, Ltd., also exhibited a 2-kW, 70-volt set for the same purpose on the stand occupied by the United Oil and Coal Corporation, Ltd.; this stand also contained one or two examples of "Railodok" electric industrial trucks, which, as their name implies, are suitable for carrying goods about on railway premises, docks, &c.; the trucks are supplied by Industrial Appliances, Ltd. Another stand which was devoted entirely to trucks of various types and sizes, including electrically-propelled ones of the solo and trailer houling and elevating platform types, was that occupied by Messrs. H. C. Slingsby.

Telephones, mostly for private use, are displayed on two stands, namely, those of the London Telephone (New System) Co., Ltd., and the Reliance Telephone Co., Ltd., and the exhibits comprise instruments of various types and sizes, switchboards, cable, and accessories suitable for intercommunication purposes in offices, factories, ships, &c. An interesting exhibit is the "round call" signal system which enables an extensive range of departments in a building to be instantaneously searched for an individual who is required to speak on the telephone. The use of the "Laryngaphone," which defies noise, is also demonstrated; it is shown as a hand set for use in conjunction with any ordinary type of telephone, and also as a head set for the use of divers and airmen, or in connection with helmets and masks for mine rescue work, &c. The Phonotas Co., Ltd., has a stand illustrating its system for the periodical cleansing and sterilising of telephones.

An interesting exhibit is that of Messrs. Chance Bros. and Co., Ltd., which, in addition to samples of special glass, includes specimens of "Chance's Daylight Glass," through which light from gasfilled lamps is filtered for colour-matching purposes. Numerous coloured objects are shown illuminated by filtered and ordinary light, and the variations of the colours are in many cases very striking. The firm has also on view a new heat-resisting glass suitable for lamp globes, &c., which can be sprayed with water while hot without any ill effects taking place.

In conclusion, it might be mentioned that of the various receptions and conferences held at the Exhibition, those of the Electrical Development Association were of most electrical interest, but it is to be regretted that neither of the functions was well attended. Mr. Ll. B. Atkinson, president of the Institution of Electrical Engineers, presided at the conference in the absence of Mr. C. H. Wordingham, and Mr. J. C. Wigham opened the proceedings with a lecture on the application of electric power in industry, in the course of which he pointed out the advantages that accrued from its use and how it tended to promote efficiency. By means of a number of excellent lantern slides the lecturer indicated the methods of electric motor driving in textile, colliery, factory, and other spheres of activity.

JOINT ELECTRICITY AUTHORITIES.

The Chester and North Wales Inquiry.

At the Llandudno Town Hall, on February 15th, a public inquiry was opened by the Electricity Commissioners with reference to the schemes for the supply of electrical energy to the North Wales and Chester electricity district. Sir John Snell, the chairman of the Commissioners, presided, and a large number of authorities, companies, and private persons interested in the schemes were represented.

Summary.

Our summary of the proceedings last week (p. 210) broke off on Wednesday afternoon, with Mr. Britton in the chair. There was at the end of the afternoon a curious incident, showing the disadvantage of questions being put by counsel (unless specialists in scientific work); a lot of time was wasted in convincing an incredulous counsel that it was not necessary to put a weir and notch across a wide river in order to obtain a fairly accurate idea of the quantity of water flowing.

On the Thursday Mr. Britton occupied the witness chair for the whole day. During the morning the North Wales Power Co.'s counsel, Mr. Miller, tried to shake his figures for the number of units to be obtained from the Dee, but in all fairness it must be said that he failed. Mr. Miller was more successful in respect of the Clwyd Valley hydro-electric proposal, and elicited an admission that there was no spare plant there, yet the distributing mains were to remain isolated from the general system for a number of years. Mr. Tyldesley Jones, for the North-Western Railway Co., made a very serious attempt to shake the witness, and succeeded in showing that there were mistakes, although they were not vital ones. Sir John Snell intervened several times to preserve a sense of proportion, and after lunch some amended figures were put in and others promised. Most of the afternoon was wasted on this bickering, but counsel, who was extremely clever and competent as a calculator, made no substantial use of the new figures when they were put in. If some of the time thus wasted in the early days of the inquiry had been saved, it would have been unnecessary, later in the proceedings, to request all who could do so to substitute written for oral statements. However, it is perhaps premature to expect the Commissioners at this early stage of development to resist learned counsel in their skilled obstruction. The late afternoon was very entertaining to those interested in the habits of salmon. Mr. Moon, counsel for the Dee Fishery Board, made great play with an old Act of Parliament requiring all mills to shut down on Sundays, and he caught Mr. Britton rather neatly as to the state of tide when Mr. Britton thought he had seen salmon ascending the fish pass. A suggestion that the Dee was frozen solid at times was neatly countered by Mr. Britton.

An important statement was elicited by Sir Harry Haward that localities which did not undertake financial responsibility would have to be supplied on the same terms as if they were paying a deficiency rate. This is inevitable, but it is a deplorable fact which strikes a blow at voluntary joint authorities. In the absence of public spirit and self-sacrifice, the selfish will benefit at the expense of those who realise their responsibilities for the common good.

The Town Clerk of Crewe pointed out the need of the far eastern salt areas for an immediate supply, and showed it to be at least as urgent as that of Chester and its environs, which would obtain it under the scheme.

On the Friday morning Sir John Snell stated that the Commissioners were getting rather concerned as to the length of the inquiry.

Mr. Britton was subjected to further cross-examination in respect of supply to collieries near Wrexham, and it was very difficult to convince the questioner that the small summer flow of the Dee would not make the supply unreliable; he evidently wanted the steam station shifted to his district—having no doubt an eye to business.

The Northwich U.D.C., represented by Mr. Cowley, evidently wants its area excluded, oblivious of the fact that the large Rural District Council which surrounds it wishes to be included—a Gilbertian situation. Mr. W. Fennell followed on behalf of the Northwich Company, urging the adoption of a bulk supply from the Mersey Power Co. as a means of giving an immediate supply to the salt areas, without necessitating exclusion, this to be retained as a stand-by connection for summer use in times of drought, &c., when the trunk main came through from Chester. Mr. Fennell attempted to draw the Commissioners as to the policy of interlinking adjoining electricity districts generally, but failed. He further urged upon the witness the necessity of joining up to the North Wales Power Company at once, but no satisfactory reply was obtained.

Mr. Amos Jones, of Rhyl, was more successful in drawing the Commissioners. He obtained a very important pronouncement, to the effect that if any undertaker could show that his works could, if extended, supply its surroundings at a cheaper rate than the bulk scheme, he would be allowed to proceed.

At the end of his cross-examination Mr. Britton agreed with Sir John Snell that it was possible that the North Wales water power would be more favourable than that of the Dee, but information had not been available. Mr. Britton received a well-earned commendation from the Commissioners in respect of the valuable pioneer work he had done.

A very interesting witness, Mr. W. H. Armistead, was called, who gave evidence in a delightful way as to the very slight effect on the salmon fishery of a series of weirs provided with proper passes for the fish.

Sir Henry Robertson, deputy chairman of the Fishery Board, also gave evidence on the other side. It is unfortunate that such matters, however interesting in themselves, should have occupied such a large share of time.

Late in the afternoon Mr. Miller, K.C., opened on behalf of the North Wales Power Co., whose scheme was described in our pages on February 11th.

At the end of the proceedings for the day, the Town Clerk of Wolverhampton appeared with Mr. S. T. Allen, the chairman of the Engineers' Committee of the Joint Conference, North-West Midlands, to explain why the areas in the vicinity of Congleton and Macclesfield have been refused by that body, and to ask that their inclusion in the North Wales and Chester area should be considered. The subject is one which will occupy a considerable amount of attention, as extremities of the new electricity districts are, in the absence of any decision as to interlinking, very difficult to allocate.

The following day (Saturday) the Commissioners decided to sit as usual (morning and afternoon) so providing those who attend the inquiry with excellent evidence that this is not a mere holiday at a watering place.

Mr. Miller's opening continued, and provided amusing interhides by reason of his Saxon attempts to pronounce names only intended for Celtic tongues.

Mr. J. H. Jack was called, and disclosed a very interesting situation in relation to the position of the North Wales Power Company and the Aluminium Corporation: he had difficulty in dividing himself. The engineering scheme, it must be said, is very attractive, and the general feeling cannot be anything but favourable to it. The question, however, whether the company, admittedly weak financially, should be given an enormously greater area, with the assistance of a mere advisory committee provided in an undefined manner from the different parts of the area, is a serious one which, it was clear, would give the Commissioners much trouble and great responsibility. The company disclosed a considerable measure of support from the North Wales area, but little from the Cheshire section of the electricity district. Mr. Jack gave his evidence in a confident manner, and must be congratulated on receiving much more gentle treatment in cross-examination than that accorded to his opponents.

There is no doubt, as a result of this inquiry, that the side which engages eminent counsel, when the other relies upon the best of town clerks, is at a disadvantage. Counsel should either be excluded or employed by both sides in these inquiries.

It appeared at the end of the sitting that a vital agreement between the North Wales Power Company and the Aluminium Corporation as to the use of the Dolgarrog water resources had only reached the stage of being vaguely in Mr. Jack's mind. This revelation indicates the complicated condition of affairs in North Wales. The agreement was drafted during the week-end, and was produced on Monday morning, and it was promptly pulled to pieces by opponents. The cross-examination of Mr. Jack by the Town Clerk of Chester produced some spirited passages, and it confirmed the feeling that the technical scheme was good and the proposed organisation a difficult proposition.

Mr. Tyldesley Jones, for the Railway Companies, asked many questions and made points, but it was clear he was neutral rather than in opposition.

On Tuesday eminent engineers were heard, all confirming the good opinion we have formed of the Welsh water power, and finally there was a remarkable speech from Mr. Tyldesley Jones, in which he, in the railway interest, opposed the formation of a Joint Electricity Authority. It was expected that the inquiry would finish at noon on Wednesday.

Mr. J. H. Dickson, town clerk of Chester, in opening the case for the Chester or "B" scheme, said that a preliminary survey of the area showed great diversity of industrial development and population. The area was approximately 4,000 square miles, with a population of about 900,000, and a rateable value of more than four and a half million pounds. It embraced really two distinct districts. The Corporation arranged that all common interests should be grouped, but provision was made against one authority being able to swamp the Board. It was thought that only one-fourth of the authorities and persons who had the right to be represented on the Board would join in the first instance. It was believed that the rest would eventually join. It had been agreed that the railway companies should have small representation on the proposed Board, which in that way would have the benefit of the co-operation and assistance of their technical experts. The Corporation had considered it of the utmost importance that the Joint Electricity Authority should not in the initial stages be overweighted with capital outlay; it therefore did not propose that the authority should buy out any existing generating stations or interfere with the North Wales Power Co. in its existing operations. Hydro-electric generating stations involved a much greater capital outlay than steam stations. In addition, there would be long lines of transmission through sparsely populated districts which would require very little current, and the expenditure would have to be incurred straightaway at present inflated prices. Therefore, the idea of conveying electricity from the west to the east would be entirely out of the question in the early stages. In the meantime the demand for the current in the east was very urgent, and it was believed that the soundest proposal was that the east should at once be developed from an up-to-date steam generating station set up on the banks of the Lower Dee, in conjunction with a series of hydro-electric low-fall stations on the Upper Dee. In the west the North Wales Power Co. would continue to operate. Its transmission lines would be gradually extended over the area, and as the development proceeded, the extension from the east would meet the extension from the west. In the Vale of Clwyd, the southern area of Merionethshire, Montgomery, and a portion of Cardigan, there were many sources of water power, and the proposed authority would, as part of its early work, make careful survey of these natural resources and ascertain how far they were capable of development on an economic basis. The scheme would encourage the development of local efforts such as those at Machynlleth, Dolgelley, and also near Aberystwyth. Certain financial proposals were said to be *ultra vires*. It was essential that the authority should have a financial backing, and provision should be made to meet any small deficit, but there was no reason to fear the provision dealing with that matter. If any deficit occurred during the initial stages of the working of the scheme, provision was made to enable the repayment to be made to the authorities out of a reserve fund, which could be built up from future surpluses. The North Wales Power Co. had lodged an objection, claiming that the Chester scheme was fundamentally unsound. The Dee Fishery Board had also made an objection on the ground that the fishing would be ruined. The assertion in the objection that the Chester hydro-electric works had proved a detriment to the Dee salmon fisheries was not admitted.

Mr. Dickson enumerated authorities in Cheshire which supported the scheme, and said that Wrexham borough supported the policy of public control embodied in the Chester scheme, but did not wish that a steam generating station should be erected unless the Commissioners were satisfied that it was absolutely necessary. It also desired compensation for discarded generating plant, but that was not a proposal that the promoters could accept. They were, however, satisfied that the different authorities could be supplied with electricity in bulk at such a price as would enable them to discard their generating plant without undue loss. Connah's Quay Urban Council contended that the administrative part of the scheme was repulsive, and alleged that the technical portion of the scheme was not conducive to a cheap and abundant supply of electricity. Rhyl Urban Council desired to perpetuate the old parochial system. He gathered that the eastern district supported the principle of public control and favoured scheme B. Several county councils were against public control and against scheme B.

At this point the chairman intimated that only those authorities and interests who had made representations on the Chester scheme would be allowed to cross-examine witnesses, with the exception of the Ministry of Agriculture and the United Westminster Collieries, Wrexham, both of whom had been unavoidably prevented from making such representations.

Mr. E. Noel Humphreys, of Chester, who was for a year the chairman of the Chester Corporation Electricity Committee, and who, since his resignation from the council, had been co-opted as a member of the committee, then gave evidence. He stated that he was until 1918 the managing director of the North Wales Power Co. His evidence-in-chief covered the points referred to in Mr. Dickson's opening, and dealt with the changes in the scheme which had been made as the result of negotiations and conferences subsequent to its being filed with the Commissioners. The proposed Joint Electricity Authority would at first comprise 74 members. The financial clauses need not alarm any of the authorities. The North Wales Power Co. had been invited to all the conferences that had been held, and there was power under the scheme for it to come in.

In reply to the chairman, Mr. Humphreys said there was a very serious fall in the rainfall in 1915, and that drought would have been disastrous to the east portion of the district had it then relied upon a supply from hydro-generating stations. A committee representing the Chester Corporation and other authorities had been negotiating with the Government to take over the steam generating station at the Government factory, Queensferry, and an arrangement was expected to be concluded without delay.

Mr. Humphreys was cross-examined by Mr. Harper, for the North Wales Power Co. Asked whether he would expect a public control scheme to be adopted even if the current supplied under public control was more costly than that supplied by a private company, witness replied affirmatively, provided the disparity were not too great. He would prefer the private supply, assuming there were permanent guarantees of quantity and price. He saw no reason why a publicly-controlled authority should not provide power as cheaply as the Power Co.

Mr. Tyldesley Jones, K.C., who appeared for all the railway companies concerned, except the Cambrian, inquired whether it was proposed to make uniform charges for current in all parts of the area. Mr. Humphreys replied that the supply was not expected as cheaply in the eastern area as many consumers in the west were already getting it.

Referring to Mr. Humphreys's statement that this was not the time to purchase generating stations, Mr. Jones asked whether it was meant to purchase undertakings at a later date. The witness replied that the North Wales Power Co.'s scheme disclosed some capital outlay valuation figures and estimates of expenditure, which—particularly the valuation figures—were considered by the promoters of the Chester scheme as inflated. It was not contemplated to purchase any other generating stations.

Replying to Mr. A. Moon, representing the Dee Conservancy Board, witness denied that the proposed weirs on the upper Dee, nine in number, would ruin the salmon fishery of the river. The promoters had expert advice on that matter.

Mr. W. O. Jones, clerk of the Anglesey County Council, suggested that if his county joined the proposed electricity district it could not expect a better supply than was available from the Power Co., and the witness concurred. He could not agree to priority of supply being given to areas not already provided for.

The inquiry was adjourned.

The examination of Mr. Humphreys was resumed on Wednesday morning when Mr. Cowley, of the Northwich U.D.C., further questioned him as to whether under the scheme the County Council would levy the rate for any deficiency on the whole county or for any specific district. Mr. Humphreys said that in the case of a county council it would be paid out of the general county fund. He was not prepared to accept an amendment giving urban authorities the same facilities for contracting out as county councils.

Mr. H. C. Vincent, representing the North Wales quarry owners, who, he said, were the largest users of electricity in the district, asked the witness if any local authority would accept any financial responsibility. On this point the witness had no information to give beyond what he gave in evidence. The large consumers in the western area were not approached on the matter further than inviting them to the conferences. So far as the west was concerned, they did not propose to carry out any operations.

How do you propose to carry out your obligations in the west?—We can help you to come to reasonable terms with the Power Co.

Yes, but supposing you fail, what would happen then?

The Chairman: If there was failure to supply there would be legal power to remedy the matter.

Mr. Humphreys said that under Section 14 of the 1919 Act there were means of bringing pressure to bear through the Commissioners on the Power Co. He could not conceive that such circumstances would arise, as they were being supplied already.

Mr. Johnson: Then I come back to the original point. What advantage would it be for us to come in as a contributing authority under this scheme? We should get our electricity from the same source, and we should have the doubtful privilege of contributing towards your deficiency when it occurs, which we do not consider an advantage.—You would have that under either scheme.

Mr. T. Amos Jones, clerk to the Rhyl Urban District Council, said that his council objected to the scheme. He noticed that the district would not be developed at the commencement of the scheme. Mr. Humphreys said that it would be left to the authority to develop the district later. He was satisfied as to the estimated charges of 1¾d. to 2d. per unit. They were not prepared to insert a clause for a maximum charge, as it generally became a minimum charge.

The Chairman (to Mr. Jones): If you join you will have a voice in the direction of affairs.

Mr. Jones: And if we join we will be taking on an unknown responsibility. So far as Rhyl and Denbigh were concerned, he said, the scheme was not a commercial proposition. Rhyl was capable of generating its own supply, and could also supply the district around if necessary.

The Chairman said the Commissioners would have due regard to that wish. Pending developments, if places like Rhyl desired to dispose of their surplus energy the authority set up could consider it.

Mr. Nethersole, clerk to the Connah's Quay U.D.C., said his council had decided to support the North Wales Power Co.'s scheme with certain amendments.

Mr. Lawson Taylor, town clerk of Wrexham, questioned Mr. Humphreys on the proposals to scrap existing plant without making any provision for meeting outstanding loans.

Mr. Humphreys replied that he did not think there was any hardship. They would have the advantage of cheaper electricity, which would make it a commercial proposition to scrap the works rather than carry them on at a loss. It was thought better to provide electricity at such a price that places like Wrexham would find it cheaper to buy in bulk than carry on their own works.

In replying to Mr. Williams, clerk to the Chester Rural Council, who suggested that any deficit should fall upon the consumer rather than the general ratepayer, Mr. Humphreys said the latter arrangement was devised in order to give the proposed authority better financial support, and to enable money to be got on the best terms.

Mr. Cartwright, clerk to the Nantwich Rural Council, said his council desired it to be made clear that those who used the electricity should be made to pay for it, and that the burden of any deficiency should not be put upon rural areas which could not obtain a supply of electricity.

Sir Harry Haward inquired what authorities had passed resolutions supporting the scheme.—No authority has distinctly supported the scheme except Chester.

In reply to questions as to what inducement Chester had to offer the various authorities to come into the scheme, Mr. Humphreys said that by managing and owning their own electricity the authorities would be able to control the price and have the advantage of any surplus that might accrue. He placed great stress on the authorities concerned taking the financial responsibilities of the undertaking, and said that, if possible, the rates should not be resorted to. The prospect of a deficiency rate was somewhat remote.

The Chairman: With regard to the capital involved in the scheme (£914,000), do you consider there would be any difficulty in raising the money?—No; of course it would depend on the money market.

Replying to further questions by a Commissioner, Mr. Humphreys said he was aware that the North Wales Power Co. was not purchasable. On the other hand, if the Power Co. wished to give a supply in bulk to other than authorised undertakings in any local government area, it would have to proceed by a special order from the Commissioners, or alternatively, by Act of Parliament.

Can you realise what would be the relations between the Joint Authority and the North Wales Power Co. seeing that they are not purchasable?—We hope it will be one of friendly co-operation so that the area will get the fullest benefit.

The Chairman: There are apparently two things which make you shy of water power—occasional drought and the unreliability of transmission lines. If you were assured that the water power was so developed as to make provision for adequate storage so as to eliminate the risk of even an unusual drought, and you were assured by your technical advisers that your fears as to transmission lines were groundless, would you then be prepared, if it were cheaper, to take your supply for the eastern area from the water power?—Until experience has proved we are wrong we think not.

This ended the examination of Mr. Humphreys, who had been in the witness chair about eight hours.

Mr. S. E. Britton, M.I.E.E., electrical engineer to the Chester Corporation, was the next witness. Examined by Mr. Dickson, he dealt with the scheme from its technical aspect, and said that the development of electricity in the district had been slower than it ought to be, owing to the absence of power supply. A cheaper rate for electricity would tend to increase the demand, as there were great possibilities of industrial development, and also of the use of electricity in agricultural areas in the same way as had taken place in Herefordshire. The water-power in the area was of such magnitude that if developed it would tend to economise the generation of electricity in large quantities. The Chester scheme embraced the utilisation of the river Dee by constructing low-fall hydro-electric stations and the erection of a steam generating station on the Dee, which would act as a safeguard against failure of supply. He considered it essential to prevent any risk of interruption of supply. Dealing with the objections of the Fisheries Board, he said that in the erection of the weirs on the Dee they proposed to provide fish passes similar to the one in existence, and there was no evidence that the weir was detrimental to the salmon or salmon fry. Witness also described the water power source in the Vale of Clwyd.

The Chairman: You heard the objection made by Rhyl that they were able to look after the district themselves. From the figures given in the Chester scheme the average cost per unit was 6.794d. From what you say now the cost would be reduced by about one-half if water power were utilised?—Yes.

Mr. Britton then went on to state that until they got their proposed power station they would get the current they required from the Queen's Ferry factory. He gave figures of the expected consumption, and the expenditure of the £914,000 involved in the first period of development. The cost of a six-wire transmission line would be £2,300 per mile, and for a single line £1,800 per mile. The cost per unit at first would be 1.369d., which would be reduced to 1.029d. in five years. In the first five years the total cost would be £472,650, with estimated receipts of £517,500.

The Chairman: So the net profit would be £45,000 after all capital charges, new plant, and transmission lines had been provided for?—Yes.

Mr. Britton was then cross-examined by Mr. A. T. Miller, K.C., representing the North Wales Power Co., on the proposed construction of the low-fall power stations and the weirs on the river Dee, and as to the figures he had arrived at in estimating the flow of the river, and the electricity that would be generated, especially in reference to the fact that in the summer the river had very little flow.

Mr. Britton described how he had arrived at his estimates, and said he had caused gauges to be placed in the river at various points.

At this stage the proceedings were adjourned.

Mr. Britton's cross-examination by Mr. Miller was continued when the inquiry was resumed on Thursday morning. Questioned regarding the capacity of the proposed new low-fall plant to be constructed on the Dee, as given in his report to the Board of Agriculture and Fisheries in 1919, he agreed that the maximum was 6,505 kW and the minimum 929 kW, the minimum being a seventh of the maximum, not a fourth, as had been stated previously.

Mr. Miller then questioned witness as to his figures regarding the maximum and minimum flow of the river, and witness replied that the maximum was 75,000 cu. ft. per minute, and the minimum was 11,000 cu. ft. per minute.

Mr. Miller: Can you tell me in arriving at those figures which add up to 929 kW average per month minimum output what efficiency factor over-all have you calculated on?

Mr. Britton: Over-all 65 per cent.

Mr. Miller: Have you got before you the details of that over-all efficiency, because I desire to challenge it?

Mr. Britton: No; I have not the details here in connection with the scheme.

Mr. Miller: My experts put it down under the low-water conditions which are, of course, special ones, at 33 per cent.

Mr. Britton: I must challenge that until I am satisfied it is correct.

Mr. Miller: It is a very serious difference, and I must inquire into it a little. These are, I assume, your steps. First your turbine, then your gearing, then through the gearing to the direct-current generator and over the direct transmission lines which go into the motor generator at the central station, passing it to the step-up transformer, which delivers your current. Are you able to tell me what your allowance is for each of those items, starting with the turbine and taking them in order?

Mr. Britton: Including the turbine, gearing, and direct-current generator, 65 per cent.

Mr. Miller then put a series of questions with a view of challenging this figure, when the chairman interposed, and remarked: "I do not want for one moment to protect the witness, but the Commissioners have very full opportunities of examining such efficiency curves as you refer to, and are able to check them. Your point, Mr. Miller, is with only one-seventh of the flow the efficiency of the six stages to which you refer, from turbine to step-up transformer, will not be as high as 65 per cent., which the witness has stated, and that, in fact, it will not be higher, in the opinion of your experts, than 33 or 35 per cent. I have made a note of that, and we will pay particular attention to the point. I would like you to give us this if you will. If your experts give the opinion that the 33 per cent. is for the six stages, would you give it for the three stages. That is, for the turbine, the gearing, and the direct-current generator, so that we may have a comparative figure with the 65 per cent."

Mr. Miller: I will get that worked out for the three stages. As they stand separately they are 55 per cent. turbine, 95 per cent. gearing, 85 per cent. direct-current generator. The direct-current transmission we put at about 98 per cent. efficiency, the motor generator at 81 per cent. efficiency, and the step-up transformer at 95 per cent. efficiency.

The Chairman: I suggest there must be some little mistake there; if you suggest that for a direct-current generator with that particular load the efficiency is only 85 per cent., can the motor generator be as high as 81 per cent.?

Mr. Miller: I will ask my experts to consider that. The total worked out on all these calculations will be 33 per cent.

Mr. Miller: In regard to your £65,000 outlay on a small station in the Vale of Clwyd, you place the kW capacity at 1,000 in 1930. Is that the demand which you expect to supply from the Vale of Clwyd?

Mr. Britton: That is the figure as to the potential supply of the district. After further technical questions on this point, the chairman interposed and said: May I put this question to you? In your scheme you have not made any provision up to 1930 for any connection between Rhyl and the Vale of Clwyd hydro station with any other part of the general transmission system in the eastern district.

Mr. Britton: That is so, the figures do not include a connecting link between the river Dee and the western district.

Questioned by Mr. Miller as to the cost set down in the scheme for producing 15,300,000 units, fuel would cost £23,900, and the cost would be .375d. per unit generally, Mr. Britton replied that the cost was based on 2d. per unit generated for coal at 35s. per ton.

Mr. Miller also questioned the witness's figures of a capital outlay of £27 10s. per kW, and asked for the detailed figures, which the town clerk of Chester promised would be supplied. In regard to the item £28,875 for capital charges which was questioned, the chairman pointed out the figure was based upon the tables for loans which the Commissioners invariably grant, the amount of interest being 7¾ per cent.

The Chairman: Supposing that it be a fact that there is surplus water power which can be generated in the west and which cannot be wholly utilised in the west, and supposing as you have said that the transmission lines can be erected at such a cost that energy can be economically delivered to the east, is it your opinion as an engineer, and would it not be your wish as one of the promoters of this scheme, that such transmission lines should be laid as soon as possible and the energy supplied to the east?

Mr. Britton: Certainly, sir. The whole point is, we are not in a position to put forward an opinion on that particular point, as we have not the detailed information. There is nothing else in it. If it can be shown that the west can generate large quantities of power there and send it to the east at a proper charge, we are quite prepared to say it would be the proper thing to do, but that is the point—we have not the information.

Mr. Tyldesley Jones, K.C., on behalf of the railway companies, then cross-examined Mr. Britton, and said he would like the witness to explain what this paragraph in his scheme meant: "The electrification of railways is considered an important national matter, and having regard to the exceptional circumstances existing in this district for the generation of cheap electrical energy this is worthy of early serious consideration."

Mr. Britton: First there is a coalfield in the area, adjacent to a river, enabling a steam generating station to be put up and electricity produced in very large quantities at a very low rate. Then you have the water power, as submitted by the Power Co. in the west. Those two conditions, I think, are peculiar, and do offer facilities for generating great quantities of electricity for railway electrification.

In replying to further questions by counsel, the witness admitted that at present Chester was only able to carry its load by means of a battery and occasional overloading of the plant. He also admitted that Chester would not transfer its hydro-electric station to the proposed Joint Electricity Authority, but would use it itself.

Mr. Jones also elicited the fact that it was proposed to lay 123 miles of mains in the first period of development.

Questioned as to the operating costs, the witness said the figures were based upon actual experience of the running costs of the installation at Queensferry.

(To be continued.)

CORRESPONDENCE.

Letters received by us after* 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Reduction in Price of Lamps.

I should like to associate myself with the remarks of Mr. R. J. Scarborough in the last issue of the Electrical Review, and to say that I also have written the E.L.M.A. and notified them that until I obtain a rebate for all lamps in stock on February 1st, 1921, I will sell no more T.L.A. lamps.

The remedy is in our hands, but only by concerted action shall we obtain satisfaction.

If all other retailers so affected will adopt the same plan we shall get the rebate. The travellers will soon be round, and when they find their usual orders missing, they, too, will no doubt press the matter.

C. Culmer Hodges, A.M.I.E.E., A.M.I.Mech.E.,

Electricity Works, Dawlish.
February 15th, 1921.

I should be glad if you could find space for a few words in reply to your correspondents' comments, regarding my letter on the reduction in the price of lamps. Your correspondent Mr. Rudd's suggestion of a clearing house would have left no room for complaints, although even a month or two's notice to the trade would have given retailers an opportunity to arrange their stocks.

As regards your correspondent "Lamp Salesman," one would appreciate his reply had he come out into the open and revealed his identity instead of hiding behind a *nom de guerre*. However, the reason is obvious. But he has forgotten that at the time when the price of lamps was increased there were more important things to be done than sitting in an office or selling lamps behind a counter; hence I had no stocks to increase in value, and no cheque to forward to the lamp manufacturers, so that Mr. Salesman can now be convinced on that point with greater amusement on seeing that he has fired a blank shot. But even if the increased value was given to the trade at the time, no doubt the retailers' stocks were low owing to war demands. It was the makers, and not the retailers, who reaped the harvest. And, after all, the average 25 per cent. discount off E.L.M.A. lamps is not a great proposition when breakages in stock, complaints of premature failures, &c., are considered. Since my first letter I have received several letters from contractors and retailers each stating that they have communicated with the E.L.M.A., who have not at present even had the courtesy to reply.

Probably this is mismanagement.

R. J. Scarborough.

North Finchley.
February 19th, 1921.

Wiring in Ferro-Concrete Factories.

The use of ferro-concrete in the construction of buildings opens out new problems in the matter of distribution and wiring systems, and I think it would be of general interest to have the opinions of others as to which is the best system to adopt in factories, built on this principle.

It is held by some engineers that the use of steel tubing in any form, screwed or otherwise, is bad practice, and wood casing, of course, is out of the question. C.T.S. cables strike me as being rather too unprotected for general use, although, of course, ideal for some classes of work, and there are several metal cased wiring systems which no doubt have their supporters. Among the latter is the concentric system with earthed outer, which can, of course, only be used on systems not connected to a general or central station supply.

It would be interesting to have the experience of users of this system with special regard to its reliability and fireproofness.

Inquirer.

February 16th, 1921.

Shop Displays.

The letters under the heading of "Shop Displays" have greatly interested me, particularly those criticising the Electrical Contractors' Association.

I am absolutely certain that all electrical contractors outside the association do not realise the tremendous work that has been done by our united efforts, particularly during the last three years.

They may have been misinformed, like myself, as to the integrity of our leaders. My only regret is that I listened to the tales of a certain wholesaler's traveller (whose name I still remember) instead of seeking direct information myself, and was thereby unduly influenced against the association for some years.

Since joining about four years ago, I have got to know a large number of our members, and find them, particularly our leaders, exceptionally capable and square dealing men who are out for the general advantage of our section of the electrical industry.

I feel heartily sorry for contractors who are qualified and have not joined; they are losing more than they realise, and if I can personally give useful information to any of them I shall be delighted to do so.

H. T. Young.

London.
February 16th, 1921.

Charging Batteries for Motor Cars.

With reference to our communication re battery-charging plant in motor garages, I would point out to your correspondents that our correspondent perhaps did not make himself as clear as he might have done.

What we actually require is a charging system which eliminates the loss by heat or light when using a resistance or bank of lamps. I already have a good system for charging with resistance so that the whole current consumed equals the battery which takes the highest current. This, however, is not what we require, and we should be glad to hear from makers who have a system in which neither a motor generator, nor resistance, nor banks of lamps are used in reducing the voltage from the main.

W. Evans,
Electrician, Rootes, Ltd.

Maidstone.
February 16th, 1921.

A Question of Ethics.

What appears to me to be an unusual breach of advertising ethics appears in your current issue. In the advertisement pages (*i.e.*, page 57 of the Supplement) is a quarter-page advertisement drawing attention to a "write-up" *and giving the page number in your news columns on which it may be found.*

I am not a bit concerned commercially in any type of the machine advertised, but I am concerned in keeping advertising free from base suggestion by its traducers. Thus, while I am justified in asking if this new departure is to be taken as a part of your future policy, I am hopeful that a slip has been made which will not be repeated.

Editorial comment should be quite independent of any advertiser, and, in my opinion, it is both bad for a journal and for advertising generally, when such evidence of prior arrangement between the advertiser and the journal appears in its columns.

W. A. Moore.

London.
February 22nd, 1921.

[We are indebted to our correspondent for drawing attention to this incident. We think it is well known throughout the trade that we hold very strong views regarding the absolute necessity for the completest possible independence to be maintained with regard to editorial contents. The insertion of the reference was not sanctioned either by ourselves or by our advertising manager, and steps have been taken which, we hope, will render a repetition of the incident impossible.—Eds. Elec. Rev.]

A Flashing Problem.

Some time ago two 40-h.p., d.c., shunt interpole motors, both of reputable English make, were moved from one factory to another part of the country; both motors had worked satisfactorily at No. 1 factory, and on starting up after installing at No. 2 factory ran sparklessly until nearing full load, when both sparked violently. The voltage in both cases was 440. The insulation on test was O.K., also a drop test on shunt and interpole coils showed a perfect balance. Nothing would correct this faulty commutator until the interpole circuit was reversed. To do this, the short lead of copper tape from the interpole coil to the + brush arm had to be lengthened to reach the terminal block, showing clearly that the original connection was as intended by the test bed results of the maker. Further, the motors had developed their full rating at No. 1 factory. The motors never gave trouble afterwards, but I never satisfied myself why this alteration was necessary, and should like to hear of any similar experience on the part of any of your readers.

Inquirer.

Referring to "Dense's" letter in the issue of February 11th and the several replies thereto in the succeeding issue, perhaps the following comments may help to clear up the difficulty.

Since the motor runs in one direction sparklessly, it proves that it is not loaded in excess of its commutating power, and that the brushes are of a quality fit to give good commutation results provided the flux element is correctly adjusted.

The fundamental principle underlying correct commutation is that when certain coils of the armature pass from a magnetic zone of one sense to a zone of an opposite sense, during which time the commutator bars to which they are immediately connected are passing beneath a set of brushes, the current in these coils must be reduced to zero, reversed, and built up to an equal strength in the opposite direction.

To bring this about, the brushes are rocked to a position such that during the time the coils are shorted by them, the coils are being cut by a fringe of flux sufficiently strong and of such sense as to build up the necessary reversed current in them before their commutator bars emerge from beneath the brushes.

The position of this fringe of flux tends to vary with every change of current in the armature, and in order to keep the coils within its influence the brushes must be suitable rocked.

The function of the interpole is to compensate for this tendency of the flux to move, and by so doing allow of a fixed brush position.

It would appear that when "Dense's" motor runs sparklessly it does so not solely by virtue of the influence of the interpole, but only partially so, and the discrepancy is compensated for by adjusting the brushes so that the coils catch up, so to speak, the aforementioned fringe of flux.

To make the interpole function properly, its flux strength must be so proportioned to the flux due to the armature ampere-turns that the resultant flux of the interaction of armature and field fluxes will remain at a fixed angle.

If "Dense" will try varying the strength of his interpole flux (as suggested by Mr. Kinch), I think he will find therein the solution to his difficulty.

E. Brown.

London.
February 19th, 1921.

I desire to thank you for your courtesy and your correspondents for their very interesting letters re the above. I have acted on several of the suggestions mentioned, but after I have had an opportunity of looking further into the matter (which may be some little time) I will have pleasure in communicating with you if I succeed in solving the problem.

Dense.

February 19th, 1921.

[This correspondence is now closed.—Eds. Elec. Rev.]

LEGAL.

F. Holbrook & Co. *v.* F. P. Bliss & Sons.

Mr. Edward Pollock, one of the High Court Official Referees, on February 16th concluded the hearing of this action, in which plaintiffs, electrical engineers and contractors, of Foster Lane, Cheapside, claimed from defendants, builders, of Rudolph Road, Bushey, the balance of an account for an electrical installation put into a house called "Oaklands," at the Avenue, Bushey.

Mr. J. B. Matthews, K.C., with Mr. Abinger appeared for the plaintiffs, and Mr. A. Powell, K.C., was for the defence.

Mr. J. B. Matthews, stating the case for the plaintiffs, said that it was really a trade dispute between tradesmen doing similar business as to the cost of doing certain work in relation to the fitting up of a private house with an electrical installation. In April of last year the defendants were doing certain building work at the "Oaklands," into which a lady named Giffard was anxious to move, and plaintiffs received from them a telephone message stating that they wished to have some electrical work done, and in the course of the conversation defendants said that it was a job which ought to cost from £50 to £60. Mr. Holbrook went down to the place and saw Mr. Cyril Bliss, who had the matter in hand. On going over the house and seeing what was required, Mr. Holbrook told Mr. Bliss that it certainly was not a £60 job, and how much it would cost it was not possible to say. It was costly work, as the wires were to be cased in steel tubing laid not on the surfaces but in chases to be made in the walls. The work was put in hand, and the result of the anxiety of the lady to get it done quickly was that men had to work night and day which involved extra outlay for labour at overtime, and while the work was in progress Mrs. Giffard wanted a good many things done in a way different from that which was originally intended. Indeed, said counsel, she exercised a lady's privilege of changing her mind and having things restored to the original condition after she had altered them. Beyond the electrical installation for lighting there was an establishment of points for the purpose of radiators being fixed, and there was a special estimate for the rewiring of the electric bells. The end of it was that the total amount of the work, including a costly list of fittings chosen by the lady or her husband, came to £275, against which there was a cash credit of £179. The plaintiffs, however, arrived at the balance of £96 by making the largest possible concessions in favour of the defendants. The issues to be tried, said counsel, were two: First, that there was a contract that the work should be done for £60, and secondly, there was a question raised with regard to the wiring of the bells. It seemed that the working did not turn out satisfactory, and it was found by plaintiffs that water had got into a portion of the work, but for that plaintiffs were in no way responsible. Defendants further said that the work was not done so well as it ought to have been done, and in respect of that they made a small counter-claim of some £14.

Plaintiff gave evidence in support of the claim, and witnesses were called to testify to the details of the work done, with additions occasioned by alterations ordered by Mrs. Giffard, the owner of the house. Several electrical engineers also gave evidence as to the efficiency of the installation and the moderation of the prices charged.

For the defence, Mr. Robert Giffard and Mrs. Giffard, the occupants of the house, were called, and while complaining of the cost of the work, asserted that the bells were left in a defective condition. Mrs. Giffard denied that she had caused a great deal of extra work, but admitted that she had caused alterations to be made after the lights had been fitted.

Mr. Cyril Bliss, who had charge of the work at Oaklands, stated that he left the work of electrical installation entirely to Mr. Joseph Holbrook, and took no responsibility for it. Mr. Holbrook's price of £60 was not, he said, to include the cost of the fittings, and the order for putting in the wires for the bells was given afterwards. When the bill was sent in it was three times as large as he expected, and when he took it to Mr. Giffard he told him how disgusted he was at having to ask for so much money. Accounting for what he termed the heavy charges for labour, he said that at starting there were four men walking about the building and doing nothing but mark the walls with crosses during the whole of one day because they had brought no materials with them, and the materials were brought down in "dribs and drabs" at different times.

In cross-examination, he said he told plaintiffs that it was a heating as well as lighting job of 28 points, but it turned out that there were 32 points for lighting and four radiator points. He admitted that it was not true to say that the men came down without any materials, because they did bring a bag down with them. He was thoroughly disgusted with Mr. Holbrook's charges, but in a postscript to a letter he had told them that he would pay their bill as soon as he obtained a settlement from his client. He said nothing about excessive charges.

Expert evidence was called on the question of the alleged excessive charges, and in the result

The Official Referee, in giving judgment, said that £50 had been paid into court, and the question was whether that was sufficient to cover plaintiffs' claim. When Mr. Holbrook went over the premises he said the job was quite different from that which he had expected, and it could not be done for £60. He declined to give an estimate. There was no mention in any letter that there had been an agreement to do it for £60 or any other amount, nor was anything said about it when plaintiffs pressed for payment. He (the Referee) could not help coming to the conclusion that the evidence of Mr. Holbrook was right and the evidence of Mr. Bliss was wrong. As to the prices, there were great differences of opinion, but that was what must always be expected where experts were called. A detailed account had been sent in, and no one had been able to say that the materials charged for had not been used, and no one had taken the trouble to ascertain whether the charges were excessive. Mr. Holbrook had, however, said that the charges were fair and reasonable, and he could not accept the suggestion that there had been any overcharge. A considerable amount of time had been spent over the suggestion that the use of slip-sockets was wrong, but there was abundant evidence to show that they were used almost universally. As a result he found that the plaintiffs had made out their claim, and there must be judgment in their favour, the £50 paid into court to be paid out to them in part satisfaction.

Judgment was accordingly entered for the plaintiff, with costs on the High Courts scale.

Watson, Marsh & Co. (Hampstead) v. Cohen.

In this action, which was commenced in the Chancery Division by Mr. Justice Eve on February 16th, and concluded on the following day, the plaintiffs, according to Mr. Clayton, K.C., who appeared for them, sought to obtain an injunction to restrain the defendant from committing a breach of an agreement entered into in August, 1917, in which there was a covenant that he should not, for a period of five years from the completion of the purchase by plaintiffs of a business at Golders Green Road which he had sold to them, carry on or engage in the business of an electrician within a certain radius of Golders Green Road. Defendant, however, who was now trading as an electrician at Cheapside, in the City, had a house near his old premises at Golders Green, and he there used the same telephone number as he had used previously in his business.

His Lordship, in the result, after hearing evidence, gave judgment for the defendant.

Llanrwst Electricity Supply Co., Ltd.

At the Festiniog County Court, last week, an application was made on behalf of a petitioner for the winding up of this company. Mr. Latimer Jones, of Llanrwst, appeared against granting the petition. He stated that he represented four-fifths of the value of the company's shares. Judgment was reserved.

British Electrical Federation, Ltd.

In the Chancery Division, on February 16th, Mr. Justice Astbury confirmed an alteration of the objects of the British Electrical Federation, Ltd. Mr. N. Greene said the company did not carry on business at a profit. Its sole business was protecting and assisting its members who comprised a large number of electrical firms, and it was found desirable that the company should act as trustee in respect of matters such as superannuation pensions and debenture issues of its members. The company not being a trading one had no creditors.

BUSINESS NOTES.

Bankruptcy Proceedings.—James Sherred Denley (trading as Denley & Co.), cycle dealer and electrician, 69, Regent Street, Cheltenham. The following are creditors in this case :—

Callender's Cable Co., Ltd. ..	£21	Wholesa'e Electric Co., Ltd. ..	£11
General Electric Co., Ltd. ..	34		

Charles Carlisle Thompson, 78, Salisbury Street, Kingston-upon-Hull, plumber and electrician.—The public examination of this debtor was recently held at Hull. The statement of affairs showed liabilities £295, against assets £14. Debtor attributed his position to losses on contracts, illness of self and family, and heavy household expenses. The examination was closed. The following are creditors herein :—

Danby & Co., Ltd...	£145	Singleton, Frank	£46
Darby, Ltd., Jas.	37	Hull Corporation Telephones ..	11
Morley, T. B.	36	Bankers	10

J. V. Bell, electrical engineer, 21, North Bar Within, Beverley, Yorkshire —First meeting, March 1st, at Official Receiver's office, Hull. Public examination, March 14th, at the Guildhall, Hull.

J. W. Gladwin, electrical engineer, Sheffield. — Trustee, Mr. C. Turner, 155, Norfolk Street, Sheffield.

Company Liquidations.—Mutual Electric Trust, Ltd.—Winding up voluntarily. Liquidator, Mr. A. E. Wake, Norfolk House, Laurence Pountney Hill, E.C. 4. Meeting of creditors, February 28th, at Laurence Pountney Hill.

Trade Announcements.—The Dawson-Manley Engineering Co., of 24, Hatton Garden, London, E.C. 1, desires to receive catalogues from the electrical trade.

Messrs. A. W. Sainsbury, Ltd., engineers and electrical contractors, Sheffield, celebrated the firm's coming of age by removing into new premises built for them in Campo Lane (Sainsbury's Buildings). The firm desire to receive up-to-date catalogues.

The Ironsides Co., of Columbus, Ohio, U.S.A., has just established an agency in this country for the sale of the Ironside roll neck and gear shield greases, which are extensively used in U.S. rolling mills. Mr. John Hanlon, 61a, Bold Street, Liverpool, has been appointed sole European agent for all the Ironside specialities.

Messrs. Cleworth, Wheal & Co., Ltd., of Castleton, Manchester, manufacturers of air filters, coolers, humidifiers, &c., are now represented in the London district by Messrs. Williams, Pell and Baring, of 5, Chancery Lane, W.C. 2.

Catalogues and Lists.—The Premier Accumulator Co., Ltd., Cattle Market Road, Northampton.—A well-illustrated catalogue of accumulator batteries, giving a number of views of installations. Fully priced.

Messrs. Hamnett & Andrew, 127, Grosvenor Street, All Saints, Manchester. List 723, giving particulars of a number of insulating materials, including fibre, ebonite, mica, silk and cotton.

Messrs. Isaacson & Brown, Ltd., 39, Furnival Street, Holborn, E.C. 4.—A priced and illustrated leaflet of "Bettalite" bowl fittings.

Messrs. S. Smith & Sons (M.A.), Ltd., 179-185, Great Portland Street, W. 1.—Literature describing the "K.L.G." spark-plug, and giving details of a competition being organised among users of this plug.

Fuller's United Electric Works, Ltd., Iddesleigh House, Caxton Street, Westminster, S.W. 1.—Lists Nos. 91, dealing with dry batteries, giving dimensions and prices; 95, miners' lamp accumulators—describing manufacture; 97, price list of plate-type lighting accumulators; and 104, illustrating and describing Fuller's patent inert cells.

Messrs. Spalding & Hodge, Ltd., Drury House, Russell Street, W.C. 2.—Illustrations of various types of motor-lorries.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Leaflet No. O 2,641, illustrating and describing the "Klersite" dynamo for lighting commercial vehicles. Installation Leaflet No. P 2,450, an illustrated description of a 1 750-kVA low-speed alternator for a water turbine. Pamphlet No. F 2,475, a price list of "Superlux" ornamental glassware for lighting; priced and illustrated.

Simplex Conduits, Ltd., Garrison Lane, Birmingham.—An illustrated booklet giving constructional details of the "Plexsim Royal" electric vacuum cleaner. Priced.

Hart Accumulator Co., Ltd., Marshgate Lane, Stratford, E. 15.—A price list of a number of types of "Hart" starter and lighting batteries.

SWEDISH GENERAL ELECTRIC, LTD., 5, Chancery Lane, W.C. 2.—Stock Lists Nos. 28 and 29, dealing respectively with d.c. type "K" motors and single phase "Century" motors, and two- and three-phase motors. Fully priced.

MESSRS. BRUCE PEEBLES & CO., LTD., Edingburgh.—"Les Convertisseurs en Cascade 'Peebles,'" Brochure F 20, an illustrated list (in French) dealing with the construction and applications of "Peebles" converters.

THE ELECTRIC HEATING CO., George Street, Croydon.—An illustrated and priced pamphlet dealing with "Elect" irons, including a tailor's "goose" type.

MESSRS. E. BROOK, LTD., Empress Works, Huddersfield.—List 53, giving details and prices of Brook three-phase mine motors.

MESSRS. MARSH & SANDERSON, 35, Station Road, Ossett, Yorks.—An illustrated leaflet describing "M & S" safety switch covers for protecting switches from mechanical damage.

MESSRS. SIEMENS BROS. & CO., LTD., Caxton House, Westminster, S.W. 1.—A new supplement (No. 3) to the firm's catalogue of wire and cable (No. 532), dated February, 1921, and giving prices, &c., of cab-tire sheathed cable and flexibles.

ERITH'S ENGINEERING CO., LTD., 83, Kingsway, London, W.C. 2.—A 24-page well-produced booklet fully illustrating and describing Erith-Roe three-stage combustion stokers, supplementary firing with waste gases, mechanical coal-handling and stoking for vessels, and Erith's feed-water heater and purifier.

THE WALTHAM MANUFACTURING CO., 2, Jackson Road, Holloway, N.—Priced leaflet dealing with lantern arc lamps.

MESSRS. TODMAN, RYALL & CO., LTD., 38, Grosvenor Gardens, Westminster, S.W. 1.—Illustrated and priced catalogue describing the general construction of "L W" dynamos and motors, and giving h.p. or kW and various speeds.

Swedish Foreign Trade.—According to the foreign trade returns of Sweden, the imports and exports in the past two years included the following :—

IMPORTS.	1919. Tons.	1920. Tons.
Electrical generators, motors, stators, accumulators, &c.	4,088	12,716
Safety apparatus, rheostats, &c.	428	791
Glow lamps	215	262
Electricity meters	3,864	4,367

EXPORTS.	1919. Tons.	1920. Tons.
Electrical generators, motors, stators, &c. ...	11,330	18,190
Telephone and telegraph apparatus	10,022	10,675
Steam turbines	3,485	3,793
Hydraulic turbines and water-wheels ...	1,358	1,086

For Sale.—By direction of the Disposal Board, Mr. C. D. Phillips will sell by auction on March 10th, at Swindon, machine tools, electrical plant and fittings, &c. On March 15th, 16th, and 17th, at Newport, Mon., machinery, office furniture, and canteen equipment, and on March 22nd and 23rd, at Bristol, a quantity of shipbuilding plant, electric generators, motors, cables, &c., lying at Beachley, Portishead, Portbury, Bath, &c.

Messrs. J. Pearce Pope & Sons will offer by auction on March 11th, at the National Filling Factory, Quedgeley, Glos., plant, machinery, building material, &c.

Beckenham Urban District Council Electricity Department has for disposal one 120-kW Belliss-Fowler alternator and exciter.

Wolverhampton Corporation Electricity Department has for disposal eight steam driven "E" type underfeed mechanical stokers, with hoppers, &c. See our advertisement pages to-day.

We have received a catalogue of motor accessories which are being offered in a special clearance sale by MESSRS. S. SMITH & SONS (M.A.), LTD., until March 7th.

German Firms in Luxemburg.—It is reported that the Siemens-Schuckert Co. proposes to follow the example of the A.E.G. and establish a branch in Luxemburg.

Exhibition at Algiers.—An Exhibition Fair will be held at Algiers from April 16th to May 8th. This exhibition will be installed on a site of about 10 acres in a suburb of the town. The principal exhibits will comprise food products, various industries, native industries, textiles, metallurgical industries, &c., automobile and motor-culture industries. Application for stands and all information should be addressed to Monsieur C. Granier, 1, Boulevard de la Republique, Algiers. We have received a copy of the prospectus.

Competition in Portugal.—"Conditions of sale" are an increasingly important factor in trade operations with foreign countries, in view of exchange and other difficulties. Attention has already been drawn to complaints at the stringent terms required by British manufacturers in comparison with those of other nations, and particularly of Germany, and to the consequent danger of loss of trade. The following instance, quoted by the F.B.I. representative in Portugal, proves yet again the urgency of the question. An important Portuguese company recently invited tenders for the supply of machinery of which it was in need. The British firms tendering asked for half payment with order and the remainder on shipment of the goods. The order was finally placed with a German firm in Spain whose terms were far more favourable. The machinery was delivered by this firm, and had been for three weeks on the wharf before any question of payment arose. A member of the Portuguese company then called on the German firm and was informed that as the Spanish exchange was so bad at present for the Portuguese firm, they were quite willing to await payment until it was more favourable to the purchasers.—*Bulletin* of the F.B.I.

A New German Development.—A further movement in the German electrical industry is impending, as a result of the announcement that the A.E.G., of Berlin, and the Linke-Hofmann Works, of Breslau, have decided to enter into a community of interests by means of an interchange of shares for 30,000,000 marks. The former will make a new issue of shares for 30,000,000 marks for this purpose, even if the emission should not assume larger dimensions, while the share capital of the latter is to be raised from 64 millions to 120 millions of marks, so as to effect the interchange and for other purposes; and there will be a mutual election of directors on each company. As one of the largest locomotive works in Europe, the Linke-Hofmann Co. entered into a close connection with the Lauchhammer Iron and Steel Co. in 1920, and thus became assured of a supply of raw materials. The transaction with the A.E.G., which has been aimed at by the latter for some time past, is understood to have in view unity of action in connection with electric railway problems which are pending in various countries in Europe. The Breslau Works are considered suitable also for the construction of electric locomotives and wagons, while the A.E.G. would be a large customer for the former's special manufactures, which apart from steam locomotives, include compressors, winding engines, turbines, &c.

Lead.—In their report dated February 19th, MESSRS. JAMES FORSTER & CO. state :—"There has been a fair amount of business this week, chiefly for prompt, but makers of red, white, and sheet lead report that the demand from the building trade is very poor, and worse than it has been for some months past, which is somewhat surprising, in view of the building which is going on. On the other hand, the electrical cable trade is well employed, and is likely to remain so for months ahead. Export is stagnant."

Ex-Service Men's Bazaar.—An Ex-Service Men's Industrial Bazaar has been opened at 52, Conduit Street, London, W., and is full of interesting and useful things, says the *Daily News*, including a pleasing display of art lamps and electrical domestic apparatus.

Key Industries.—The *Birmingham Post*, in a forecast of the Government's new Trade Bill, designed to protect key industries, prevent dumping, and remedy the disturbance caused by collapsed exchanges, says it is possible that the measure will be introduced into the House of Commons for a formal first reading this week. "The scheme proposed by the Board of Trade is that an import duty shall be placed on the goods sent from countries with collapsed exchanges, not with the intention of cutting out competition, but to give our manufacturers a fair chance with the home markets. The duty, which will seek to establish a parity between the price of the imported goods and the price of the home-made goods, will rise or fall with the exchange rate, the variations being arranged over a period of weeks, and not day by day. The schedule of 'key' industries included in the Bill will practically be the same as the schedule in the previous Bill introduced by Sir Auckland Geddes when he was President of the Board of Trade. The list includes at least two items of importance to the Midlands—magnetos and hosiery needles—while fine chemicals is another item in the schedule. While this part of the Bill is very much the same as before, the clauses dealing with dumping have been considerably modified. The Board of Trade will not be given absolute authority to deal with dumping, as would have been the case had the previous Bill become law, and the safeguards provided will, it is hoped, meet the objections of many Free Traders. The proposal is that an independent Committee shall be set up to examine complaints about dumping. This Committee will report its findings to the Board of Trade, which has the authority to act upon the recommendations made."

25th Anniversary.—We congratulate MESSRS. ERNEST F. MOY, LTD., of Greenland Place, Camden Town, N.W., on having attained their 25th anniversary. In celebration of the event, a company of nearly 100 sat down to dinner last Saturday, under the chairmanship of Mr. Ernest F. Moy. After a programme of music and song had been rendered, Mr. W. B. Dykes proposed "The Firm," which he said was launched by Mr. Moy and a few gallant stalwarts in 1895. He referred to the great strides which the firm had made. The employés had put their backs into the work, and were always ready to adapt themselves to circumstances. They did not go to America for their foremen, they were all the developments of the firm. The employés wished to express their appreciation of the managing director, Mr. Moy; and Mr. Dykes, on their behalf, presented him with a cut-glass silver-mounted tantalus. Mr. Moy responded. Mr. P. H. Bastie, one of the directors, proposed "The Visitors," and Major Tegetmeier responded. Having watched the development of Messrs. Moy's business since the day of small things in 1896, we wish them a record of even greater progress and prosperity during the next quarter century.

Patent Application.—Application has been made by MR. J. D. HAWORTH for the restoration of patent No. 2,045, of 1915, for "Improvements in electric accumulators."

Australian Prohibition of Bosch.—In June last the Australian Commonwealth Government issued a proclamation prohibiting the importation into the Commonwealth of magnetos bearing the word 'Bosch." The restrictions against the firm which employs this title have now been extended, and all goods bearing the word 'Bosch" have been placed on the prohibited list by the Department of Customs.—*Reuter's Trade Service* (Melbourne).

German Electrical Trade.—The correspondent in Germany of the Federation of British Industries has reported on the progress of German engineering and electrical industries, and in the issue of the *Bulletin* of the Federation for February 15th, the following notes appear regarding the electrical situation :—

"As a result of the reduction in the supply of coal to all industries, there has been a considerable increase in the demand for electric power. In order to cope satisfactorily with this demand the erection of very large power stations on the coalfields themselves is becoming necessary. At Dortmund the various big electricity works of Western Germany have formed a Committee to draw up a plan for the construction of a single giant power station.

"Export trade is much brisker than business at home. In spite of the recent fall of the mark, prices in some branches of the electrical industry are still so high that exports are only possible at prices below those quoted for the home trade. Thus, the Official Labour *Gazette* recently reported that export business in the electromotor, dynamo and transformer industry was increasing, but that all of it was done at very low prices—below those current in the home market.

"The electric cable industry had a bad year during 1920. Goods sold abroad during the first six months did not total as much as 30 per cent. of the pre-war figure and during the last half year fell below 25 per cent. Sales in Germany ceased altogether.

"The position of the lamp industry was rather more favourable. It has always been largely concerned with foreign buyers, as about half of its total pre-war production used to be sent abroad. Germany's best markets in those days were Austria-Hungary and Russia. The Osram-Gesellschaft, which is a union of the Allgemeine Elektrizitätsgesellschaft, the Siemens-Halske Aktiengesellschaft and the Auer Gesellschaft, now controls seven-eighths of the German electric light bulb production. It appears to aim at gaining a complete monopoly of this industry. At the end of 1920 this company obtained control of the largest German factory making glass for electric bulbs (the Lausitzer Glaswerke). It is consequently in a very strong position for a struggle with the few factories still remaining outside the combine.

"Generally speaking, the position of the electrical trade may be considered moderately good."

Air Service to British Industries Fair.—Owing to the enterprise of the *Mercantile Guardian*, visitors to the section of the Fair at Castle Bromwich will be able to save time by making the journey by aeroplane. An arrangement has been made with Messrs. S. Instone & Co., Ltd., for service during the period of the Fair ; the aeroplane used will be the famous "Vimy" Rolls-Royce Twin Engine Limousine Type de Luxe, similar to the machine that flew the Atlantic. The seating capacity is for 15 passengers, and the journey will take under an hour. The pilot will be one of those who were engaged on the London and Paris Peace Conference air mail service. Full particulars can be obtained from the General Manager, British Industries Fair, 95, New Street, Birmingham.

War Office and Costings Clause in Contracts.—At the meeting of the Executive Committee of the F.B.I., on February 9th, Mr. Stuart A. Russell made a statement which will be read with interest by members concerning the War Office attitude towards the costings clause in tenders. While other Government Departments have agreed to eliminate this clause, the War Office has hitherto held out for its inclusion. Mr. Russell announced that in the rubber manufacturing trade all contractors had agreed to strike out this clause from their tenders, and that the War Office had accepted the situation.—*Bulletin of the F.B.I.*

Fire at Vickers's Works.—The *Sheffield Independent* states that a fire broke out in the electric welding department of Messrs. Vickers's Brightside Works, Sheffield, on February 12th. The welding shop was entirely burnt out, the hardening shop was damaged, and a 4-ton electric vehicle was also seriously damaged. The cost of the damage is estimated to be about £3,000.

Progress of Peel-Conner Works.—Considerable progress is being made with the Peel-Conner telephone works at Coventry, designed for the employment of 2,000 hands. The premises are laid out for the production of the whole range of apparatus required in the telephone industry, from a complete exchange to a small domestic set. The company is also engaging in the making of ebonite and preparing it for various uses.

Trade Conditions in Australasia.—Current trade in Victoria is on a fair scale, despite the shipping dispute. Leather prices are irregular. Trade in general merchandise in Sydney is less depressed, and greater confidence prevails. There are indications that in some cases the bed-rock has been reached. In South Australia trade is steady, but recent heavy arrivals of long-standing orders are restricting speculation. A review of business conditions in Queensland during January shows that trade has been up to the average, with a general decrease in prices. Trade in hardware is dull. There is every indication that the sugar-cane harvest will be excellent. Trade conditions in New Zealand are very fair, and demand on the part of consumers is keen.—*Reuter's Trade Service* (Melbourne).

The Situation in Germany.—The general report on the industrial and economic situation in Germany in December, 1920, recently issued by the Department of Overseas Trade, was sold out within a few days of publication. A further edition has been printed, and the report (Cmd. 1,114) can be obtained, price 9d. (post free 10½d.) on application to the branches of H.M. Stationery Office.

Coal Prices in the London Area.—The Board of Trade has approved a scheme submitted by the London Coal Committee for maximum retail prices of coal and coke in the London area, which will be published as soon as possible. The scheme follows very closely the general lines of the Household Fuel and Lighting Order, 1918.

The Electric Vehicle Committee.—The accounts of the Electric Vehicle Committee of Great Britain for the year ended March 31st last, show an income of £1,996, as against £888 in the previous year. Expenditure, however, increased in greater proportion, having been £1,978, compared with £778. The surplus was thus £18—a large fall from the 1918-19 figure of £110. The excess of assets over liabilities shown by the balance-sheet is £149.

Irish Railway Electricians' Wages.—An Industrial Court having heard an application by the Electrical Trades Union on behalf of the train lighting staff, arc lamp trimmers, and wiremen's helpers employed by the Great Northern Railway of Ireland at Dublin, Belfast, and Dundalk, for payment of wages rates prevailing in the respective districts, and for re-grading of carriage men, decided that the weekly hour rates for the three grades should be increased to :—Grade 1, 38s. ; grade 2, 35s. ; grade 3, 30s. ; these rates to be subject to the addition of war advances of 33s. 6d a week and the bonus of 12½ per cent. on earnings. The decision takes effect as from September 3rd, 1920. The claim for district rates was ruled out.

A Committee on Patents.—The Lord President of the Council has established an Inter-Departmental Committee on Patents, with the following terms of reference :—

1. To consider the methods of dealing with inventions made by workers aided or maintained from public funds, whether such workers be engaged as research workers, or in some other technical capacity, so as to give a fair reward to the inventor, and thus encourage further effort to secure the utilisation in industry of suitable inventions, and to protect the national interest.

2. To outline a course of procedure in respect of inventions arising out of State-aided or supported work, which shall further these aims, and be suitable for adoption by all Government Departments concerned.

As at present constituted, the Committee consists of the following members :—

Mr. Kenneth Lee, LL.D. (chairman) ; Mr. W. St. D. Jenkins, C.B.E., Admiralty, Director of Contracts ; Mr. F. E. Smith, O.B.E., F.R.S., Admiralty, Director of Scientific Research ; Air Vice-Marshal Sir E. L. Ellington, K.C.B., C.M.G., C.B.E., Air Ministry, Director-General of Supply and Research ; Mr. H. W. W. McAnally, C.B., Air Ministry, Assistant Secretary ; Mr. P. W. L. Ashley, C.B., Board of Trade, Assistant Secretary, Industries and Manufactures Department ; Colonel W. H. D. Clark, O.B.E., Board of Trade, Assistant Comptroller of the Patent Office ; Sir H. Frank Heath, K.C.B., Department of Scientific and Industrial Research, Secretary ; Mr. A. J. Stubbs, M.Inst.C.E., M.I.E.E., General Post Office, Assistant Engineer-in-Chief ; Mr. H. H. Dale, C.B.E., M.D., F.R.S., Medical Research Council, Head of Department of Biochemistry and Pharmacology ; Mr. W. J. Coombs, Ministry of Munitions ; Lieut-Col. P. K. Lewes, C.M.G., D.S.O., R.A., War Office, Assistant Director of Artillery ; Mr. P. Tindal Robertson, Barrister-at-Law, Royal Commission on Awards to Inventors, Secretary ; Sir R. A. Gregory, F.R.A.S., Editor of *Nature* ; Mr. D. M. Kerly, K.C., and the Hon. Sir Charles A. Parsons, K.C.B., LL.D., D.Sc., F.R.S.

The Secretary to the Committee is Mr. A. Abbott, to whom all communications should be addressed at 16 and 18, Old Queen Street, Westminster, London, S.W. 1.

Costing.—The following are the March arrangements of the Institute of Cost and Works Accountants' lectures to be held in the Hall of the Institute of Chartered Patent Agents, Staple Inn, at 7 p.m. :—March 2nd, "Some Deviations in Costing Principles," by R. J. H. Ryall ; March 9th, "Economics in Relation to Costing," by Wilfred Grainger ; March 16th, "Some Observations on the Proposed Amendments of the Workmen's Compensation Act 1906," by H. G. Simmons.

New Devices.—We understand that the "Utility" electrical current limiter, the "Turner-Schattner" selenium cell automatic street lighting device, and some novel cooking apparatus which Messrs. Electrical and Engineering Development, Ltd., have developed in the course of the last 12 months, will shortly be placed on the market.

The E.P.E.A. Award.—The Stockton Electricity Committee reported, at a special meeting of the Town Council, on February 15th, the latest developments with regard to the dispute with the E.P.E.A., and recommended that, under the whole circumstances existing nationally, the conditions and schedule, as issued, should be adopted. The recommendation was agreed to.

The threatened strike of the engineers at the Keighley power station has been averted, as a conference between the Special Committee appointed by the Town Council and Mr. W. A. Jones, general secretary of the E.P.E.A., resulted in the Committee agreeing to pay the men concerned in the dispute salaries in accordance with Scale C of the Schedule, and, in the meantime, appeal is to be made to the District Joint Board on the question of the grading of the Keighley power station.

Calendar.—Messrs. British Electrical Repairs, Ltd., of 24, Fennel Street, Manchester, have issued a wall calendar with a block of daily date slips beneath a photographic reproduction of an armature badly in need of the services that they are able to render.

Social Events.—The third social evening of the staff and friends of the Ediswan Electric Co., Ltd., at Bristol, was held in the company's show-room there, on 2nd inst. The district manager, Mr. Fifield, presided over a company of about 70. A varied programme of music, &c., was provided, the "Ediswan Jazz Party" being one of the "star turns" of the evening. Votes of thanks were accorded to the chairman, artists, and organisers, for their efforts in connection with these friendly gatherings.

On February 19th the town and country members of the staff of Messrs. Drake & Gorham, Ltd., and Messrs. Drake & Gorham Wholesale, Ltd., were entertained at luncheon by the chairman and directors, at the Connaught Rooms. The company numbered some 250, and Mr. Bernard M. Drake presided. After an excellent luncheon, followed by the toast of "The King," Mr. Drake delivered an impressive address with reference to the critical times through which the country was passing. He held that the future depended upon loyalty and the suppression of Bolshevism, with all that it implied. The cost of the war could only be paid by hard work on the part of everyone: but since the armistice a spirit of self-seeking had pervaded the whole country. There had been no fewer than 300 strikes—but not only the workpeople, but also shopkeepers and employers had been to blame. Prices had been forced up to such a ridiculous pitch that orders were now scarce, and electric lighting was too dear, with the result that unemployment was rife. The "Ca' canny" policy meant taking money that had not been earned; it led to loss of employment, and could not go on. They were up against the hard realities of supply and demand, and foreign competition. Doles to men out of work had to be paid by those who were in work, and the result was excessive taxation. Capital and Labour—both manual and mental—were all dependent upon one another. Since he started the business 40 years ago (D. & G. was now 35 years old) he and his colleagues had put the profits into the business; the brain-worker had worked well since the armistice, better than the manual worker. Bolshevism was a mischievous propaganda inspired from abroad, and it was the duty of every one of them to stop it—not to leave that duty to the Government. If employers had always treated their men well, and admitted them to a share in the profits, the Trade Unions would never have come into existence. Now they had the whip hand—it was to be hoped they would get good leaders. The success of the Ford factory was due to the use of machines, which enabled the firm to pay high wages and employ 15,000 men, none of whom received less than £1 a day (pre-war). The power used per man in America and Germany was 3 h.p.—in England only 1 h.p.; they must make greater use of machines, to secure good wages and cheap products. The studious man was not allowed to earn more than the slacker, whom he was carrying on his back; there should be an inducement to every man to improve his position. Payment by results was essential, and must come about. He appealed to the manual workers to adopt broad views, and put their backs into their work; then they would achieve success, and better times would come, and come quickly. The whole world was looking to England for a lead; let them show a good example.

Mr. R. W. Smith expressed his agreement with the chairman, and proposed the health of Mr. Drake, his son, and the directors, which was drunk with musical honours. An excellent concert followed, which was greatly appreciated.

Cast-Iron and Allied Industries Research Association.—The Research Association for the Cast-Iron and Allied Industries has been approved by the Department of Scientific and Industrial Research. The secretary of the Committee engaged in the establishment of this association is Mr. Thomas Vickers, 174, Corporation Street, Birmingham.

Japanese Lamp Exports.—Japan's output of electric lamps this year is estimated at 14,000,000. Their sale is increasing in India, China, and the islands to the south of Asia.—*Indian Textile Journal.*

Book Notices.—"Collected Researches of the National Physical Laboratory." Vol. XV. 1920. Pp. 329. London: H.M. Stationery Office. Price 20s. net.—Eighteen papers are included in this volume. Half of these are metallurgical in character, dealing with metallic structures, pyrometry, &c. Other papers are "On the Measurement of Small Inductances and on Power Losses in Condensers," "Note on the Measurement of the Peak Potential of an Alternating Source," "Experiments on the High-Tension Magneto," "Notes on the 'Break' of a Magneto or Induction Coil," and two papers on radioactive luminous compounds.

A special issue of *Nature* for February 17th is mainly devoted to articles on the principle of Relativity, a subject which is foremost in the minds of physicists to-day. Following on the Michelson-Morley experiment, and the deductions of Fitzgerald, Larmor, and Lorentz, indicating that no experiments could ever reveal absolute motion through the ether, Einstein showed that on this basis remarkable consequences as to time and space resulted, and the sensational support given to his theory by the British solar eclipse expedition of 1919 brought the matter into the forefront. In the special number some 14 articles on various aspects of the theory by leading authorities appear, together with a bibliography of the subject, making the issue one of permanent value.

"The *Journal* of the South African Institution of Engineers." Vol. XIX. No. 6. January, 1921.—This issue contains an illustrated paper on "Rubber Manufacture in South Africa," together with a subsequent discussion.

"The Practical Electrician's Pocket-Book," 1921. Edited by H. T. Crewe, M.I.Mech.E. Pp. lxxii + 530 + diary. London: S. Rentell & Co. Price 3s. net.—The edition for 1921 has been enlarged by several pages, of which a certain number have been absorbed by the growth of the central stations in the United Kingdom. The section on wiring has been most carefully revised and extended, in order to bring it in line with the latest developments in conduit practice, as set down by the I.E.E. Rules, while Mr. Raymond J. Mitchell has rewritten the chapter on accumulator road traction, which is undoubtedly growing very rapidly in favour in the United Kingdom. An entirely new section has been devoted to an illustrated description of the Pulsynetic system of electric clocks, and the chapter on electric welding has been revised, so as to include a practical description of the "Quasi-Arc" process, which is being used so largely in the shipyards and engineering works on the Clyde, Tyne, Mersey, &c.

"Wireless Telegraphy." By B. Leggett. Pp. xvi + 486; 230 figs. London: Chapman & Hall. Price 30s. net.

"Science Abstracts." A and B. Vol. XXIV. Part I. Jan. 31st, 1921. No. 277. London: E. & F. N. Spon, Ltd. Price 2s. 6d. each part.

Lantern Slides on "Wireless."—We are informed that Messrs. Newton & Co., Ltd., have recently prepared a set of lantern slides for a lecture on "Wireless Telegraphy," dealing more particularly with the Elwell-Poulsen system. They are accompanied by a full set of notes, which provide alternative methods of treatment for audiences of varying degrees of acquaintance with the subject. Many of the slides are from hitherto unpublished photographs. Messrs. Newton's address is 37, King Street, Covent Garden, W.C. 2, and a small charge is made for the hire of the set.

LIGHTING AND POWER NOTES.

Bromley (Kent).—Prices.—The Ministry of Transport has informed the Town Council that, at the request of the Electric Light and Power Co., Ltd., the temporary increases of charges order has been revoked, and that the company has given an undertaking not to enforce, without previous sanction of the Ministry, a higher minimum charge per quarter to consumers than 12s. 6d. for any amount up to 15 units for each of the quarters ending March 31st and December 31st, and 8s. 4d. for any amount up to 10 units for the other quarters of the year.

Continental.—Italy.—The hydrographic service in Italy dates no further back than 1917, when it was called into being by the Consiglio Superiore delle Acque (Water Board) on the lines suggested by Prof. Fantoli. Italy is now divided into eight sections—namely, Pisa, Rome, Naples, Catanzara, Chieti, Bologna, Cagliari, Palermo—each section allotted to separate river systems. The rainfall is measured at stations, the number of which has risen since 1918 from 371 to 1,300; the flow of the rivers is measured either at the rainfall stations or at special stations, of which 300 new ones are scheduled; data are also compiled of the state of mountain lakes and artificial reservoirs, as well as statistics of electrical energy, based on the daily reports of each company.

Four rivers of the Trentino, says *l'Elettricista*, could supply the Adige and Brenta each with half a million horse-power, which would equal the power generated by two million and a-half tons of coal, costing a milliard lire each year.

Trentro is building a second large central station, Rovereto is enlarging its own, a big trust has been embodied to utilise the water power of the Giudicarie, and a private company is to harness the Avisio. With these undertakings the electrification of the Brenner line becomes assured.

East Ham.—Installation Costs.—A statement in one of our lay contemporaries that electricity was being installed in new houses at Ilford at a cost of £85 per dwelling led us to make inquiries into the truth of the matter. We are informed that for the 16 houses erected by the Council the cost of the electrical installation was £12 1s. per house, while for a further 20 houses the figure has been reduced to £10 10s. The decision to install electricity was arrived at after due consideration of estimates submitted by the gas company.

Electricity District.—Mersey and West Lancashire District.—The Electricity Commissioners have definitely arranged to resume the adjourned inquiry at Liverpool on Tuesday, March 8th, and the following days.

Eston.—Electric Light Order Approved.—The Council's Electric Lighting Order having been passed by the Commissioners, the Clerk has been instructed to approach the Cleveland and South Durham Power Co. and Messrs. Bolckow, Vaughan and Co., Ltd., for their terms for a bulk supply.

Finchley.—Loan Sanctioned.—The Electricity Commissioners have sanctioned the borrowing of £53,650 by the Council for the extension of the electricity undertaking.

Galashiels.—Proposed Price Increase.—The Electricity Supply Co., Ltd., has applied for an order to increase the price of electricity for power from 3d. and 2d. per unit to 5d. and 2½d.; and for lighting from 10s. up to 20 units and 6d. beyond to 15s. and 9d.

Greenock.—Supply to Cotton Mill.—Messrs. J. & P. Coates, Paisley, have applied to the Corporation Electricity Committee for a supply of electricity to their Ferguslie Mill. Mr. Whysall, the burgh electrical engineer, has been instructed to submit a scale of charges proposed to be made, and correspondence is being carried on between the Paisley firm and the Corporation.—*Glasgow Herald.*

Ipswich.—New Plant.—A new rotary converter is to be installed at the Duke Street sub-station, at an estimated cost of £5,400.

Lochaber Water-power Scheme. — Application for Order.—A petition has been presented to the Secretary of State for Scotland for the grant of a provisional order incorporating a company under the name of "The Lochaber Power Co." The general purposes of the company are stated to be to provide and supply water, hydraulic and motive power, and to generate and supply electricity. The share capital of the company is proposed to be £3,000,000. Power is also to be sought to empower the company to subscribe for shares in other undertakings which the directors "may consider advantageous to the company." The works proposed to be constructed by the company are all within the County of Inverness, and comprise, mainly, the construction of dams for upholding the waters of the rivers Spean and Treig, and of Loch Treigh and Idir Loch. Other works include a deviation of the West Highland Railway, of the North British Railway for a distance of over 1¼ miles, and the impounding of the waters of the rivers Spey and Mashie, and the waters of Loch Laggan and numerous streams.—*Financier.*

London.—Greenwich.—The London County Council has prepared a scheme for increasing the plant at the Greenwich generating station at a cost, says *The Times*, of £400,000.

Electricity District Inquiry.—The Electricity Commissioners have provisionally fixed Tuesday, June 7th, 1921, as the opening date for the local inquiry which is to be held in connection with the schemes which have been submitted for reorganising the supply of electricity in the provisionally delimited London and Home Counties Electricity District.

Luton.—Price Reduction.—Owing to the efficiency of the new plant resulting in a substantial profit, the Electricity Committee recently recommended that all charges for electricity should be reduced 25 per cent. The recommendation was adopted by the Council, and the new charges will take effect after the March meter readings. The rates will be still double the pre-war charges.

Mesopotamia. — Baghdad Lighting Profit. — *The Times* states that the latest information from Baghdad indicates that the electrical section (military) is extremely efficient. The energy is produced cheaply, and watt-hour meters are preferred by some consumers as being cheaper than the fixed-price system in general vogue. The undertaking is working at a profit.

New Brunswick.—Water-power Development.—The water powers at Musquash, N.B., are being developed by a commission appointed for the purpose. The work will cost approximately £250,000. The commission generates the electricity, and supplies it at cost to the municipality. The distribution is left to the latter body, which can either handle the power direct, after erecting its own distribution system, or sell it to an existing company, safeguarding the community as to the rates to be charged. In the case of St. John, where the New Brunswick Power Co. operates the tramway and lighting and power system, it will have to be decided whether that company using steam shall receive the power or meet the competition of the municipality with hydro-electric power.—*The Times.*

Newfoundland.—Suspension of Services.—A series of blizzards culminated in a storm which crippled the electric service, thus depriving the city of light for a week, and caused a suspension of the railway, steamship, and tramway services, isolating every section of the country. The conditions prevailing have been the worst for 30 years. Snowdrifts as high as 20 ft. have lain on the ground for several days. No express trains have arrived or left St. John's for 10 days, and it will probably be another week before connections are resumed.—*Reuter.*

Peterborough.—Electricity for New Houses.—In a recent Town Council discussion, a speaker pointed out that the cost of electricity was not the only thing to be considered when deciding upon the lighting of the new houses at Paston Lane. Utility and cleanliness were important factors. It was decided finally to install electricity for lighting and gas for cooking.

Perth.—New Plant.—On the recommendation of the Electricity Committee, the Corporation has agreed to install a 1,000-kW d.c. set and an additional boiler at the Corporation electricity works, at an estimated cost of £50,000. The extension is to be proceeded with at once.

Preston.—Purchase of Undertaking.—It is announced that the Corporation has entered into a provisional agreement to purchase the National Electric Supply Co., the money to be met partly by mortgage bonds. Three directors are to receive £8,400 for loss of office, and the officials' position is also to be considered. The bonds will bear interest at the rate of 6 per cent., but a definite sum has not been fixed for the purchase. The annual report of the company shows expenditure on capital account for the year of £25,340, including the acquisition of a valuable site on the riverside and the purchase of a third turbo-generator. With a balance from last year the gross profit was £21,089; it is recommended to place £5,000 to depreciation and £3,000 to reserve; to pay 4 per cent. on preference shares and 2s. 6d on ordinary shares for the half-year ending June 30th, and 6s. 6d. per share for the second half-year, making 9s. per share for the year; to pay a dividend of £5 8s. 6d. on each of the founders' shares of the company, and to carry forward £1,366.

Swansea.—Change of Supply System.—The borough electrical engineer considers that the Uplands area should be changed over from a d.c. to an a.c. supply, and, if this were to be done, it would mean that the whole of the motors would have to be changed, together with the meters, the total cost being approximately £6,000; but, as he will be able to utilise the present motors and meters (which he values at £6,200) for other purposes, the actual change-over can be effected without cost. Regarding the Morriston supply, he reports that the present cable is practically running at its maximum capacity, and, in order to be able to give a full supply next winter, he recommends that the e.h.p. main, which is at present being laid as far as the Lower Forest Foundry, be extended to Wychtree Bridge, where a sub station should be erected, the cost of the alteration being approximately £6,000. The Electricity Committee approved the recommendation of the report, and asked the electrical engineer to report on the question of distribution in other parts of the borough.

Electricians' Wages.—The Secretary of the Amalgamated Engineers' Union has written expressing inability to accept the decision of the Council with regard to the wages of the skilled men at the Corporation electricity station, and asking that the wage of the £5 16s. per week be assured to the men whether the ultimate award of the National Joint Council be lower or not. The Council has resolved to adhere to its previous decision.

Extension of Supply Area. — The Corporation has under consideration a scheme involving an expenditure of £40,000 to extend the Corporation electricity supply to the large and growing area of the Amman Valley, and a special meeting of the Council is to consider the details. Several important works and collieries are seeking electric power and light; Ammanford, Gowerton, Gorseinon, and Pontardulais, important industrial areas, come within the scope of the scheme, which, according to the chairman of the Electricity Committee, Alderman Sinclair, has enormous possibilities, apart from the fact that a return of £5,000 per annum is assured from the start.

Tasmania.—Hydro-Electric Developments.—It is reported from Hobart that with the arrival of heavy machinery from England and America, the extensions in connection with the State Hydro-Electric Department's works are being rapidly pushed forward, and it is anticipated that the present connected load of 17,000 h.p. will be increased to 57,000 h.p. in a little over a year. The work connected with the raising of the existing dam at the outlet of Arthur's Lakes by over 18 in. has been completed, and the level of the lake is now slowly rising. Various improvements have already been made to Hobart port, and a report is being made on the cost of a new 25-ton electrically-driven crane to meet modern requirements, a new crane being necessary to cope with the big shipments of heavy machinery which are to follow.—*Reuter's Trade Service* (Melbourne).

The Grampian Scheme.—Competition with Municipalities.—In an interview with a correspondent of the *Dundee Advertiser*, Major J. S. Barnes, of the Hydro-Electric Development Co., Ltd., the promoter of the Grampian Scheme, stated that it was not intended to compete with the municipalities in the supply of electricity. Nevertheless, if a settlement was not arrived at, the company was under no obligation to refrain from introducing supply into the territory at present served by the Dundee Corporation, and would naturally be ready to discuss proposals for the supply of power to consumers within the area.

TRAMWAY AND RAILWAY NOTES.

Argentina.—Strike Ended.—The Rosario municipal workers and tramcar drivers have, says *The Times*, returned to work.

Australia.—New "Tube" System.—The Sydney *Sun* recently gave full details of the new partly underground railway system for which excavations are proceeding. The present Central Station of the New South Wales Railway system is in an inconvenient position, and the new city railway is designed to convey passengers to the centre of the city, the water front and the suburbs. The new railway will be below ground for about 2·5 miles, and its total length will be about 5·1 miles. There are to be six stations each with a platform 520 ft. in length. The new Central Station will be above ground; four island platforms are to be provided giving the station a capacity of 210 trains per hour. Where the line runs underground practically the whole of the tunnelling is through hard sandstone; the tunnels will be lined with brick and concrete, and steel frame construction will only be used at certain points. The work was commenced in 1916, but in June, 1918, had to be stopped owing to the difficulty of obtaining plant and materials. The original estimate of the cost was £3,750,000, but this will probably be £8,000,000, owing to the large increases in all charges.

Birmingham.—Proposed Railless Cars.—The Tramways Committee has received the report of the Committee which has been studying the railless car system of Bradford with a view to applying the system to Birmingham. The report is a very favourable one, and it is considered that railless cars will be most suitable for a number of routes where the traffic is comparatively light. It is hoped to have an experimental route from the centre of the city to a suburb open within a year. A considerable amount of new track is being laid in various parts of the city. This work is estimated to cost about £70,000.

Continental. — France. — Omnibus and tramway-car tokens of 25 and 50 centimes value (nominally 2½d. and 5d.) have made their appearance in Paris. The tokens are good for payment only in tramway-cars, in the Underground trains, and in the motor-omnibuses.—*Daily Mail.*

India.—Electric Vehicles to be Introduced.—Mr. F. L. Milne, the municipal electrical engineer, Punjab, while on home leave last year, was deputed to go into the question of adapting electric vehicles to conditions of running on the Simla roads. On his return he made his recommendations and, as a result, the municipality has now decided to order the chassis of a one-ton electric lorry which will be equipped with a 'bus body suited for carrying about 12 passengers, to be run between Simla and Mashobra as an experiment Should the venture prove a success, as anticipated, electric vehicles for running in and about Simla will, it may be taken for granted, be introduced on a considerable scale.—*Indian Textile Journal.*

Calcutta Strike. — A party of armed European police that had been sent to quell the rioting of the tramway employés, who have been on strike for three weeks, was attacked by the mob last week, says the *Daily Mail*; the police opened fire, and after one rioter had been killed, and two injured, the mob dispersed.

Ipswich.—Additional Loan.—The Town Council finds it necessary to amend its original application for sanction to a loan of £4,000, to defray the cost of a building for the electric vehicles, by the addition of a further £1,000. Two hangars were purchased from the Disposal Board, and these were put together to form one large shed covering an area of 6,900 sq. ft.

Liverpool.—Minimum Fare.—A minimum fare of 2d. on the tramways of the Corporation came into operation on the 21st inst.

London, Brighton, and South Coast Railway.—At the annual meeting on Wednesday, last week, the chairman, Mr. C. C. Macrae, in the course of his remarks, said :—The directors were very anxious to get on with the scheme for the electrical equipment of the suburban railways, and, as the late chairman stated last year, the Government had been approached with a view to authority being given for the work to proceed, but up to the present they had not succeeded in carrying the matter much farther. This was to be regretted, as in the directors' opinion the extension of electrical working would have a very beneficial effect upon the company's business.

London.—Proposed New "Tube."—The City and South London Railway Co. recently received from the Wandsworth Borough Council a suggestion that extensions should be constructed from Clapham Common to Southfields (*via* Wandsworth) and to Tooting. The company states that the present time is not favourable for the execution of such extensions, and more urgent work has to be proceeded with, including the enlargement of tunnels and the improvement of the existing lines.

Trailer Cars —The Minister of Transport has intimated that he approves of the use of passenger trailer cars at any time on 22 tramway routes in the L.C.C. area, in addition to those on which they are at present used.—*The Times.*

Combined Tramway and 'Bus Routes.—Through tramway and omnibus tickets, *via* Victoria Station, came into operation on February 16th, under an agreement between the Highways Committee of the London County Council and the London General Omnibus Co. The scheme provides for both the Council and the company to issue through tickets, *via* Victoria, at fares of 2d., 3d., 4d. and 5d., based on the addition of 1d. to the tramway fares of 1d. 2d., 3d. and 4d., from Victoria, the company to convey through passengers by any omnibus for a 1½d. stage from Victoria. Certain of the omnibuses will be diverted from Victoria Station-yard so as to facilitate the interchange of passengers, and early morning omnibuses will be provided to connect with the Council's workmen's cars. Through tickets, however, will not be issued in connection with either workmen's fares or the 2d. mid-day fare.—*The Times.*

Northampton.—Loss in Working.—Northampton Corporation tramways show a loss estimated at £8,900 during the current financial year ending March 31st. but the expenditure includes £9,300 for relaying the track.—*Manchester Guardian.*

Oxford. — Opposition to Company's Bill. — The Council has decided to petition against the Parliamentary Bill being promoted by the City of Oxford Electric Tramways, Ltd., by which the company seeks an extension of its powers.

Portsmouth. — Reduced Services. — The municipal tramways began working short time, and with a reduced service on February 21st, says *The Times.* This step has been taken because the system is being worked at a loss.

Tramway Inquiry.—Position of Industry.—At the tramway wage inquiry on February 17th. Mr J. B. Hamilton, of Leeds, stated that for the industry as a whole the actual revenue at present fell short of the approximate expenditure by 3·55d. for every car-mile run, a deficiency amounting to 3s. 2½d. for every £1 of traffic receipts. If the wage increase claimed were added to the present approximate expenditure the corresponding figures would be 5·14d. and 4s. 8d. The industry had been carried on at a dead loss of at least £1,555,859 during the last financial year. For 1920-1921 it would be approximately £3,310,000 on the same mileage ; with the additional charge for wages now asked the loss would be approximately £4,793,000.—*The Times.*

Wigan.—Fare Increase.—The Corporation is revising tramway fares, as it is estimated that there will be a deficit of £15,000 on the present year's operations. Alterations, reconstruction of rolling stock, and other expenditure, which has been paid out of revenue, total over £6,000, so that the deficit is not actually so large as it seems.

TELEGRAPH AND TELEPHONE NOTES.

Australia. — Wireless Telegraphy.— Arrangements are being made by the Postmaster-General's Department for the establishment of wireless stations at Camoweal, near the Queensland border, and Powell's Creek, in the Northern Territory. The scheme for which approval has been given, is the first step in linking up the outposts with the centres of business of the Commonwealth. The initial cost will be in the vicinity of £4,000. It is also hoped that private persons will be encouraged to adopt wireless telegraphy and negotiations are already in process with that view. The idea of the department is that the stations at Camoweal and Powell's Creek will act as collecting offices for private plant. In other words, they will be the central exchanges through which business will be conducted. Full rates will be charged for all messages received from and dispatched to private plant. These will be somewhat higher than telephone or telegraph rates.—*Reuter's Trade Service* (Melbourne).

China.—Wireless Station Contract Cancelled.—With regard to the Chinese Government having signed a contract with the American Federal Telegraph Co. for the erection of a high-powered wireless station at Shanghai, and the protests thereto which followed from the Marconi Co. and the British Government representatives, *Reuter's Trade Service* reports from New York that the *World's* Washington correspondent says that the State Department has notified China that the U.S. Government will regard as an unfriendly act China's cancellation of the contract with the American Federal Telegraph Co., and adds that the State Department has communicated with the British Foreign Office on the subject. *The Times* says that Denmark and Japan also protested, and the British Government is understood to back the Marconi Co.'s claim, while America supports the U.S. Co. on the ground that the Marconi Co.'s franchise is a monopoly, and as such not only contrary to its communications policy, but also out of harmony with the policy of the "open door" in China.

China has accepted the invitation to participate in the next International Wireless Convention.—*Reuter's Trade Service* (Peking).

Germany.—Wireless Telegraphy.—According to the Swiss *Elektro-Industrie*, the German wireless services are of three kinds—the international, the home, and the special. The stations at Nauen and Eilvese afford communication with overseas countries, and that at König-Westerhaus with European countries. The home service is catered for by 15 stations, besides 15 coastal stations for communication with shipping. The Nauen station has lately undergone considerable modifications, with a view to facilitate the service with America. At present duplex communication has been set up between Nauen and the Marconi station at Marion, and transmission is made simultaneously in the two directions. The Marion messages are not received at Nauen itself, but at Geltow, near Potsdam, and 10,000 words per day are sent, but this number might be fourfolded. Nauen is able to transmit 24,000 words per day. The transmission plant consists of two high frequency machines, each of a capacity of 500 kW, and a smaller 200-kW machine, with corresponding transformers. There are two antennæ, entirely distinct. It is in contemplation to double the plant, with the object of providing a separate service to South America.

India.—Bombay Strike Ended.—The strike of the postal and telegraph peons (messengers) has come to an end, says *The Times*, after having lasted close upon five months.

Telephone Service. — New Inquiry. — Sir Gordon Hewart, the Attorney-General, announced in the House of Commons, on February 18th, that the Government had consented to set up a select committee to inquire into the "administration and the organisation of the telephone service," and that the "method of making charges" should also be investigated, but stipulated that the new rates must come into force on April 1st. He read a typical letter to show what it was that was complained of. "Hear, hear!" cried members, as they heard the familiar phrases about wrong numbers and numbers reported as "engaged" when that was not the fact. "Yes," said the Attorney-General genially, "but the letter is dated January, 1907, and was addressed to the old National Telephone Co." He would not concede the flat-rate system, and said that it would be administratively impossible to make any repayments if the Select Committee reported against the new charges. But on Wednesday Mr. Bonar Law had said that if by any chance the House disagreed with the decision of the

Government, a rebate would be given. That is a difference of opinion which, no doubt, will call for further explanation in the House.

Wage Bill.—In the House of Commons, on Feb. 21st, Mr. Illingworth (Postmaster-General), replying to a question, stated that the total number of officers in the employment of the National Telephone Co. at the time the undertaking was transferred to the Post Office was about 19,650, and the company's annual wage bill amounted to £1,243,000. The average number of Post Office servants employed in the telephone service in the financial year 1919-20 was approximately 44,500, and the total amount paid to those officers was £7,300,000, including war bonus. The figures relating to the Post Office included the staff employed on services—*e.g.*, the trunk service—which were not controlled by the company.

U.S.A.—Combined Wire and Wireless Telephony.—A telephone conversation between a ship in the Atlantic and Catalina Island (30 miles south of Los Angeles), in the Pacific, has been accomplished by a combination of wireless and overland wire communication by the American Telegraph and Telephone Co. Calls were also relayed across the American continent to New York and other cities.

International Communications Conference.—The Conference, which resumed sittings at Washington on February 11th, is again unable to reach an agreement on the subject of the disposal of the former German cables. Dispatches from Washington state that the deadlock is as complete as that which caused the break-up of the Conference several weeks ago, and the *New York Times* states that there is reason to believe that the United States Government has intimated to the Conference that it reserves the right to take such measures for its national interests as conditions may require if an agreement is not reached before March 15th, which is the date of the expiry of the *modus vivendi* established at the last meeting of the Conference.—*The Times.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Aberdare.—March 4th. Urban District Council Electricity and Tramways Department. Stores for one year, including cable, meters, lamps, &c. (February 11th.)

Australia.—Melbourne.—March 2nd and 9th. Victorian Railways. Reactances and condensers (for power signalling), electric crabs and equipment for cranes.*

April 19th. P.M.G. Telephone switchboards (Schedule No. 1,670). Specifications may be seen at Department of Overseas Trade (Room 59), in London.

April 19th. P.M.G.'s Department. Switchboards, schedule 1,670. (See this issue.)

April 27th. Victorian Railway Commissioners, Spencer Street. Caustic soda primary cells, complete (Contract No. 33,914). Specification may be seen at Department of Overseas Trade (Room 59), in London.

Brisbane.—March 30th. P.M.G.'s Department. Switchboard apparatus and parts.*

Belfast. — Tramways Committee. Two 500-kW, 500/550-V converters. (February 18th.)

Belgium.—Antwerp.—March 1st. Supply and erection of an electric motor pump group at No. 7 dry dock of the Lefebre basin at Antwerp. Particulars from the Direction Générale du Port d'Anvers.

March 2nd. Belgian Ministry of National Defense. Supply of 109 kilometres of telephone cable. Tenders are to be sent to the 3e Direction Générale du Ministere de la Defense Nationale, 10, Rue du Meridien, Brussels, whence particulars may be obtained.

Croydon.—March 7th. Electricity Department. Two natural draught cooling towers. (February 18th.)

Dumfries.—March 2nd. Education Authority. Electric lighting installation at Woodbank Hostel. Mr. W. Arnott, 163, Hope Street, Glasgow.

Holland.—Fixed electric revolving crane for the quay at the Waterworks, Oude Plantage of Rotterdam; 2,500 kilos. lifting capacity; radius, 7 metres; 400-V supply available. Mr. A. Van Delden, Acting Manager of the Municipal Waterworks, Rotterdam (mention H.M. Consul-General as source of information).

Leeds.—March 8th. Electrical work required in the Education Committee's schools for the year ending March 31st, 1922. Architect, Education Department, Calverley Street.

London.—H.M. Office of Works. March 2nd. Six or twelve months' supply of electric lamps. (February 18th.)

Camberwell.—February 28th. Libraries Committee. Installing electric light, &c., in the Central Library, Peckham Road, S.E. (February 18th.)

Macclesfield.—March 14th. Cheshire County Asylum, Parkside. Stores, including electrical goods, for six months. W. G. F. Tingay, Clerk.

Manchester.—April 4th. Electricity Committee. 33,000 and 6,600-V switchgear, induction regulators, &c., for controlling sub stations of large capacity. (February 18th.)

New Zealand. — Wellington. — March 1st. Public Works Tender Board. Seven 4,000-kVA single-phase transformers, with accessories, for Lake Coleridge electric power scheme.*

March 5th. Government Railway Department. Two overhead travelling cranes.*

Portsmouth.—Electricity Supply Department. Three 1,500-kVA Scott-connected transformer groups, 3-phase, 6,600-V switchgear. (February 11th.)

Rhondda.—April 5th. Electricity Department. A.c. house service meters, cable, joint boxes, &c. (See this issue.)

South Africa. — Pretoria.—March 10th. Municipal Council. One 20-ton overhead crane, six boilers (350-lb. working pressure), three 3,000-kW steam turbo-generators with condensing plant, five 750-kW converters. Further particulars can be obtained from Mr. T. C. Wolley-Dod, general manager, electric lighting department. Specifications (five guineas) from the town clerk.

May 3rd. S.A. Railways and Harbours. Plant for the electrification of the Cape Town-Simonstown and Durban and Pietermaritzburg Railways. (February 11th.)

Stockton-on-Tees. — February 28th. District Fund. Gas and Electricity Committees. Articles and stores for six months. (February 18th.)

March 9th. Electricity Department. A.c. 1 p. switchgear. (See this issue.)

Uruguay.—Monte Video.—March 29th. State Power House. Single and three-phase meters.*

March 31st. A telegram from H.M. Minister at Monte Video (Sir C. C. Mallet, C.M.G.), to the Department of Overseas Trade, states that general tenders are invited until March 31st for the construction of the projected port works at Paysandu, for which an expenditure of $280,457.30 has been sanctioned. The construction of a dyke, the acquisition of electrical handling and lifting apparatus, the extension of the mole and the construction of anchoring grounds, are included in the scheme.

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

London.—Battersea.—Electricity Undertaking Committee. Accepted :—

Pipework in connection with the plant extension.

Aiton & Co., Ltd., £1,404; Babcock & Wilcox, Ltd., £298.

FORTHCOMING EVENTS.

Edinburgh Electrical Society.—Friday, February 25th. At the Philosophical Institute. At 8 p.m. Paper on "Telephone Troubles," by Mr. J. McEwan Brown.

Electrical Trades Benevolent Institution (North-East Coast Section).—Friday, February 25th. At the Grand Assembly Rooms, Newcastle-on-Tyne. Second annual dance in aid of the funds of the Section.

Physical Society of London.—Friday, February 25th. At the Imperial College of Science, South Kensington. At 5 p.m. Ordinary meeting

Institute of Transport.—Monday, February 28th. At the Institution of Civil Engineers, Great George Street, S.W. At 5.30 p.m. Paper on "Electrification of Main Line Railways in Relation to Traffic Working," by Sir P. Nash.

Manchester Wireless Society. — Wednesday, March 2nd. At the Albion Hotel, Manchester. At 7.30 p.m. A discourse on "Workshop Hints as applied to Wireless Telegraphy," by Mr. R. Hallam.

Chelmsford Engineering Society. — Thursday, March 3rd. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Direction and Position Finding by Wireless," by L. D. Hills.

Chemical Society.—Thursday, March 3rd. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

Institution of Electrical Engineers.—Thursday, March 3rd. At the Hotel Cecil, Strand, W.C. At 7 for 7.30 p.m. Annual dinner and reunion.

Informal Meeting. — Monday, February 28th. At the Institute of Patent Agents, Staple Inn Buildings. At 7 p.m. Informal social evening.

North-Eastern Centre.—Monday, February 28th. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Lecture on "Thermionic Valves," by Mr. W. D. Owen.

Liverpool Sub-Centre.—Monday, February 28th. At the Liverpool University. At 7 p.m. Paper on "Temperature Limits of large Alternators," by Mr. G. A. Juhlin.

East Midland Sub-Centre.—Tuesday, March 1st. At the College, Loughborough. At 6.45 p.m. Paper on "Phase Advancers, Rotary and Static," by Mr. G. A. Pearson.

Birmingham and District Electric Club.—Friday, March 4th. At the Grand Hotel, Birmingham. At 6.45 p.m. Annual dinner.

British Electrical Development Association (Inc.).—Friday, March 4th. At the Offices of the British Electrical and Allied Manufacturers' Association, 36, Kingsway, W.C.2. At 12 noon. Adjourned first annual general meeting.

Royal Institution of Great Britain.—Friday, March 4th. At Albemarle Street, Piccadilly, W. At 9 p.m. Lecture on "Severn Crossings and Tidal Power," by Mr. W. A. Tait.

Saturday, March 5th. At 3 p.m. Lecture on "Electricity and Matter," by Sir E. Rutherford, F.R.S. (Lecture I.)

Royal Society of Arts. — Friday, March 4th. At John Street, Adelphi. At 4.30 p.m. Lecture on "Brown Coals and Lignite: Their Importance to the Empire," by Prof. W. A. Bone, F.R.S.

Salford Technical and Engineering Society. — Saturday, March 5th. At the Royal Technical College. At 7 p.m. Paper on "The Barton Electric Power Station," by Mr. S. L. Pearce.

NOTES.

Electricity v. Gas for Libraries.—At a meeting of the Camberwell Borough Council, on February 16th, the lighting of the Central Library was referred to. The open-access system had been agreed to, and the question was whether the lighting would suit the altered conditions. The Public Libraries Committee reported :—"In the first place, we directed our attention to the question whether the library should continue to be illuminated by gas, or whether it would be advisable to substitute electricity, and in connection with this matter we had before us a report made by Dr. S. Rideel with regard to ventilation and the action of the acids in the gas and air upon the books in the institution. There can be no doubt that these acids have a prejudicial effect on the leather bindings of the books, and this has resulted in additional expenditure being necessary for reinstatement, and has materially affected the life of the books throughout the borough. The question of the renovation of the buildings was also considered, and we are satisfied that the cost of any works to the institution in this direction will be considerably reduced in the event of our recommendation in favour of the installation of electric light being adopted. In addition, the cost of maintenance of electric fittings, lamps, &c., will, we estimate, be less than the present outlay for maintenance of mantles, glasses, &c., and we recommend that gas be abolished, and the entire building be illuminated by electricity." The recommendation was agreed to.

Service Notes.—Lieutenant T. J. Linberry has been posted to H.M.S. *Tamar*, depôt ship at Hong-Kong, China, for charge of the wireless station at Singapore—"the Gate of the Far East." This station is one of the most important in the chain of stations which links up the Imperial route. Commander Linberry saw much service in the late war, prior to which he specialised in "wireless." Lieutenant-Commander R. W. Bayley has been appointed to H.M.S. *Jumna*, depôt ship at Bombay, India, for charge of the wireless station at Aden, Arabia. Aden is a great fortress, and like Singapore, a most important link in the wireless route round the Empire.

Fatalities.—Strong criticism of a bell system fell from Mr. S. W. Morgan (coroner), who inquired into the death of Francis Weetman, of Hightown, killed at the West Cannock Colliery, Hednesford, on February 4th. The evidence showed that Weetman was leaving the cage at the pit bottom when the cage suddenly rose, and he was crushed against the side and terribly injured. It was alleged that the electrical system of signalling installed in November last was ineffective, and the instrument sometimes did not record signals after they had been given, and it was also suggested that the bell had rung when no signal had been given. The jury returned a verdict of "Accidental death," and exonerated the engine winder from blame.—*Birmingham Post.*

While a cart was being loaded at Harrow (Metropolitan) Railway Station, on February 12th, the horse took fright and bolted across the lines. It trod on a live rail, and was killed instantly.—*The Times.*

The Engineering Golfing Society.—The report of the Committee, submitted at the annual general meeting at the Institution of Civil Engineers, on Thursday, showed a membership of 156; 50 members took part in the Spring Meeting at Coombe Hill, and 52 in the Autumn Meeting at Royal Wimbledon, the chief prize in each case being won by Mr. C. H. Hayward. Sir Alex. B. W. Kennedy is proposed as president for the ensuing year, Mr. E. W. Timmis as captain, and Mr. W. L. Mansergh as hon. secretary (5, Victoria Street, S.W. 1).

All-Electric Houses at Glasgow.—On the occasion of a visit by the members of the Glasgow Lighting Association to the Corporation showrooms, Mr. Hardie, of the Corporation electricity department, delivered an interesting address dealing with recent developments in electrical heating and cooking apparatus. While the rapid growth of the demand for electricity for illumination purposes was satisfactory, it was emphasised, he said, that to ensure a progressive reduction in prices charged for electricity, its use for purposes other than lighting should become more general. Load factor, *i.e.*, the ratio of average to maximum load, must be kept as high as possible, and the general adoption of electricity for power, heating, and cooking contributed to that end. The widespread use of electrical cookers and fires would have a material purifying effect on the atmosphere of large cities. In conclusion, Mr. Hardie referred to a forthcoming experiment in houses being built by the Corporation, which are to be fitted up as all-electric houses, and said the saving in building costs by the omission of chimneys, chimney-heads, and fire-places would be considerable.

Lifting Magnets.—The value of electric lifting magnets for handling loose metal sheets, plates, billets, &c., in iron and steel works, was discussed by Major F. A. Hooper, at a meeting of the Staffordshire Iron and Steel Institute, on February 18th. The lifting magnet, he said, made it possible to operate cranes at their maximum speeds continually, and in numerous cases as many as 60 to 70 trips per hour were being performed by magnet cranes. He explained, according to the *Birmingham Post*, that three types had been evolved—namely, the circular magnet for handling loose metal, the rectangular magnet for handling sheets and plates, and the bi-polar magnet for handling sections and billets. In Germany a number of magnets were being constructed with aluminium instead of copper coils, the advantage claimed being that the oxidation of the outer skin of the aluminium formed sufficient insulation, thereby cheapening the cost of construction considerably. Actual performances showed that when dealing with solid loads a magnet would lift as much as 5 to 15 times its own weight. A magnet 26 in. in diameter, weighing 6 cwt., would lift a block of steel weighing 100 cwt., and a magnet of 66 in. diameter, weighing 60 cwt., would lift a block of steel weighing 15 tons.

When, however, light scrap had to be handled, the capacities came down to 1½ cwt. and 12 cwt. respectively, this being due to the low weight per cb. ft., and the fact that the scrap was usually so entwined that, even if the top layers were attracted, they were sometimes pulled off by the weight of the bottom layers. These were the two extremes, and such material as pig-iron, billets, and bars came between the two limits. A magnet crane of average capacity would not cost more than £3,000 to £4,000, and with wages as they were at present, a capital expenditure of as much as £1,000 was justified to replace one man, making full allowance for depreciation, capital charges, &c., on a 10 years' purchase basis. Numerous instances of magnets saving as many as 10 men had been recorded. The greatest savings were effected when handling loose materials, as these could not possibly be slung, but material of regular shape could also be dealt with efficiently.

A Novel Sparking Plug.—A new type of plug has been placed on the French market, and is called the Bougiver, which has a glass insulator. The glass is run into the body of the plug when the latter is at a high temperature, and the joint thus made is said to be compression tight. The insulator is also peculiar in the fact that it completely fills all the space right down to the plug points. Owing to the perfectly smooth surface of small area exposed within the cylinder, the plug is said not to soot up. The plug is extremely simple, and should be cheap to produce.—*Technical Review.*

Training Disabled Men.—At the Efficiency Exhibition, included in the collective exhibit of the Ministry of Labour, the Croydon Polytechnic shows a variety of examples of work done by disabled men under the direction of Mr. F. H. Taylor, A.M.I.E.E. The exhibits include a design in teak-wood casing, french polished; a metre wire bridge, accurately made and well finished; specimens of pipe bending, sunk pipe work, and jointing in cables and bus-bars; a starting panel built up of angle and flat iron, and a charging board. The high degree of manual skill attained by the trainees is remarkable, and indicates that they were not only well trained, but also very willing to learn.

New "Microscale" Balance.—M. Hans Petersson, of Gothenburg University, and Dr. Ragnar Stroemberg, of Stockholm University, have perfected a new invention called a "microscale." It is claimed for this invention that it will render it possible to register weights so small as three millionths of a milligram, and that it will thus be of great importance to establishments concerned with chemical or physical research, in cases where extraordinary precision is required. It is announced that one of these new instruments has already been ordered by the electrical laboratory of Oxford University.—*Reuter's Trade Service* (Stockholm).

Russia's Electrification Schemes.—At the eigth congress of Soviets in Moscow a report was read by M. Kryzhanovsky on electrification. According to the *Manchester Guardian* he said :—

"In the problem of increasing the intensity of labour by the mechanisation of labour, and the proper organisation of labour, the chief part belongs to electricity. A vital problem in Russia is the elimination of the fuel crisis. With the restoration of the Don Basin we shall receive 40 per cent. of the fuel we require, but it will be impossible to transport wood. Nevertheless, by using the new method of exploiting peat by water power, it will be possible to satisfy our requirements and to employ, instead of 3½ million people, only 100,000.

The construction of an electricity station in the peat bogs will afford us the opportunity of receiving cheap energy, which may be transmitted within a radius of 200 kilometres. Electricity will also play the chief part in minimising the use of oil, which the whole world requires. This will permit us to export our superfluous stock in exchange for machines.

Russia, from the earliest times, has suffered from inefficient agriculture, and, even before the war, famine was an ordinary occurrence in our land. The mechanical cultivation of land and the use of electricity will allow us to escape from the mystic circle. The regions suffering from drought will be irrigated by electricity. The land suffering from too much water will be drained by electricity. By draining bogs we can recover in the coming year 90 million acres of excellent land. Electricity will considerably increase the harvests. In the reconstruction of transport the chief part will be played by electricity. The use of electricity will permit us to convert our weak railway system into a mighty means of communication. We are dreadfully poor in metals, and electrification is the only way of obtaining the metals we require. The work of electrification is closely estimated to take ten years. It will heal the wounds of war; it will raise the economic level of Russia twice as high as it was before the war. The energy which the electricity stations will give us will be equal to the work of fifteen million people."

Pointing to a plan, M. Kryzhanovsky pointed out the construction of 27 electric stations, and when he indicated the regions in which the stations will be built small electric lamps lit up, giving the Congress an ocular demonstration of the scheme. The first station will be erected in the Don Basin.

Transport and Supply Problems in Paris.—As was mentioned a short time ago, all the surface transport undertakings in Paris and the Departement de la Seine are being acquired by the Conseil General of that department in cooperation with the City Council of Paris, and are being transferred to a new company as a purely operating company under the control of the Conseil General as from the beginning of this year. The object in view is to secure uniformity in working, and in the execution of necessary extensions, so as to be able adequately to deal with the growing traffic on the surface. A similar question has now arisen in connection with the Metropolitan and the Nord-Sud underground railways. The impression has been formed that the municipal authorities are not favourable at present to the redemption of the concessions held by the two underground companies, although a closer association of interests between the city and the companies is not improbable.

The Compagnie Parisienne de Distribution d'Electricité, which holds a monopoly of the supply branch in Paris under the Municipal Council, is now confronted with the prospect of a modification of the 1907 agreement, which appears to be an attempt to bring the undertaking into harmony with the new order of affairs arising from the war. According to a memorandum presented to the Municipal Council by M. Autrand, prefect of the Seine, the scheme proposes to put an end to all legal and other disputes existing between the company and the Council. The modifications projected under the proposed supplementary agreement refer to the tariffs, the personnel, the extensions of works, and the rental due to the city. It is calculated on the basis of index figures for coal and wages that the present charges for supply, which were largely increased early in 1920, will be the maximum, and that it will probably be possible to reduce them as from next July as a result of the fall in the price of coal. As to the company's employés, whose wages were assimilated some time ago to those of the workmen in the employ of the Municipal Council, and involved the latter in an annual expenditure of 8,000,000 fr., it is proposed to leave the wages entirely at the charge of the company in future. On the other hand, the scheme contemplates the levying by the Municipal Council of a sum of 13,000,000 fr. on the working of the company for the purpose of new works, while the rental for premises is to be increased by up to 25 per cent. It is calculated that the scheme would relieve the municipal budget by about 18,000,000 fr. per annum. At least this is the official view of the problem. It remains to be seen what the company has to say on the matter.

Electricity in Switzerland.—The Commercial Secretary to H.M. Legation at Berne has drawn the attention of the Department of Overseas Trade to the increasing demand on the part of the public in Switzerland for cheaper electricity. In the case of energy used for heating purposes the industries connected with electric heating cannot possibly exist unless the price of electricity is greatly reduced. To-day when coal and other fuel is scarce and expensive, the public is turning more and more to electricity for heating purposes, and efforts are being made to increase the number of water-power stations for the production of cheaper electricity. Unfortunately the cost of building water-power stations has increased enormously of late; it has been stated that the costs of erection are treble, and in some cases five-fold, what they were before the war. Swiss electric power stations, with very few exceptions, have been obliged to raise their prices, and electricity has become an increasingly expensive commodity. It has now been suggested that there are at present only two ways of supplying electricity at cheaper rates: One way consists in erecting larger stations and constructing more extensive artificial lakes in the high-lying mountain valleys. The second suggestion is to encourage the use of electricity during the night by reducing the charge during hours of darkness. The tendency in Switzerland seems to be to increase the number of artificial lakes, and in this way to build up reserves of water power. In the towns electricity is being increasingly used for household purposes; for ironing, for grilling, toasting, or warming up dishes, for cooking, and innumerable other purposes. The number of bakers and confectioners who bake by electricity is rapidly increasing. Chemists and dentists are also largely using electricity. A new industry is also growing up for the construction of electric stoves for the heating of private houses. The electricity used for the stoves is generated at night, during which time the stoves are heated up, whilst in the morning the electricity is switched off, and the stoves remain warm during the whole of the day. The stoves contain either water, oil, or terra cotta. In all modern houses and hotels, a large quantity of water is heated by electricity, the electricity for which is produced between midnight and 6 a.m., and which in consequence can be provided at a cheaper price. It is asserted that provided the price of electricity used at night can be sufficiently reduced, electric heating in Swiss houses will in time become the rule, and not, as now, almost the exception. At the present cost of coal and wood the hydroelectric plants supply the bakeries with electricity at a price more favourable than that for which coal or wood could be furnished. For producing 100 kilos of bread there is used on an average 20 kilos of coal at a cost of 4.05 francs. An electrically-heated oven uses about 80 kw.-hours for the same amount of bread. At a price of 3 centimes per kW-hour for a supply at night, the electricity costs only 2.40 francs. Even the day supply can be used in successful competition with the coal-heated ovens. When baking about 37,000 kilos of bread per day a saving of 370 tons of coal per month is effected. The present demand for the installation of electrically-heated ovens is considerably in excess of the ability of the Swiss manufacturers to supply them.

Appointments Vacant.—Technical assistant, Grade I (£300), two ditto., Grade II (£250); repairs superintendent, £300 +, for the L.C.C. Tramways Department. See our advertisement pages to-day.

INSTITUTION NOTES.

Institution of Electrical Engineers. Magnetic Susceptibility of Low Order.—Prof. E. Wilson, M.I.E.E., delivered the first and second of a series of three lectures on the above subject before the Institution, on February 17th and 24th respectively, and the third lecture is to be delivered on March 1[illegible]th. One of the most important problems at the present time is that of magnetic separation of minerals; therefore, their susceptibilities must be considered, and since the magnetic properties of certain minerals can be changed by oxidation or reduction, it follows that this and other aspects of the problem must also receive attention. But apart from magnetic separation, the subject of rock susceptibility has a bearing on magnetic survey work, a knowledge of the subject is necessary to those engaged on the construction of scientific instruments, and there are possibilities of its application in other directions.

The author dealt with the subject primarily from the standpoint of its practical applications, and his first lecture was devoted to a description of the instruments used in the experiments; the second dealt with the results obtained, and the third will outline their practical applications. The lectures were illustrated by means of diagrams and lantern slides; apparatus was exhibited, and experiments were performed.

I. *Instrumentation.*—When the volume susceptibility is larger than about 0·15, the correction for "end-effect" with short thick bars becomes too uncertain if the magnetometer is employed. Weiss prolonged the specimen in each direction by soft iron bars, the whole being placed in a solenoid, and the magnetising force was inferred from the difference in e.m.f. induced in the two sections on reversing the magnetising current. Other methods are to insert the specimen in holes in the pole pieces of a ring-shaped yoke of "Stalloy," and by supplementing the magnetometer with an induction balance, Rücker measured susceptibility as low as 0·00013. Wiedemann and Currie's torsion balance covers the range of the magnetometer; its upper limit is at most 0·15, and with it measurements can be made to less than 1×10^{-6}. If the instrument is to have a wide range of utility it must be so constructed that the strength of the magnetic field can be varied; such an instrument was exhibited by the lecturer. Moreover, a portable torsion balance has been developed, in which the test-piece hangs between fixed soft-iron pole-pieces which are magnetised by two concentric rings of hardened tungsten steel with north and south poles at opposite ends of a diameter. By varying the relative azimuths of the rings, the field between the pole-pieces can be varied. In this manner a variable field can be obtained without the use of a magnetising coil and battery.

In the case of the torsion balance the deflection varies as the square of the magnetic force impressed upon the test-piece. In fact, it is difficult to measure the susceptibility of a given specimen outside a narrow range of magnetic force of about one to four or five. An electromagnetically-controlled balance has been developed, which permits of a wide range of variation of the magnetic force. The force due to torsion is replaced by an electromagnetic control in which the mechanical force exerted is due to two components—one proportional to the magnetic force impressed upon the test-piece, and the other variable if the susceptibility varies. The instrument can be modified by replacing the electromagnets by permanent magnets after the manner of the portable torsion balance. The test-piece is supported from the beam, and the position of the magnet must be such that when the test-piece is just about to leave the field the pointer is at zero of the scale, thus eliminating the torsion in the fibre.

If the strengths of the magnetic fields are fixed in value, then the mass susceptibility, for equal weights, is proportional to the current in the moving coil. But the entire range (κ_r = 0·15 to less than 1×10^{-6}) would necessitate a weakening of the field in the permanent magnet when the susceptibility became high in which case the ratio of the squared values of the fields has to be taken into account.

II. *Susceptibility Values.*—Magnetite crystals have curves of magnetisation resembling those of iron and the susceptibility along the axes of the crystal varies in magnitude for a given magnetising force, although all tending to the same limiting value. The volume susceptibility can have a maximum value of the order of 1·0 C.G.S. units, the largest susceptibility of any known natural substance, excluding meteorites and traces of metallic iron.

Arkansas magnetite will interest engineers on account of its high retentivity and coercive force. The value of κ_r is increased about 42 per cent. on heating to 1,000° C., the residual magnetism is also increased, but the coercive force is reduced, and this agrees with what happens in the case of hardened steel. As Arkansas magnetite is so highly retentive, and may possibly be found useful for the purposes of permanent magnets, it is of interest to compare its magnetic properties with those of hardened tungsten steel. The ergs per cycle per cb. cm. are 90,000 when the value of H_{max} is 525, whereas they are of the order 200,000 in tungsten steel. The coercive force of the tungsten steel is roughly half that of this magnetite, but the retained magnetism is very much larger, the values being about 10,000 in the case of tungsten, and 1,300 in the case of this magnetite. That reverse force H which, being less than the coercive force, gives a maximum value to the product B H, is about 39 in tungsten steel, as against 80 in this magnetite, and the maximum values of B H are 270,000 and 46,000 respectively. The intensity J retained by a 4-cm. bar after being in a magnetic field H of 18,000 C.G.S. units has diminished 20 per cent. in 2¼ years. The effect of heating Penryn magnetite to 1,000° C. is to increase the susceptibility, coercive force and retentivity. The intensity of magnetisation J in the unheated 4-cm. bar has only diminished 3·5 per cent. in 2¼ years.

The lecturer examined the properties of other natural minerals whose composition can be represented by a formula of the same type as that of magnetite [$FeO \cdot Fe_2O_3$], and pointed out that another example which would interest engineers was that of the mineral chalybite (spathic ore or ferrous carbonate). A specimen highly oxidised on the surface was tested as regards the susceptibility of the surface layer and the innermost unweathered portion. The value of κ_m of the surface layer was found to be $34{\cdot}7 \times 10^{-6}$, whereas for the innermost portion the value of κ_m was 103×10^{-6}. The highly oxidised portion has a susceptibility almost identical with specimens of red or brown hematite. After roasting with free access of air both the oxidised layer and the innermost portion gave almost the same values of κ_m, namely, 0·014 and 0·0138. The high susceptibility found in ferric oxide is associated with the passage through the stage of magnetite during its production, but an inspection of chrome iron ore and hornblende shows a reverse effect, that is, a diminution is produced by heating.

The effects of heating and cooling freely in air certain minerals in powder form was next dealt with; the analysis of the compounds at the various stages of heating is still under consideration, but it is indicated by the experiments that a different susceptibility can be obtained by heat treatment according to fineness of division and access of air, and this is important in the event of large quantities having to be dealt with.

The transformation temperatures of natural and artificially prepared minerals and alloys have been examined by many workers, and the results published. The magnetic properties of salts have been investigated by many workers, and it is an interesting fact that copper has a negative susceptibility and its salts are positive, whereas magnesium is positive and its salts are negative. Wiedemann showed as early as 1865 that paramagnetic salts when hydrated give a higher value than the anhydrous salts, although water itself is diamagnetic.

SUMMER MEETING.—The summer meeting of the Institution will take place in Scotland on June 7th to 10th, and will include visits to Glasgow, Fort William, and Oban.

NORTH-WESTERN CENTRE.—The syllabus for the second half of Session 1920-1921 is as follows:—March 8th, "Electric Driving in the Paper Mill on Heat-Economy Lines," by A. B. Mallinson; March 22nd, To be announced later; April 6th (Wednesday), Popular lecture, by Prof. E. W. Marchant, D.Sc., on "Modern Developments in Wireless Telegraphy and Telephony"; April 12th, Annual general meeting and smoking concert.

NORTH-EASTERN STUDENTS' SECTION.—On January 28th, Mr. C. C. Paterson, O.B.E., M.I.E.E., gave an address entitled: "The Electric Lamp from the Inside," in which detailed information upon the manufacture of an electric lamp was given. The speaker also dealt with the "Edison effect," and the metallurgy of tungsten.

Manchester Wireless Society.—On February 16th, Mr. J. McKernan lectured on "Colour Photography," to a large audience. The lecture was illustrated by some wonderfully-tinted photographs taken by the speaker.

Institute of Post Office Electrical Engineers.—At a meeting of the Bristol Centre on February 15th, Mr. A. J. Stubbs, Assistant Engineer-in-Chief, gave an address on "Fifty Years of State Telegraphs," which was confined to the historical side of the subject.

Physical Society of London.—At the annual general meeting, on February 11th, the reports of the Council and the treasurer were unanimously adopted. The officers and Council elected for the ensuing year are the following:—President, Prof. Sir W. H. Bragg, C.B.E., M.A., F.R.S.; secretaries, Messrs. F. E. Smith, O.B.E., F.R.S., National Physical Laboratory, Teddington; D. Owen, B.A., D.Sc., 62, Wellington Road, Bush Hill Park, N.; foreign secretary, Sir Arthur Schuster, Ph.D., D.Sc., F.R.S.; treasurer, Mr. W. R. Cooper, M.A., B.Sc., 82, Victoria Street, S.W. 1; librarian, Prof. A. O. Rankine, D.Sc., Imperial College of Science and Technology. After the conclusion of the general business, a discussion on "Absolute Measurements of Electrical Resistance, and Instruments based on the Temperature Variation of Resistance," was held.

Royal Institution.—On Saturday, March 5th, at 3 o'clock, Sir Ernest Rutherford will deliver the first of a course of three lectures at the Royal Institution on "Electricity and Matter." The Friday evening discourse, on March 4th, will be delivered by Mr. W. A. Tait on "Severn Crossings and Tidal Power."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

The Times states that MR. JOHN NOBLE, the vice-chairman of Sir W. G. Armstrong, Whitworth & Co., Ltd., and MR. R. WATERS, the head of the company's commercial organisation, are sailing this week on an extended business mission to South America.

MR. W. R. MONTGOMERY, A.M.I.E.E., for some years on the engineering staff of the E.P.S. Co., and until lately sales engineer to Mr. H. P. Girling, M.I.E.E., of Maldon, has joined the staff of Messrs. Agricultural and General Engineers, Ltd., Central House, Kingsway, W.C. 2. He will be responsible for the sales in the eastern zone of the associated firms' electrical products, including the "Garrett" electric vehicle.

MR. J. M. KEENAN, late deputy borough electrical engineer at Torquay, has been appointed engineer and manager of the Thanet Electric Co., Ltd., Margate.

MR. LEONARD HARVEY, of 25, Victoria Street, Westminster, who has during the past few years made a special study of pulverised coal applications and uses, and has been representing an American firm as European manager, is relinquishing this position, and will practise as a consulting engineer upon matters pertaining to pulverised coal and colloidal fuel, at the address mentioned.

Messrs. H. W. Smith & Co. (1920), Ltd., have appointed MR. S. M. HAMMETT (who was for some years with Messrs. Baxendale and Co., Ltd.), as their representative in Lancashire.

MR. A. FLINDERS CAINE has resigned his position as manager of the heating and cooking department of the Edison Swan Electric Co., Ltd., Ponders End.

Obituary.—MR. R. RANKIN.—We regret to record that the death of Mr. Robert Rankin, B.Sc., occurred at his residence at Leamington on the 17th inst. Since 1918 deceased was managing director of Messrs. Van Raden & Co., Ltd., Coventry. He commenced his training in the engineering profession when 15 years old, and became assistant to the Professor of Electrical Engineering in the Glasgow and West of Scotland Technical School. After having been in business in London with the Electrical Storage Co., and subsequently with Messrs. Pritchetts & Gold, Mr. Rankin undertook Government work during the war, and subsequently took up his Coventry appointment. In 1918 he was elected chairman of the Junior Institution of Engineers, and he was the holder of the Vickers Prize Gold Medal of that body, 1915-16, and the bronze medal, 1917-18. He was the author of a work upon "Electric Accumulators," and joint author of an electrical laboratory course for junior students. As one of the leading members of the Informal Meetings Committee of the Institution of Electrical Engineers, full of native humour and ready wit, he was extremely popular; and as a technical man he had a very promising future. Deceased, who was only 35 years of age, leaves a widow and three children.

MR. J. H. CARSON.—We regret to record the death which occurred in London on February 19th, of Mr. James Hamilton Carson, late manager of the Anglo-American Telegraph Co., Ltd., in his 81st year.

NEW COMPANY REGISTERED.

James Antifouling Appliances, Ltd. (173,121).—Private company. Registered February 12th. Capital, £3,000 in £1 shares. To acquire from J. E. James and others the benefit of certain existing inventions relating to the manufacture and working of improvements in electrical apparatus for protecting the hulls of ships and other submerged structures from barnacles and other forms of aquatic life. The subscribers (each with one share) are: W. H. Larter, 67, Wynnstay Gardens, W. 8, engineer; H. Neville, "Ambleside," Downs Court Road, Purley, engineer. The first directors are: J. E. James, of Bolton; J. B. Wilkie, of Liverpool; and one other to be appointed by holders of shares No. 2,085 to 3,000 inclusive. Secretary: W. H. Larter. Registered office: 1a, Cockspur Street, S.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Ilford Dry Battery Co., Ltd.—Debentures dated February 2nd, 1921, to secure £1,000 charged on the company's undertaking and property, present and future, including uncalled capital. Holder: R. Baickie, 3, Clarence Road, Nottingham.

Europe and Azores Telegraph Co., Ltd. (39,452).—Capital £200,000 in £10 shares. Return dated December 15th, 1920. All shares taken up. £144,320 paid. £55,680 considered as paid. Mortgages and charges, nil.

Berry's Electric, Ltd.—Memorandum of deposit on February 3rd, 1921, to secure all moneys due or to become due from company to London Joint City & Midland Bank, Ltd., charged on company's interest in land in Spring Road, Yardley, Birmingham, with factory thereon.

Tok Manufacturing Co., Ltd.—Satisfaction in full on February 11th, 1921, of debentures dated July 28th, 1920, securing £2,000.

Electrical Finance & Securities Co., Ltd.—Particulars of £20,000 debentures, authorised December 16th, 1920, and covered by trust deed dated February 3rd, 1921; present issue £17,000, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: Union Commercial Investment Co., Ltd.

CITY NOTES.

Fife Tramway, Light and Power Co., Ltd. Mr. George Balfour, M.P., presiding at the annual meeting, held at Edinburgh on Friday, said it was very satisfactory, in face of all the trade depression, that they were able to produce a satisfactory account. After dealing with the accounts of the tramway undertaking, he said that the Fife Electric Power Co. showed a substantial increase in net revenue due to the large expenditure on capital account which had been made in previous years. The gross receipts amounted to £114,905, compared with £73,560 for 1919. The net trading profit, including the profit under the Electric Lighting Orders, amounting to £36,998, as compared with £21,990 in the preceding year; 19,579,000 units were sold from the power station at Townhill, compared with 14,891,000 for 1919. The cousumers connected numbered 2,995, an increase of 449. During the last three years the number of consumers connected had been more than doubled. The demand for electricity continued unabated, as was evidenced by the figures, and by the fact that at the moment some 150 consumers, large and small, were awaiting connection. The total load connected with the power station was approximately 11,840 kW, compared with 8,830 kW for the preceding year. Various extensions to the plant had been carried out during the year to cope with the increasing demands and for the purpose of effecting economies in supply. After referring to the electric lighting orders in the Cowdenbeath area and in various parts of the county of Fife, Mr. Balfour said these undertakings were granted direct to the company, and a supply of electricity was given over a large and scattered area under the provisions of these orders, the supply being obtained in bulk from the Fife Electric Power Co. The issued share capital now stood at £720,000, an addition of £320,000 for the year. The gross revenue from the traction, lighting, and power undertakings amounted to £72,801, compared with £48,393 for 1919. The directors recommended a dividend on the ordinary shares at the rate of 8 per cent. per annum, being the same rate as was paid on a considerably smaller capital for the previous year. They had no doubt shareholders would endorse the policy they had adopted of strengthening the reserves by the appropriation of £20,000 and of paying the same dividend to the ordinary shareholders as was received last year. The directors felt sure that this policy would appeal to the shareholders as being a sound and prudent one to follow, particularly under the present financial conditions.

Underground Electric Railway Companies. The ordinary general meetings of the five companies forming this group were held at Caxton Hall, Westminster, on February 17th, Lord Ashfield (chairman) presiding. The reports of the companies were abstracted in our last issue.

At the City and South London meeting, the chairman stated that the passing of the London Electric Railways Fares Act had enabled the business to approach a level of financial stability, and the receipts in the last three months of the year showed a 30 per cent. advance upon those of the first three months, but the number of passengers carried fell by 14 per cent. The difficulty of raising the £1,750,000 required for the reconstruction of the railway had prevented any progress in this direction, but the directors hoped to commence the work when funds were available on reasonable terms. The principles of grouping outlined by the Minister of Transport possessed many obvious advantages, and would be acceptable to the group. The positions of main line railways and the London lines were very different, however. The former were extensive and fully developed, whereas the underground railways were still unfinished, and required much more capital for their completion. With a probable decline in working costs the position of the companies would improve considerably in the near future.

The chairman explained at the meeting of the shareholders of the Metropolitan District Railway that the company was one of those taken over by the Government at the beginning of the war. One of the terms of control was that the net revenue of 1913 should be guaranteed to the company. When the common fund of the group was set up in 1915 this arrangement was modified. The increased fares were allowed on the understanding that the special arrangement of 1915 was cancelled. This was found impracticable, and it was agreed, therefore, that the railway should be freed from Government control; this decision had been justified by the improved condition brought about by the increase in fares. The receipts of the four railways had increased by 23 per cent. during the last quarter, as compared with the first three months of the year, although the number of passengers carried had fallen by 10 per cent. Speaking of future developments, Lord Ashfield said that the construction of a Hampstead and Edgware line through Hendon to Golders Green was being considered; Parliamentary powers had been received for this work. This line should be proceeded with immediately, as it would prove a very remunerative undertaking. The speaker looked for useful developments from the negotiations taking place between the authorities concerned with the London traffic problem; if a successful outcome could be arrived at the result would be simplification and improvement. Lord Ashfield told the shareholders of the Central London Railway Co. that their undertaking had benefited most from the increase in fares, the increase as between the first and last quarters of the year having been 35 per cent.; this was partly due to a small increase in the traffic. The traffic upon the new Shepherd's Bush-Ealing extension was at present unsatisfactory, but hopes of improvement were entertained by the directors. The chief obstacle to its growth was that main line fares were being charged. The G.W.R. Co. was contemplating the provision of two additional stations on this extension at Old Oak Common and Twyford; these should materially increase the number of passengers carried. Referring to future developments, the speaker said that Parliament had sanctioned the construction of a connecting line with the London and South Western Railway at a point near that company's station at Shepherd's Bush. This would provide a through run to Richmond. Although this work would be carried out at the earliest possible moment, the present financial stringency prevented an immediate commencement.

At the meeting of the London Electric Railway Co., Lord Ashfield said that the position had taken a turn for the worse during the present year, two members of the group having incurred a deficit. The result of this had been that the common fund had had a distributable amount of £354,492, as compared with £496,387 in the previous year. This was due to the delay in sanctioning the increases which were finally put into force in September last. Since that date, however, the receipts had advanced by 27 per cent., comparing the first and last quarters, and the number of passengers had been reduced by only 12 per cent. The expenditure on capital account of £88,404 was chiefly on account of joint rolling stock for the extension to Watford over the L. & N.W. Railway, of the cost of which one-third was paid by the company. Capital commitments amounted to £182,500, chiefly due to the purchase of 40 new trailer cars for the Bakerloo section, and improvements to the lifts to expedite their working. Future works included the construction of a line linking up the Hampstead section with the City and South London Railway. This would cost about £1,142,000, but the present time was not propitious for the raising of this amount. Upon the whole, the chairman said he could not consider the year under review as satisfactory, but he hoped to report a substantial improvement at the next annual meeting.

Tyneside Tramways & Tramroads Co.—At the half-yearly meeting, held in Newcastle-on-Tyne on 15th inst., Mr. J. T. Merz said that the year had been an exceptional one in many ways, but especially in their business. In other concerns prices could be advanced to meet the needs of the moment, but they had to go to Parliament before they could increase fares. Going to Parliament, however, meant a delay of six months, which had a due effect on the balance sheet. However, the next half-year should show a normal state of affairs in the business of the company. Owing to the coal strike in October the autumn races at Gosforth were abandoned; that meant a loss of revenue. The dividend was only 4 per cent., as against 5 per cent. for 1919, and 6 per cent. for 1918.

City of London Electric Lighting Co., Ltd.—Dividend on the preference shares 6 per cent., being 1s. 2.4d. per £1 share; on the ordinary shares 12 per cent., being 2s. 4.8d. per £1 share. On account of these dividends 7.2d. per preference share and 9d. per ordinary share was paid in September, 1920. In addition, the directors recommend a bonus of 2 per cent. per ordinary share, being 4.8d. per £1 share, on account of the reduction of dividend for the year 1916, leaving the reductions in 1917 and 1918 to be dealt with in the future. This bonus will also be subject to deduction of income tax. After payment of the dividends and bonus less income tax, and providing for other appropriations, £23,000 will remain to be carried forward.

Midland Electric Corporation for Power Distribution.—Final dividend at the rate of 6 per cent. on the ordinary shares, making 10 per cent. for the year; on the new ordinary at the rate of 10 per cent. Carried forward subject to E.P.D., £36,486.

Tramways, Light and Power Co.—Profit for 1920, £53,697 plus £3,833 brought forward. After paying debenture charges and putting £5,000 to reserve, 6 per cent., less tax, is paid on the ordinary shares. £2,256 is carried forward.

Paisley Tramways Co.—After paying preference interest and putting £1,000 to preference sinking fund, £65,457 is carried forward.

Mansfield and District Tramways Co., Ltd.—It is proposed to increase the capital from £130,000 to £180,000 by the creation of 50,000 new ordinary shares of £1.

Melbourne Electric Supply Co., Ltd.—Resolutions authorising the recent issue of 8 per cent. £5 preference shares were confirmed at a meeting held on Tuesday.

Northampton Electric Light & Power Co., Ltd.—The business showed considerable expansion during 1920, and there was an increase in net profit. Units sold increased from 6,589,108 to 7,646,577. The balance of the new 7 per cent. second debenture stock will be offered shortly. The capacity of the Hardingstone Junction generating station is to be increased; the engine and boiler houses will be enlarged, and orders for a 6,000-kW turbo-alternator, boilers, &c., have been placed. £12,360 has been put to depreciation (£1,360 allocated to motors, of which 4,607 h.p. are let out on hire). A battery suspense fund is being formed to spread the occasional heavy expenses for repairs over a longer period. After paying 5 per cent. on the preference shares and 8 per cent. on the ordinary for the year, £1,500 is to be carried forward.

County of London Electric Supply Co., Ltd.—Final dividend on the ordinary shares for the past half-year at the rate of 11 per cent. per annum, less tax, making 8 per cent. for the year. £50,000 to depreciation; £62,500 to general reserve; £18,500 forward.

Stock Exchange Notices.—The following have been ordered to be officially quoted:—

Erinoid.—265,278 shares of 5s. each, fully paid, Nos. 700,001 to 965,278.

Melbourne Electric Supply Co.—£96,365 consolidated ordinary stock.

Dealings in the following have been specially allowed by the Committee, and the shares are now included with those in which special settlements have already been granted:—

Major & Co.—79,510 8 per cent. participating preferred ordinary shares of £1 each, fully paid, Nos. 1 to 79,510; and 20,000 ordinary shares of £1 each, fully paid, Nos. 1 to 20,000 (issued to deferred ordinary shareholders).

Smithfield Markets Electric Supply Co., Ltd.—Gross profit for 1920 £9,262, against £6,588 in 1919; net profit £8,718, against £5,464 in 1919. £3,500 to depreciation; £800 to debenture stock redemption fund. After including the balance at credit of profit and loss account at end of 1919, £5,748 remains. A dividend of 5 per cent. per annum on the ordinary shares requires £3,000; to reserve £2,000; carried forward £748. The removal of official control of the markets in July, 1920, re-established normal conditions during the second half of the year, resulting in a satisfactory increase in output.

Rushden & District Electric Supply Co., Ltd.—Connections greatly increased during 1920; consumers (chiefly for lighting) grew from 223 to 308, but owing to the depression in trade during the last six months, the output of electricity has remained stationary. When trade revives considerable expansion is expected. Maximum load, 365 kW; units sold, 584,220. £1,075 to depreciation, £100 written off preliminary expenses; final dividend 4 per cent., making 6½ per cent. for 1920. £316 forward.

Tullamore Electric Light & Power Co., Ltd.—At a general meeting of this company, Mr. P. J. Egan presiding, the directors reported that 11,835 £1 shares had been issued for cash—5s. per share, payable on application; that the purchase of dynamo and engine, consulting engineer's fees, absorbed £1,950, and purchase of power house £175; and that preliminary expenses were estimated at £800. Mr. Kelly (secretary) said the machinery would be installed by March, and all should be in readiness for lighting the town in October next.

Liverpool Overhead Railway Co.—Gross revenue receipts for 1920 £229,130; working expenses, including appropriation to reserve, £199,881; leaving £29,248, plus £6,015 brought forward. Debenture interest £6,755; dividends for the year 5 per cent. on the preference shares and 3 per cent. on the ordinary; £5,577 forward. Passengers carried: 1920, 21,020,839; 1919, 22,440,103.

Charing Cross, West End & City Electricity Supply Co., Ltd.—Dividend on the ordinary share capital of the West End undertakings for the half-year ended December 31st, 1920, at the rate of 5s. 6d. per share, making, with the interim dividend already distributed, 8 per cent. for the year 1920.

Bournemouth & Poole Electricity Supply Co., Ltd.—Final dividend on the ordinary shares at the rate of 7 per cent. per annum, less tax, making 6 per cent. for 1920.

Chelsea Electricity Supply Co., Ltd.—Dividend of 7 per cent. for the half-year, making 6 per cent. for the year; £17,312 to depreciation; £2,178 written off cost of extinction of founders' shares; £2,925 written off investments; £2,429 carried forward.

Traction & Power Securities Co.—Net revenue for 1920 £33,819, plus £10,932 brought forward. Dividend 7s. 6d. per share, free of tax, carrying forward £12,722 subject to corporation tax.

Kensington & Knightsbridge Electric Lighting Co., Ltd.—Dividend of 5 per cent. on the ordinary shares for the last half-year, making 9 per cent. for the year.

India.—Ahmedabad Electricity Co., Ltd.—Fourth dividend for the year ended September 30th, 1920, at the rate of 10 per cent. per annum.—*Indian Textile Journal.*

National Boiler & General Insurance Co., Ltd.—Dividend of 18s. per share, less tax, for 1920. To investment reserve £6,841; carried forward £3,949.

STOCKS AND SHARES.

Tuesday Evening.

The electricity supply companies are certainly doing well in regard to their dividend announcements. Up to the time of writing, increases have been declared by the City of London, Chelsea, Charing Cross, Kensington, Metropolitan, and South Metropolitan companies. There may be others to come. In no case has the 1919 dividend been diminished. This is a performance which cannot fail to be observed when trade conditions become more normal and investors are looking round for opportunities to place their money in commercial undertakings offering prospects of steady improvement. It is interesting to compare the results of the past three years as follows:—

	1920 p.c.	1919 p.c.	1918 p.c.
Charing Cross	8	7	4
Chelsea	6	4	3
County	8	8	7
Kensington and Knightsbridge ...	9	7	6
London	2½	2½	nil
Metropolitan	7	6	5
St. James's	12	12	10
South Metropolitan	8	6	6
Westminster	10	10	8

The City of London dividend makes 14 per cent. altogether, as against 13 per cent., in all, a year ago.

Prices are harder. Westminsters have advanced to 5¼ and Metropolitans to 3. County preference are 5s. higher at 8⅜. The rest are firm at the quoted figures. Sir Eric Geddes stated in the House of Commons on Monday that the Ministry of Transport had received many applications from supply companies for permission to put up the price of electricity. Sir Eric was guarded in his remarks, but apparently the applicants have not been sent empty away in all cases.

In spite of the firmness in the market for supply shares, a fairly general decline has taken place in the list of prices in the shares of manufacturing companies. Amongst those which have fallen this week are English Electric 13s., Electric Constructions 13/16, General Electrics 1 3/16, Siemens 19s. 4½d., the new at 18s. 3d., Metropolitan-Vickers ordinary 18s. 1½d., and Edisons at 10s. The disappointment felt in connection with the Edison dividend is reflected in apprehensions that other manufacturing companies may not be able to keep up their previous distributions, and having regard to the tightness of money, it is not unreasonable to regard such fears as justifiable. People are afraid to buy anything of the manufacturing type of share at the present time, and therefore when there is any slight pressure to sell, prices have to give way, because there is no support to back them. Callender's 6½ per cent. preference, however, are in request, the price being better at 17s. 6d.; the 7½ per cent. preference hardened to 19s. 3d.

The Home Railway market has again been very flat, with substantial falls in debenture, preference, guaranteed, leased lines, and other prior-charge securities, There seems to be no stopping the fall in this particular market, a fall started by the Colwyn report and accelerated by the growing nervousness felt as to the Government's readiness to discharge its obligation to hand back the railways next August in as good a condition as they were taken over from the companies upon the outbreak of war. The Undergrounds are exceptional in the list of ordinary stocks as showing a fair amount of strength, speeches at the various meetings of the Underground companies last week serving to maintain prices, although here also there has been some little reaction from the best. Underground incomes are 2 points higher at 70½. District 4 per cent. debenture has fallen to 52½, and the company's 4 per cent. debenture of 1902-3 is weaker at 52.

It may be remarked parenthetically that a firm of outside brokers is sending out circulars offering Contingent Certificates of the Underground Electric Railways of London at 1s. 3d. each net. The firm are prepared to sell the shares for cash outright or on the instalment principle. Curiosity may wonder where the certificates are coming from to supply the demand, but as they are obtainable in the Stock Exchange at about sevenpence apiece, it is not difficult to understand the source of supply.

Cable stocks show little disposition to halt in their steady upward march. This week, rises are marked in Western Telegraphs at 16⅛ and Eastern Extensions 15⅝. Eastern ordinary has been 162, but reverted to 160½, while Great Northerns are ¼ down at 21¾. Indo-Europeans, which for some time past has been quoted at the extraordinarily wide margin of 25—35, changed hands the other day at 26 and 26½. Holders of stocks in the Eastern group of companies are being exhorted in some quarters to watch with close attention the developments in connection with the Great Northern and Indo-European companies, since as soon as these two get going in full swing again, they may prove formidable competitors to the Eastern and its associated companies. Under ordinary trade conditions, however, there is plenty of room and plenty of traffic for them all. Anglo-American preferred at 81½ is a point lower. Orientals weakened to 2 3/16, and Marconi's are heavy at 1⅞, while Radios of both classes are a trifle down at 8s. 3d. for the common and 11s. 3d. for the preferred. There is nothing doing, however, in any of the Marconi shares, and the dullness of the market is due to the indifference shown by those who commonly support Marconi's when prices are depressed.

British Columbia deferred has gone back 3 points to 48½, with business marked as low as 47½. Considering the high yield offered by the stock, it is difficult to account for the flatness in the price. Financial affairs in the Dominion, however, seem to be none too happy, according to the private letters, and the tightness of monetary conditions is as noticeable there as it is on this side of the Atlantic. Mexican issues have gone back, the principal fall this week being one of 3½ points in Mexican Light & Power preferred shares. Anglo-Argentine Tramways second preference gave way to 3⅛, the 5 per cent. debenture stock, however, advancing to 60½, the stock being steadily absorbed by the smaller investor. British Electric Traction 5 per cent. debenture is harder at 61.

The rubber market is virtually dead. The various panaceas put forward to assist the price of the raw produce make no headway against the apathy of raw rubber buyers, and, until a change occurs in business conditions in America, it is not likely that the price of rubber will make any material improvement. The weakness of armament shares was arrested by a slight recovery in Vickers, which assisted Armstrongs and other members of the group, but the market in the shares as a whole does not appear to have much staying power, and the recovery was partially lost. It is well, however, to keep in mind the fact that E.P.D. comes off before long, and that the payments which have been made by industrial companies on account of this tax constitute a kind of hidden reserve that will be of assistance to some of the companies most heavily hit.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Feb. 22, 1921.	Rise or fall.	Yield p.c.
Brompton Ordinary	8	12	5⅞	—	£10 4 4
Charing Cross Ordinary	4	7	4	—	10 0 0
do. do. do. 4½ Pref.	4½	4½	2¾	—	8 8 8
Chelsea	8	4	8½	—	9 10 6
City of London	8	10	24/3	—	8 5 4
do. do. 6 per cent. Pref.	6	6	17/8	—	6 17 2
County of London	7	8	7½	—	10 18 4
do. do. 6 per cent. Pref.	6	6	8⅛	+ ½	7 7 8
Kensington Ordinary	6	7	8⅞	—	11 11 4
London Electric	Nil	2½	¾	—	10 0 0
do. do. 6 per cent. Pref.	6	6	2¾	—	10 18 2
Metropolitan	6	6	8	+ ⅛	11 18 4
do. 4½ per cent. Pref.	4½	4½	2 9/16	—	8 15 8
St. James' and Pall Mall	10	12	6¼	—	9 12 0
South London	6	6	2⅝	—	9 2 10
South Metropolitan Pref.	7	7	13/9	—	10 8 6
Westminster Ordinary	8	10	5½	+ ⅛	9 10 6

TELEGRAPHS AND TELEPHONES.

	Dividend 1918.	Dividend 1919.	Price Feb. 22, 1921.	Rise or fall.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	81½	−1	7 8 8
do. Def.	33/6	1½	16½	—	9 6 8
Chile Telephone	8	8	5⅝	—	*5 6 8
Cuba Sub. Ord.	7	7	8½	—	*10 15 4
Eastern Extension	10	10	15⅝	+ ⅛	*8 8 0
Eastern Tel. Ord.	8	10	16½	—	*6 4 5
Globe Tel. and T. Ord.	8	10	15⅝	—	*6 8 0
do. do. Pref.	6	6	9	—	6 18 4
Great Northern Tel.	22	22	21¾	− ½	10 2 4
Indo-European	18	10	80	—	8 6 8
Marconi	26	26	1⅞	− 1/16	–
Oriental Telephone Ord.	10	12	2 1/16	− ⅛	*6 9 7
United R. Plate Tel.	8	8	8½	—	*6 8 0
West India and Panama	1/8	Nil	9/16	—	Nil
Western Telegraph	8	10	16⅛	+ ⅛	*6 5 0

HOME RAILS.

	Dividend 1918.	Dividend 1919.	Price Feb. 22, 1921.	Rise or fall.	Yield p.c.
Central London Ord. Assented	4	4	43½	—	9 4 0
Metropolitan	1	1½	20½	—	7 6 4
do. District	Nil	Nil	15	—	Nil
Underground Electric Ordinary	Nil	Nil	2	+ ⅛	Nil
do. do. "A"	Nil	Nil	5/6	—	Nil
do. do. Income	6	4	70½	+ 2	2 16 9

FOREIGN TRAMS, &c.

	Dividend 1918.	Dividend 1919.	Price Feb. 22, 1921.	Rise or fall.	Yield p.c.
Anglo-Arg. Trams, First Pref.	Nil	6½	2⅝	—	10 9 6
do. do. 2nd Pref.	Nil	Nil	3⅛	− ⅛	Nil
do. do. 5 % Deb.	6	6	60½	+ 1	8 8 0
Brazil Tractions	Nil	Nil	33	—	Nil
British Columbia Elec. Rly. Pfce.	5	5	56	—	8 18 6
do. do. Preferred	2½	6	68½	—	*8 16 0
do. do. Deferred	Nil	3	48½	− 3	*12 17 8
do. do. Deb.	4½	4½	67½	+ 2	7 10 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	40½	− 2	Nil
do. 6 per cent. Bonds	Nil	Nil	24½	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	18	−3½	Nil
do. 1st Bonds	Nil	Nil	63½	—	Nil

MANUFACTURING COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Feb. 22, 1921.	Rise or fall.	Yield p.c.
Babcock & Wilcox	15	15	2¼	—	6 13 8
British Aluminium Ord.	10	10	17/-	− 3d.	11 15 4
British Insulated Ord.	12½	15	1⅝	—	9 5 10
Callenders	25	15	1⅜	—	10 18 2
,, 6½ Pref.	6½	6½	17/6	—	7 8 7
Castner-Kellner	20	17	2⅞	—	7 12 9
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	10	10/-	—9d.	—
do. do. 5 per cent. Deb.	5	5	70	—	7 2 10
Electric Construction	10	10	13/16	− 1/16	12 6 2
English Electric	—	8	13/-	—	10 19 2
Do. Pref.	—	6	14/-	—	8 11 6
Gen. Elec. Pref.	6½	6½	18/6	—	7 2 6
do. Ord.	10	10	1 3/16	− 1/32	*8 8 5
Henley	25	15	1 7/16	—	10 5 0
do. 4½ Pref.	4½	4½	3¼	—	6 18 6
India-Rubber	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	1 1/16	—	8 16 4
Siemens Ord.	10	10	3 1/32	− 1/16	*10 6 2
Telegraph Con.	20	20	21½	—	*6 11 8

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, February 22nd.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/1	3d. dec.
a Ammoniac Sal	per ton	£100	£ 0 dec.
a Ammonia, Muriate (large crystal)	,,	£73	£8 dec.
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£38	...
a Copper Sulphate	,,	£35	£3 dec.
a Potash, Chlorate	per lb.	7d.	½d. dec.
a ,, Perchlorate	,,	10d.	2d. dec.
a Shellac	per cwt	£16	10s. dec.
a Sulphate of Magnesia	per ton	£16	£2 dec.
a Sulphur, Sublimed Flowers	,,	£22	£4 dec.
a ,, Lump	,,	£18	..
a Soda, Chlorate	per lb.	4½d.	½d. dec.
a ,, Crystals	per ton	£7	...
a Sodium Bichromate, casks	per lb.	1/-	...
METALS, &c.			
p Babbitt's Metal Ingots	per ton	£96 to £300	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/0½	...
c ,, Tubes (solid drawn)	,,	1/2½ to 1/2¾	¼d. dec.
c ,, Wire, basis	,,	1/0⅞	...
c Copper Tubes (solid drawn)	,,	1/4¾	¾d. dec.
c ,, Bars (best selected)	per ton	£120	£4 dec.
c ,, Sheet	,,	£120	£4 dec.
c ,, Rod	,,	£120	£4 dec.
d ,, (Electrolytic) Bars	,,	£79	£2 inc.
d ,, ,, Sheets	,,	£143	...
d ,, ,, Wire Rods	,,	£95	£1 inc.
d ,, ,, H.C. Wire	per lb.	1/0⅜	¼d. inc.
f Ebonite Rod	,,	8/6	...
f ,, Sheet	,,	8/-	...
n German Silver Wire	,,	2/9	...
h Gutta-percha, fine	,,	14/- to 16/-	...
h India-rubber, Para fine	,,	11½d.	¼d. dec.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£50	...
g Lead, English Pig	,,	£20 15s.	65/- dec.
g Mercury	per bot.	£12 10 to £12 15	...
e Mica (in original cases) small	per lb.	6d. to 4/8	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
p Phosphor Bronze, plain castings	,,	1/5 to 1/10	1d. dec.
p ,, ,, rolled bars and rods	,,	2/4 to 2/7	1d. dec.
p ,, ,, rolled strip & sheet	,,	2/4 to 2/8	1d. dec.
d Silicium Bronze Wire	per lb.	1/4	...
r Steel, Magnet, in bars	,,	1/8	...
n Tin, Block (English)	per ton	£165 to £166	£8 inc.
n ,, Wire, Nos. 1 to 16	per lb.	4/6	...
p White Anti-friction Metals	per ton	£78 to £300	...

Quotations supplied by—

a G. Boor & Co.	*g* James & Shakespeare.
c Thos. Bolton & Sons, Ltd.	*h* Edward Till & Co.
d Frederick Smith & Co.	*i* Bolling & Lowe.
e F. Wiggins & Sons.	*l* Richard Johnson & Nephew, Ltd
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.	*n* P. Ormiston & Sons.
	p ————

r W. F. Dennis & Co.

Mersey Railway Co.—The report for 1920 states that the total amount available for payment of interest is £48,815, which has been applied as follows: Interest on new first perpetual debenture stock £26,775, interest at 4 per cent. on the 1866 debenture stock; 3 per cent. on the 1871; 3 per cent. on the 1882-3-5 stock; and 1½ per cent. on the "B" debenture stock; leaving £58 to carry forward. The directors have applied to the Ministry of Transport for the exclusion of the railway from the Government grouping scheme.

Tasmanian Zinc Works.—Press reports to hand show that it was decided to cease production on December 31st last at the Electrolytic Zinc Co.'s works at Risdon (Tasmania), but constructional work on the plant was to be continued. Severe dislocation of trade and industry with the heavy fall in metal prices led the company to this decision.

Clyde Valley Electrical Power.—Final dividend on the ordinary shares at the rate of 10 per cent. per annum for the half-year, making 7½ per cent. for the year. For 1919 a dividend of 5 per cent. was paid.

Chelsea Electricity Supply Co., Ltd.—Dividend of 7 per cent. per annum on the ordinary shares for the half-year, making 6 per cent. for the year.

North London Railway Co.—Net receipts for 1920 £160,234, against £165,143 in 1919. Dividend on consolidated stock 5½ per cent.

Telegraph Construction & Maintenance Co., Ltd.—Further dividend of 7½ per cent. announced.

Mather & Platt, Ltd.—Total dividend on the ordinary shares for 1920 at the rate of 10 per cent. per annum, free of tax.

Crossley Bros., Ltd.—Final dividend on the preference shares is announced, but no further distribution on the ordinary, which received an interim dividend of 3 per cent. for the first half. £51,161 carried forward.

THE BROWN-BOVERI MERCURY ARC RECTIFIER FOR LARGE OUTPUTS.

By R. L. MORRISON, A.M.I.E.E.

(*Concluded from page* 219.)

Short Circuits.—Though short circuits inside the rectifiers are now very rare, it is interesting to know of the difficulties that were experienced in this respect, and the steps taken to eliminate them. It was at first found that there was the liability of short circuits occurring if the pressure was raised above 220 volts, and for some time all the efforts that were made to overcome this tendency proved futile. However, after careful and prolonged investigation a design was gradually evolved in which it has been proved by years of experience that the risk of short circuits is almost negligible. The main causes that were found to be responsible for these occurrences were—condensed mercury running down the surface of the anodes, the effect of ultra violet rays, contact between the anodes and the negative flame already referred to, insufficient vacuum, and continuous abnormal overloading.*

The effects of the first three have been so far eliminated that the possibility of anything of this nature occurring is no more than what might be expected in any other form of electrical plant. The fourth point—insufficient vacuum—has been largely met by the provision of a very satisfactory type of air pump which ensures that the user is fully safeguarded in this respect. Furthermore, it is to his interest to keep the vacuum at a higher level because not only does it improve the overload capacity of the rectifier, but it reduces the drop in the arc, and hence improves the efficiency.

Dealing now with continuous abnormal overloading—the extent to which one can go is governed by the limiting temperature permissible at the anodes, in the same manner that temperature rise fixes the overload capacity of any type of machine. If the temperature of the anodes were allowed to exceed the safe working limit, the valve action would cease. The current would then flow in both directions, this constituting a short circuit. In practice, such contingencies are fully covered by the provision of suitable protective gear.

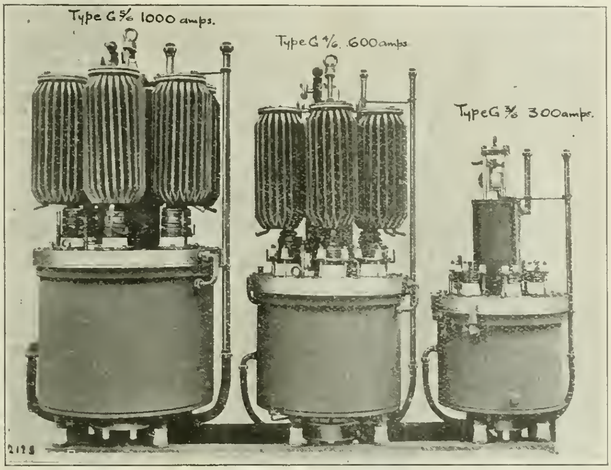


Fig. 9.—Rectifiers Rated at 1,000, 600, and 300 A.

Rating.—From what has already been said it will have been gathered that the rating of a rectifier must be governed by the current-carrying capacity of its anodes, and it is on this basis that three sizes have been standardised for dealing with 300, 600, and 1,000 amperes normal continuous rating (fig. 9). The same design can be used for any pressure up to 750 volts, and with small modifications up to 1,500 volts, while tests indicate that 3,000 or even 5,000 volts is not impossible with perfect safety—in fact the problem is much easier of solution with the rectifier than with the rotary converter.

With these higher pressures it is necessary to reduce the current rating somewhat, and to space the anodes rather further apart. The reason for the current being reduced is not very definitely known, for though a greater pressure drop in the arc has to be contended with, due to increasing the distance between the anodes, yet it is believed that the physical features of the arc play a more important part than is at first apparent. It will be realised that the potential difference between opposing anodes may be nearly double the working pressure, and as this is increased, the tendency to "back firing," as it is called, is also increased, and means must be adopted to keep such tendencies within limits. This "back firing" is probably due to the overcrowding of the molecules when excessive currents are handled. As the potential difference is increased, a point may be reached when some of the unionised gas particles are driven from their path and come near enough to the opposing anodes to be attracted to the positive ions coming from that anode. The resulting impact splits up the particles, and if the newly formed positive ions take the wrong path and come into contact with the opposing anode, cathode spots will be started on that anode. These spots will throw out elec-

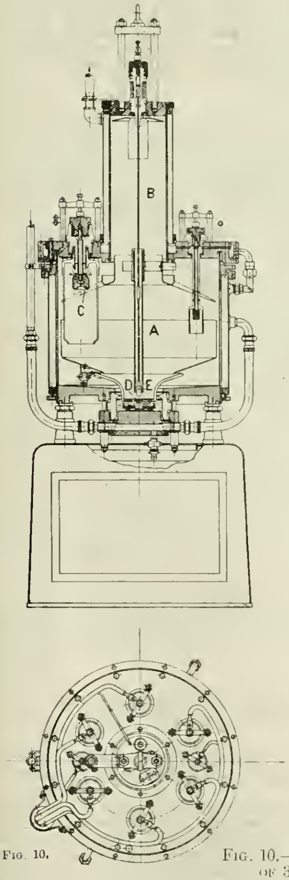


Fig. 10.

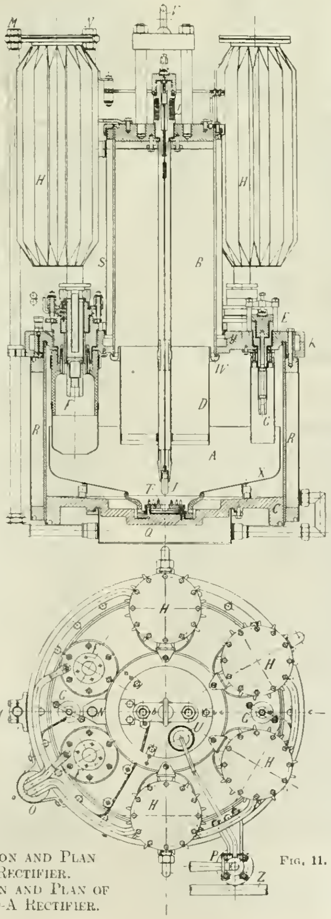


Fig. 11.

Fig. 10.—Section and Plan of 300-A Rectifier.
Fig. 11.—Section and Plan of 600 and 1,000-A Rectifier.

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* See *B.B.C. Review*, No. 6, 1919.

trons which split up the neutral particles in the vicinity of the anode, thus creating fresh positive ions which travel back to the anode and increase the size of the cathode spots. This process would continue until the valve opened and a short-circuit would ensue. The simplest way of avoiding such occurrences is to reduce the current rating of the anodes as well as spacing them somewhat further apart.

There is practically no limit to the output that can be dealt with by rectifiers by operating two or more cylinders in parallel, with a common transformer or a transformer for each cylinder as the conditions dictate.

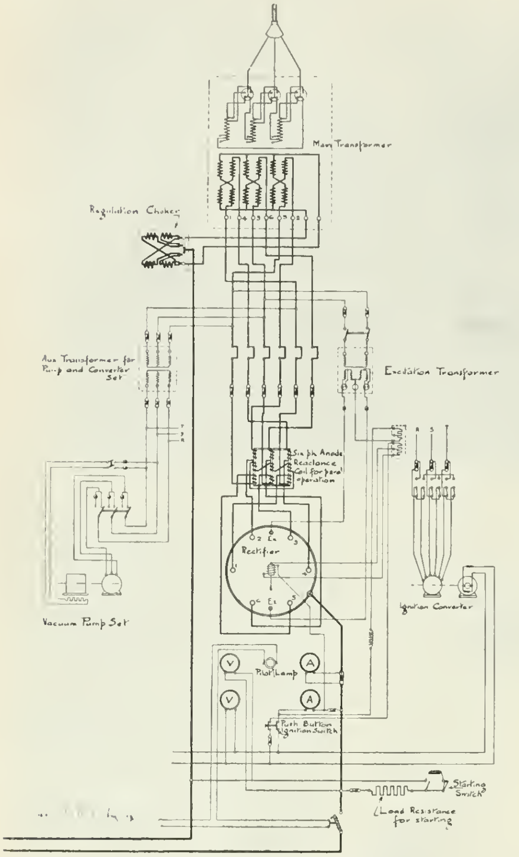


Fig. 12.—Diagram of Connections.

Fig. 10 shows a section through a Brown, Boveri rectifier with a normal rating of 300 amperes. The arc operates in the large lower chamber A between the main anodes C, of which there are six, and the cathode D, while the ascending vapour is condensed in the narrow upper cylinder B. Cooling is provided by water circulating through the jacketing round both sections of the rectifier as well as through the cathode base and the anode plate, which is the hottest part of the rectifier. Ordinary town water is invariably suitable, the quantity required being very small, but if there is any doubt as to its purity it is advisable to utilise a separate recooling system consisting of a number of radiator coolers through which the water is circulated, either on the thermo-siphon principle or by means of a ½-h.p. centrifugal pump. If, however, one pole of the system is earthed or the pressure exceeds 600 volts, the recooling arrangement must in any case be provided to eliminate as far as possible the effects of electrolysis.

The main anodes are completely encased by specially designed leading-in insulators and steel arc guides. The arc is thus confined to a well-defined path, and the possibility of direct short-circuits across the intervening space between the anodes is eliminated. These arc guides terminate in a cylindrical steel dish placed immediately above the cathode. The anodes, which are of special close-grained iron, are rounded and highly polished to remove all ridges or particles of metal from the surface, as irregularities of this nature would tend to produce short circuits.

The larger rectifiers for dealing with 600 and 1,000 amperes are depicted in fig. 11. The design is generally similar to that already described except that the main anodes are water cooled by means of the radiator coolers H. With the smaller cylinders the heat generated at the anodes can quite easily be dissipated through the leading-in insulators to the water cooled anode plate, and by radiation to the interior of the cylinders.

The arc is started by the ignition anode J which is connected to the iron core of the solenoid L by a long rod passing down the centre of the cylinder. The ignition current is provided by a small 110-volt converter. The connections are so arranged that, when the ignition push button switch is closed, the solenoid is energised and the ignition anode, which is normally about 10 mm. above the surface of the mercury, is drawn down against the pressure of a spring until it touches the mercury. The current then flows through the rod to the mercury—thereby short-circuiting the solenoid coil, thus allowing the spring to push the core upwards, which again separates the ignition anode from the mercury. A small arc is started at the point of rupture, and within a second or so sufficient vapour is formed to start the main arc working. The whole operation is extremely simple, and rectifiers that are in continual use can often be started up and paralleled on to the bus bars within a few seconds.

Parallel Operation and Regulation.—Reference has already been made to rectifier units operating in parallel to obtain higher outputs than are afforded by single cylinders. To enable this to be done in cases where a single transformer supplies several units, six-phase anode reactance coils are placed in the anode circuits, these coils also serving to ensure correct parallel operation with converters of other types. By variously connecting the windings any desired inherent regulation can be given. In some instances each rectifier cylinder is provided with its own transformer, and under such circumstances anode coils can be generally dispensed with.

The direct current voltage is controlled either by step-by-step regulation from the primary side of the transformer or by an induction regulator hand or automatically operated. The arrangement with the induction regulator is decidedly preferable for lighting supplies, as the voltage can be varied smoothly and to any extent, and when automatically controlled it is possible to leave the sub-station largely unattended, thus effecting a considerable saving in the matter of attendance. For the case of traction supplies, and where the question of regulation is not of primary importance, the rectifier can be given a shunt characteristic with a 4-5 per cent. rise of pressure with falling load, by the use of a specially designed regulation reactance coil connected in the neutral of the main transformer. An equipment arranged in this manner is very simple and easily operated.

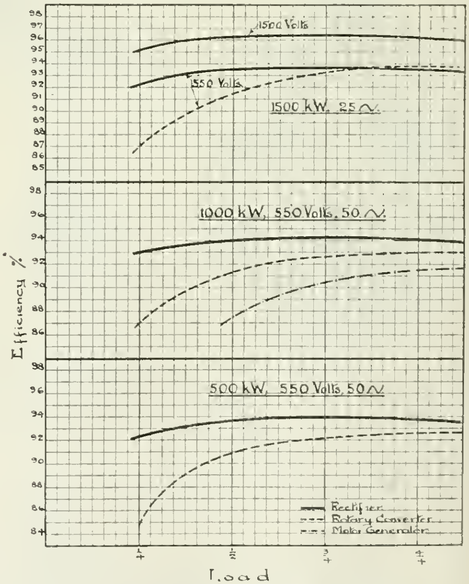


Fig. 13.—Comparative Efficiencies of Rectifiers, Rotary Converters, and Motor-Generators.

A typical diagram of connections showing all the auxiliary gear usually employed is given in fig. 12, the details of which are self-explanatory.

Excitation.—When working at low loads of about one-fifth normal load and below the arc has a tendency to become unstable, and would probably in many instances be extinguished. To obviate this, separate excitation in the form of a small auxiliary arc is provided. This arc is fed by a single-phase exciting transformer connected through a choker and resistance to the two small anodes G seen in fig. 11.

With highly fluctuating loads such as traction, rolling mills, &c., the excitation is kept permanently in circuit; the consumption represented is less than ½ kW per cylinder.

Vacuum.—One of the most important items of auxiliary gear provided with large rectifiers is the vacuum pump set for maintaining the high degree of vacuum essential to satisfactory operation. The vacuum required under normal conditions is about 0.01 mm. Hg. The drop in the arc, and hence the efficiency, is directly proportional to the vacuum which reaches a very high figure (in some cases as much as 0.005 mm. Hg) after the plants have been in operation for some time. These conditions are brought about by a highly efficient two-stage mercury air pump consuming about 1 kW when in use. The vacuum is measured by a very accurate and reliable form of gauge which is calibrated to give direct readings of the vacuum. With this gauge distinct readings of pressure differences as small as 1×10^{-6} mm. Hg. can be made. The gauge is mounted in an iron pillar to prevent breakage. If desired, the rectifiers can be provided with electrical vacuum indicators, the voltmeter portion of which is calibrated to give direct readings of the vacuum, and can be mounted in any convenient position, such as on the switchboard.

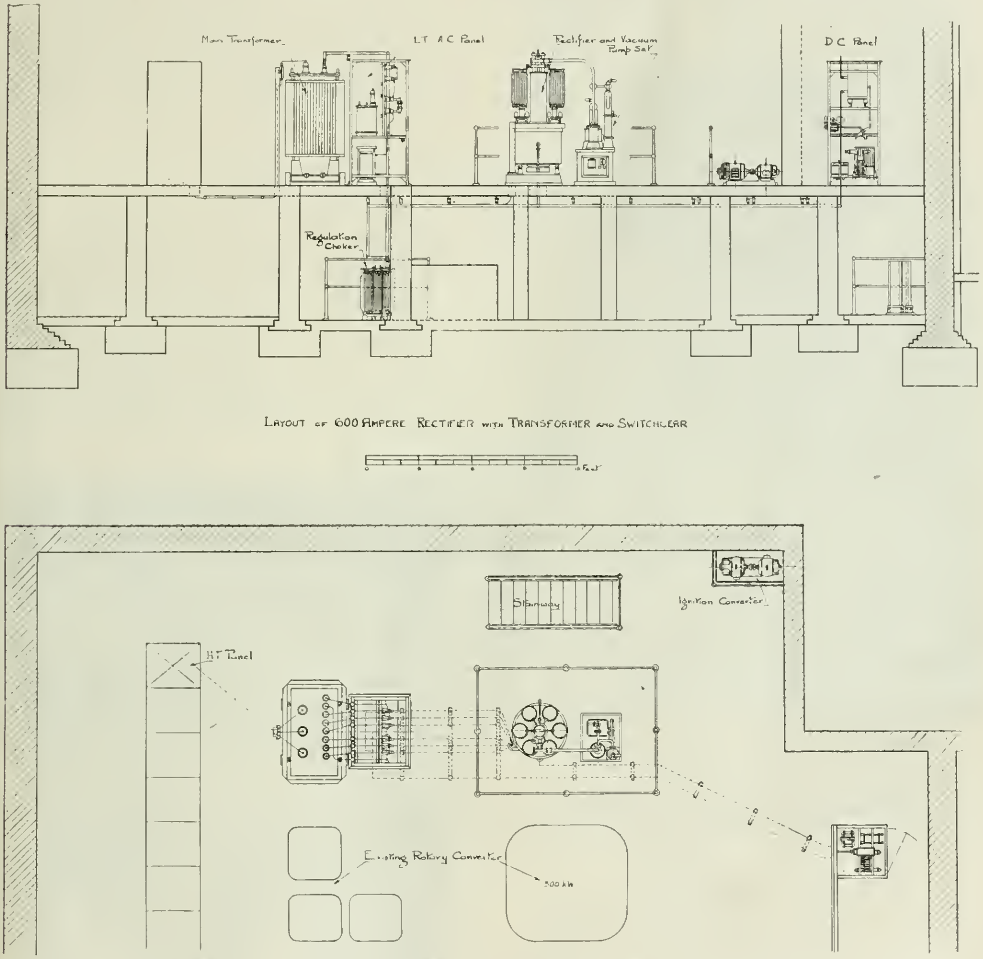

Main Transformer
LT AC Panel
Rectifier and Vacuum Pump Set
DC Panel
Regulation Choker
LAYOUT OF 600 AMPERE RECTIFIER WITH TRANSFORMER AND SWITCHGEAR
0
10 Feet
Stairway
Ignition Converter
HT Panel
Existing Rotary Converter
500 kW

FIG. 14.—TYPICAL LAY-OUT OF SINGLE-CYLINDER RECTIFIER, TRANSFORMER AND SWITCHGEAR.

Efficiency and Power Factor.—It has already been shown that the efficiency of a rectifier remains constant at all loads. To obtain the over-all efficiency, however, account must be taken of the losses occurring in the main transformer and auxiliary gear. Curves have been plotted for various sizes of units in fig. 13, and for purposes of comparison those applicable to rotary converters of equivalent output are also included. It will be seen that the over-all rectifier efficiencies remain practically steady down to nearly ¼ load when the constant losses, such as the transformer iron loss, begin to be felt and the curves commence to fall. The results are, on the whole, a good deal better than those obtained with the rotary converter, and would improve in course of time, due to the better vacuum that would obtain. In this respect it might be said that the value of a rectifier appreciates instead of depreciating as with other converters.

For the higher traction voltages of 1,500 and upwards now coming into use, very high over-all rectifier efficiencies can be given. A curve for a 1,500-kW unit at this pressure is also indicated. In general the power factor varies between 90 and 97 per cent.

General.—In many respects the mercury arc rectifier is decidedly superior to all other forms of converting plant. In the matter of efficiency there is no question of its superiority, except perhaps at low direct current pressures. It is entirely reliable in operation under all conditions, and requires no highly skilled attention. In this connection it might be said that automatic operation by remote control will probably be possible in the near future.

As regards weight—it is less than half that of a rotary converter of the same output at 550 volts, while the floor space required is in general a good deal less. There are no running parts, and in consequence little or no wear, this particularly applying to the rectifiers themselves. Due to the anodes and mercury operating in a high vacuum no oxidisation occurs, and for spares the makers merely recommend stocking a few insulators and fuse elements.

No converter is so capable of handling highly fluctuating loads as the rectifier. It is insensible to short circuits of short duration, but prolonged ones must naturally be cleared by suitable protective gear.

Frequency has no bearing on its output or operation, and has only to be taken account of in the design of the transformer and auxiliary gear. It is thus possible to couple rectifiers in parallel when supplied with current at different frequencies.

In operation the rectifier proper is noiseless, and sub-stations can with impunity be erected in crowded areas without the locality being aware of the existence of converting plant in their midst. To illustrate the possibilities in this respect it might be stated that one set at present on order will probably be placed in the basement immediately below the supply company's show-room.

For high-pressure direct-current traction there is no doubt the rectifier will find an extensive field of application. Several sets have already been installed on the Continent for this class of work at 1,100 and 1,200 volts, and others are in prospect, while pressures up to 3,000 volts will eventually be dealt with.

The lay-out of rectifier plants is a very simple matter. In fig. 14 is depicted one for a small set to be installed in this country. It will be noticed that no special foundations are provided, the only requirement in this respect being that the floor should be level and strong enough to take the weight of the plant. In this respect alone, apart from all other considerations, the saving effected is quite appreciable, and when a new sub-station is required a much lighter design can be adopted than would be the case if a rotary converter was under consideration.

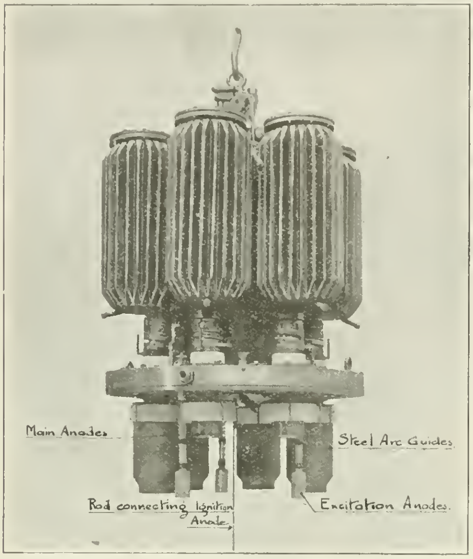


Fig. 15.—Top Half of Large Rectifier (Arc Chamber Removed).

Up to the end of 1920 the total number of rectifier sets either installed or on order was 134, the aggregate output of which is 53,000 kW. Having regard to the comparatively short time the Brown, Boveri rectifier has been commercially manufactured, the manner in which it has been taken up is very gratifying, especially when one considers the large amount of spade-work that had to be done.

In conclusion, the author desires to express his thanks to Messrs. Brown, Boveri & Co., Ltd., and Power-Rectifiers, Ltd., for giving him the facilities and materials upon which this article has been based.

THE SEVERN BARRAGE SCHEME.

On February 10th and 11th a joint meeting was held in Birmingham of the Institutions of Civil Engineers, Electrical Engineers and Mechanical Engineers to discuss the Severn Barrage scheme, and particularly the third interim report of the Water-power Resources Committee. A large gathering attended both meetings. The chair was occupied by Mr. J. D. Watson, M.Inst.C.E. (President of the Birmingham Association of the Institution of Civil Engineers), who was accompanied by Mr. F. Forrest, M.I.E.E. (chairman of the South Midland Centre of the Institution of Electrical Engineers), and Sir Gerald Muntz (representing the Institution of Mechanical Engineers). In introducing the subject, Mr. Watson said the Severn Barrage scheme had been thrust upon the public by a fanfare of trumpets in a manner suggesting political stage management; the subject was intensely interesting, the more so perhaps because it was fraught with many difficulties.

The discussion was opened by Mr. R. A. Chattock, M.I.E.E. (chief electrical engineer to the City of Birmingham), who summarised the particulars which had been published by the Ministry of Transport and the Water Power Resources Committee, and then went on to discuss the financial possibilities of the scheme. The Ministry of Transport scheme mentioned one million h.p. with an average of half a million h.p. over a 10-hour day. The Water Power Resources Committee mentioned an average of 250,000 kW over a 10-hour day, and he took the latter figure as a basis for calculation. The average efficiency of the Ministry of Transport scheme would be about 63 per cent. from the brake-horse-power on the barrage turbine shafts to the overhead transmission lines. Working back from this, it was obvious that the capacity of the generators at the barrage should be 476,000 kW. Taking this figure as a basis, he had estimated that the cost of the necessary electrical machinery would be £17,707,000. This was far too high; he therefore put forward a suggestion to use constant-current d.c. generators in place of constant-potential generators, and to run them in series on the Thury system. The average efficiency of this scheme would be about 62 per cent. from the barrage turbine shafts to the transmission lines, and the scheme would require a generator capacity at the barrage of 456,000 kW. The cost of the electric plant, exclusive of foundations, buildings, &c., in this case, would be, he estimated, £11,998,000. Mr. Chattock also estimated that on the basis of electrical machinery only energy would cost on the Ministry of Transport scheme 0.544d. per unit, and on his suggested scheme 0.369d. per unit. It appeared probable that the cost of other sections of the work would be far heavier than the cost of the electrical equipment, and in order that the whole question might be properly gone into, he welcomed the suggestion of the Water Power Resources Committee that the Board of Trade should appoint a Special Committee of Inquiry to undertake the necessary investigations.

Prof. F. C. Lea, D.Sc., M.Inst.C.E., discussed in detail with the aid of diagrams the complex tidal variations which occurred in the Severn, and described the geological features of the site. In his opinion, before decisions were made it was necessary that careful hydrographic surveys and records should be made, particular attention being given to the problem of silting, and that the geology of the district should be carefully examined. Data were required concerning the daily and the 14-day variations of the tide, and if a reservoir was decided on, its proposed capacity should be considered in relation to both these tidal variations, which were by no means constant. The turbines should be capable of working efficiently at heads varying from 6 to 36 feet. The whole scheme was worthy of consideration, but in view of the large capital expenditure which would be involved, and the possible cost of removing silt, and loss to vested interests, the scheme should be thoroughly examined before any policy was decided upon.

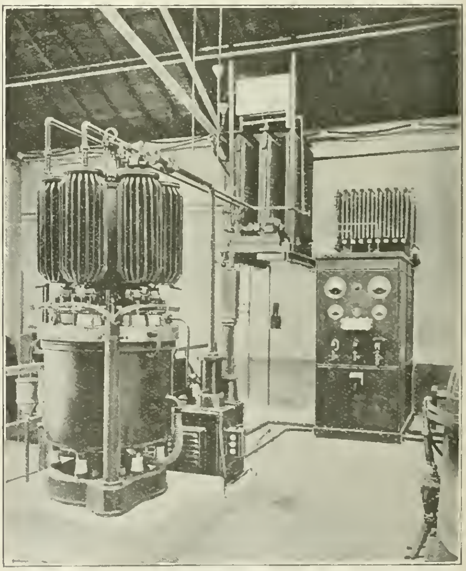


Fig. 16.—300-kW, 600-V Rectifier and Switchgear at Asnieres (Paris).

Mr. J. W. Twinberrow, M.Inst.C.E., after outlining the history of tidal power utilisation, and particularly proposals relating to the Severn, described the scheme which he had submitted to the W.P.R. Committee. Referring to the scheme which had recently been published by the Ministry of Transport, he said that on February 24th, 1920, he and his collaborators were advised by the chairman and secretary of the

Water Power Resources Committee that the Ministry of Transport, having seen their interim report, was asking to be supplied with a copy of their evidence; they also suggested that they should attend a conference with the committee and the Ministry of Transport. On February 28th they agreed to both suggestions. On March 11th, 1920, they attended the conference, the Ministry of Transport being represented by Sir Philip Nash and Sir Alexander Gibb. Their projects were then explained, and another meeting with the Ministry's engineers was fixed for March 19th, 1920, at which their proposals were further explained. The meeting ended with a discussion of the next steps to be taken. Their opinion, as already explained to the Water Power Resources Committee, was that further elaboration of designs and details was superfluous in view of what they had already done, but that:—

1. The geology of the Severn Tunnel and Beachley sites required careful expert investigation supplemented by borings or trial holes.

2. Tidal gauges should be set up at both spots and continuous records kept thenceforward.

3. Samples of the water should be taken from all points of the estuary and at all states of the tides with a view to ascertaining the quantity of silt in suspension and its rate of deposition. Also that the probable action of the silt on the runners of the turbines should be investigated.

4. A geographical survey should be made of the highlands within a large radius in order to establish beyond doubt whether better sites for reservoirs existed than those they had chosen near Tintern, or not.

5. The vested interests in the neighbourhood should be ascertained, and the probable effect on them of the altered régime of the river should be carefully investigated.

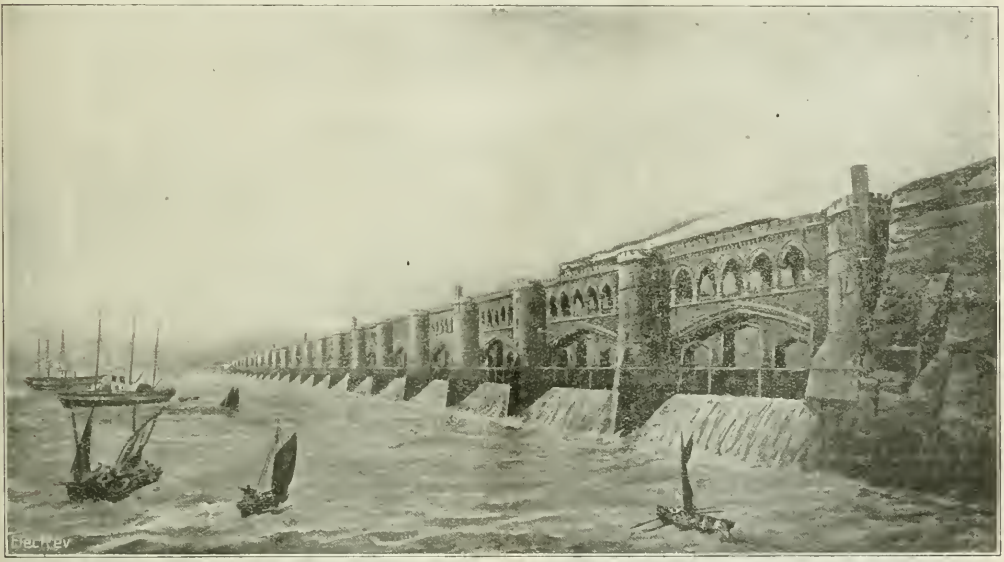
6. The question of high-pressure generators and transformers working in the particularly humid atmosphere of the estuary should receive attention.

7. A fresh survey of the estuary should be made.

Mr. H. P. Raikes, M.Inst.C.E., said that as a civil engineer, who had for many years had occasion to study the tidal currents of the Bristol Channel, he could not too strongly emphasise the need for further investigation. About 14 years were occupied in driving the Severn tunnel, when immense difficulties were encountered owing to the great springs met with. If it was only found economical to draw off the water down to about half-tide level or ordnance datum, then the silting-up of the estuary might become a very difficult problem. The dam could no doubt be utilised to carry a road and railway across the river, but the economy of this seemed likely to be largely counterbalanced by the extra cost of constructing a dam to serve the double purpose. He thought all would agree in deprecating the manner in which the scheme had been introduced to the public by the Ministry of Transport without any engineering evidence of its practicability.

Mr. F. W. Macauley, M.Inst.C.E., referring to the proposed dam for the reservoir up the Wye valley, said that the proposed site was in a limestone formation. He did not think that any engineer would take the responsibility of impounding water, especially brackish water, on a limestone formation. Mr. Twinberrow had foreseen this, and had said that it was suggested to make the reservoir of the lined type; that was an infinitely more expensive method of construction. A very great amount of careful investigation was absolutely necessary before it could be said that the barrage and the reservoir were feasible.

Mr. F. H. Clough, M.I.E.E., said that with the assumptions he had made, a rough estimate of the cost of machinery, switchgear, and transmission lines came to about £20,000,000, and he had assumed that the capital charges on this money should be taken as 15 per cent. (based on 15 years' life), so that the annual capital charges would be £3,000,000, and if this was based on a continuous output throughout the 24 hours of 150,000 kW the price per unit due to this capital charge would be 0.67d. The civil engineering he had only guessed at, and put down the figure of £10,000,000. Allowing a capital charge of 7½ per cent., based on 50 years' life, the cost per unit would be 0.17d. for 150,000 kW load, and proportionately higher for smaller loads. The capital charges on the machinery, which formed the bigger figure, would remain approximately constant whatever the load, being proportionate to the amount of load developed, and if the machinery cost, as would seem to be the case in this scheme, was the greater cost, then it would seem possible, if the barrage were built, to develop the more expensive part of the scheme gradually as the demand warranted it, or as money could be obtained. In this respect the scheme differed from many water-power schemes where the whole capital expenditure must be incurred before any power could be delivered. In speaking of the technical side of the scheme, Mr. Clough referred to the tidal irregularities in the Severn, and suggested that these might be due to a "resonance" effect. It was important,



A Severn Barrage Scheme of 1843.

The idea of damming the Severn is at least a century old. About 1818 the Gloucester and Berkeley Canal Co., being unable to raise capital to complete the canal, requested the Government to advance the necessary funds. Telford was instructed to examine the scheme, and on the strength of his report the Government provided the money, appointing him as engineer to see that it was properly expended. There is a tradition that whilst he was engaged on this work he proposed to erect a barrage at Beachley; but no details have been left on record. About 1843 Mr. Fuljames, an architect and county surveyor, took up the matter, and prepared the water-colour drawing which, thanks to the courtesy of Mr. Cullis, engineer, Gloucester Dock Co., and Mr. Addenbrooke, we are enabled to reproduce; it will be seen that it comprises all the features of the latest proposals except, of course, the installation of turbines. Evidently the scheme was too expensive, for Mr. Fuljames applied to the Admiralty in 1845 for permission to carry a high-level bridge across the estuary at the same place; Mr. Walker, a leading civil engineer, reported on the scheme, and permission was granted, but nothing came of it. Mr. Fuljames's petition and Mr. Walker's report have been found in the archives of the Institution of Civil Engineers.

therefore, to inquire whether this effect would be materially modified by the barrage, as this might have an important bearing on the calculated performance of the machinery which it was proposed to install.

The proceedings on the second evening of the discussion were opened by Mr. G. L. Addenbrooke, M.I.E.E. In dealing with the history of the Severn scheme, he said the public were chiefly acquainted with the project through the proposals which were blazoned forth at the end of last November by the Transport Ministry, and in a less degree, and within a much more restricted circle, by the third interim report on Tidal Power by the Water Power Resources Committee, which was dated December 1st, 1920, but was not actually issued until two or three weeks later. The committee was appointed by the Board of Trade on June 20th, 1918, and Sir John F. C. Snell was chairman. It was desirable to remark that Sir John Snell was appointed chairman in his private capacity, and had remained chairman in that capacity since. He was appointed Chief Electricity Commissioner some six months later, but this was, so to speak, an accidental circumstance. The committee consisted originally of about 15 members. Five members were added later when the Government decided to include the question of water supply, as well as power supply, within the terms of reference. The first hearing before the committee was held on December 5th, 1918. It was impossible to deal with all the evidence at one hearing, and the matter was adjourned until May 29th, 1919. Two days later he and his colleagues received a letter from the secretary, stating that they had made out a *prima facie* case, but asking for certain further fundamental data to enable the committee to carry out independent calculations. A long series of correspondence and interviews with the secretary, and an interview with Prof. Gibson, extending over some months, followed this communication. On February 24th, 1920, they received a letter from Sir John Snell asking permission to place all their evidence at the disposal of the Transport Ministry. A Conference of the W.P.R. Committee and representatives of the Transport Ministry took place on March 11th, 1920, and was adjourned at Sir Alex. Gibb's suggestion to discuss matters further with him privately, the adjourned meeting taking place about a week later. Beyond the forwarding of a geological report, only two or three unofficial interviews took place between Mr. Addenbrooke and the Ministry of Transport during the next nine months, when, without a word of warning, the Ministry launched the now familiar proposal in the newspapers. More could be said on this disagreeable part of the subject, and what he said he had said with reluctance, believing it in the interests of the engineering profession that the facts should, at any rate so far, be publicly known. He did not think it was wrong to assume that should such procedure be repeated by Government departments, the confidence of independent engineers in placing proposals before them, either on their own behalf or on that of clients, would receive a rude shock. On behalf of himself and his committee, Sir John Snell authorised *The Electrician* a short time since to state that neither he nor his committee had any part in those proceedings. He thought it was due to Sir John and to the committee to take this opportunity of publicly thanking them for the patience and care with which they had investigated the somewhat novel proposals which were put before them, and to point out to the engineering profession, what an advantage it would be if there were some private tribunal of a more permanent character, before which engineers could place proposals connected with public utilities before incurring the vast expense and uncertainty of putting the matter to the test by private Bill. After outlining the scheme and giving extracts from a report to him by Prof. W. C. Unwin, Mr. Addenbrooke said that further inquiries, Parliamentary procedure, and the raising of the necessary finance, would almost certainly make it impossible that the first sod could be turned under four years. It would take at least another two years to get in the foundations of the barrage, and to get it up to a point where the final specification of the exact method to be used for electric generation need be absolutely settled. While, therefore, practical methods were available now there were six years at least in which these matters could receive further consideration.

Mr. N. B. Rosher, M.I.E.E., dealt with the problem of transmission to Birmingham, a distance of approximately 70 miles. If this could be shown to be economical, then the remaining transmission lines certainly would be so, as they were all very much shorter. The problem was how best to transmit a maximum load of 100,000 kW from the Severn barrage to the Birmingham district. On the question of cost, the advantage was heavily in favour of overhead transmission. The cost of a system of buried cables would be approximately four times that of an overhead system for the same section of copper. He suggested that two double-circuit lines should start from the generating station and be carried either together or preferably at a distance of several miles apart to two separate sub-stations, at points convenient for feeding into the systems in and around Birmingham and district. Supply could be given to towns and large consumers *en route*. Each circuit would transmit 25,000 kW, or 50,000 kW per tower line. The conductors would be spaced at 6-foot centres, three on either side of the tower. The towers would be steel structures approximately 65 feet high, and spaced ten to the mile or 525 feet apart. The clear height of the lowest conductor above the ground would be about 22 feet. At intervals of 20 to 25 miles switchgear would be provided so that in the event of a breakdown occurring on one circuit, the other circuit could take the load until repairs had been effected in the faulty circuit. There would also be changeover switchgear at both the generating and the receiving end. At present-day prices the advantage was with copper as against aluminium, and therefore a copper line had been assumed in his calculations. The load factor had been assumed to be 40 per cent. The total cost of two transmission lines capable of transmitting 100,000 kW a distance of 70 miles, and including two sub-stations with switchgear, step-down transformers, and induction regulators, he estimated at £1,000,000. Allowing interest at 7 per cent. and depreciation at 5 per cent., the capital charges amounted to £120,000. The units transmitted to Birmingham would amount to 350,400,000 per annum, therefore the capital charges per unit would be 0.081d. The units lost in the transmission line would be 35,000,000; assuming a generating cost of ½d. per unit, this amounted to 0.05d. per unit. The total charges were, therefore, 0.131d. per unit, which had to be added to the assumed generating cost of ½d. per unit, making the price delivered into the Birmingham mains 0.631d. per unit. An addition of 0.16d. per unit should be made to cover the cost of distribution and supply to local consumers; the selling price would, therefore, be 0.791d. per unit, or, say, 0.8d. per unit. As the present average price of electricity sold in Birmingham and district was 2d. per unit, it would appear that from the figures given above the transmission of energy from the Severn barrage was justified.

Prof. F. W. Burstall, M.A., M.Inst.C.E., dealt with the generation of power from fuel, pointing out that it might be possible to generate power on a small scale at a cost very little higher than the wholesale production, and in that case any transmission system would involve not merely lost power but interest and depreciation. It was possible to obtain a h.p.-hour from a Diesel motor for something under 0.4 lb. of oil; taking oil at £10 per ton, that was 0.43d. per b.h.p.-hour. With the Crossley cold-starting solid-injection engine it was possible to get a consumption of 0.425 lb. per b.h.p.-hour, or a fuel cost of 0.45d. The gas engine using a solid fuel was under a very serious cloud, but there was running in Belgium an engine of more than 6,000 h.p. in four cylinders, so that the problem was not impossible. Speaking generally, the suction producer would give a b.h.p.-hour for about 13,000 B.th.u., or about 1 lb. of anthracite coal; at £3 per ton this represented a cost of 0.33d. He had during the past two years been making a considerable number of experiments in which Messrs. Crossley Bros., of Manchester, had greatly assisted him, towards solving the problem of increased economy by regeneration—storing up the heat of the exhaust in a chamber, and passing through this chamber the incoming air and steam to the producer, while the other half of the regenerator was being heated by the exhaust gases. Working in this manner he had been able to obtain a b.h.p.-hour for 0.7 lb. of coal put into the producer, a result which he thought was unequalled in the development of the heat engine. It would be deplorable if enormous sums of money were expended on schemes for the production of cheap power, and then it was discovered that still cheaper power could be obtained.

Mr. W. Willet, M.Inst.C.E., said that something was to be said in favour of constructing a road and railway viaduct first. The amount of water run off through the shoots to generate a maximum of 1,000,000 h.p. would be very large, and would cause a swift current in the comparatively narrow channel; this would render navigation very difficult and very deep lock gates would be needed. Possibly a short ship canal round one end of the barrage would be necessary to avoid this current. He thought the scheme was on the whole very desirable, and if successful would afford a stimulus to industry and production.

Mr. C. M. Shaw, M.I.E.E., said that at Worcester some 25 years ago the Corporation decided to harness the water of the Teme. Very great things were expected of the scheme in its early days, but they only realised about one-tenth of what should have been obtained. Vested interests had prevented the proper development of the water power. At Worcester the civil engineering cost might be put at 150 per cent. of the electrical section of the undertaking. The pumping station was to be situated some miles up the river Wye; assuming that the barrage was at or near the confluence of the Wye and the Severn, and the Wye was left in its present state, a vast quantity of water would have to be pumped, and he was inclined to think the result would be a reversal of the flow of the Wye at certain states of the tide.

Mr. H. C. Young, A.M.I.E.E., deprecated the whole scheme on the ground that the estimated saving of 2½ million tons of coal per annum did not justify the heavy capital expenditure involved in the Severn barrage; it was but a small fraction of the 264 million tons annually raised in this country. If the Government would offer a prize of £1,000,000 to anyone who could show how the over-all efficiency of their coal consumption could be increased by 2 per cent., it would be a much less costly expenditure than that proposed, and would result in a greater saving of coal.

Prof. W. Cramp, D.Sc., M.I.E.E., dealt with the subject from the point of view of the consumer. At Walkerburn on the Tweed there was a waterfall of 12 feet, which a certain firm had been using for about 60 years past. Recently the scheme had been extended so as to provide for pumping the water in the night hours a height of 1,000 feet to storage, in order to double the h.p. capacity of the installation. This had cost £100,000; and on this basis he arrived at an outlay of £50,000,000 instead of £40,000,000 as an estimate of the cost of the Severn barrage scheme. The interest and depreciation alone on such a large outlay would be very heavy, and the price per unit at which the energy could be sold was not much better than 1¼d. per unit, under the best conditions. Was it necessary for the scheme to provide for such large storage as would enable the maximum power to be given day and night all the year round? It should be possible to make arrangements in the large centres of industry, and possibly with large individual customers, to install storage batteries to give them such energy as they might require during the periods when they were not having the full direct load, and it might pay the Government to make allowances, or even pay for such storage batteries, rather than build enormous reservoirs. He did not think the Severn barrage would hold water.

Mr. W. Wilson, M.Sc., A.M.I.E.E., speaking from experience of successful hydro-electric schemes in distant parts, said he had not known a single hydraulic scheme to be a failure. The Severn scheme should be given their most favourable consideration from a national point of view.

Mr. F. J. Moffett, B.A., M.I.E.E., said that if they were going to make an experiment, they should make it on a small scale. There were several tidal basins round the coast which could be used for the purpose. He instanced a piece of land, about 800 acres, which had been reclaimed by a sea wall; recently the sea had made a breach in the wall, which could be used for the construction of an experimental power house. There was 700 b.h.p. available for four working periods of 2½ hours each per day. The units developed per annum would be 150,000,000; the capital cost was £350,000. Taking interest and depreciation at 10 per cent., representing £35,000, and estimating that 120,000,000 units would be utilised, that would amount to a charge of about 0.7d. per unit, to which must be added transmission and distribution losses. Even with those additions, the energy could still be supplied at something like a penny per unit, and that in the South of England would be quite a moderate price.

Dr. Gisbert Kapp said the suggestion had been put forward that the idea of a hydro-electric station should not be dismissed merely on the ground of expense, but it was important in considering such a station to be clear in their minds of certain difficulties. He was, at first, much impressed with the idea put forward in favour of the Thury system, but on closer consideration he believed the system to be impossible.

Mr. Addenbrooke, in replying on the discussion, said he would like to say that as designers they put the whole matter before the Water Power Resources Committee for investigation. They had not said that the scheme was practicable or not, they had simply said that as far as their figures went the matter was worth inquiring into further. The report of the Water Power Resources Committee showed that practically it had taken that view. It was most unfortunate from many points of view that the Transport Ministry should have dragged this sort of red herring across the trail in almost every direction.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New "Tricity" Oven.

The British Electric Transformer Co., Ltd., 50, Oxford Street, W. 1, has recently added a new oven to its range of apparatus. This oven, which is made in two sizes, is illustrated in fig. 1. The construction is of sheet steel with cast-iron door, frame, front, sole plate, top, and feet. The oven is double-walled and lagged with slag wool. The loading of the smaller size is 1,500 watts, while that of the larger is 2,000 watts. The controls in the case of the 1,500-watt size consist of a switch controlling the two upper elements, a three-heat switch controlling the other four elements, and a "Zed" fuse all fixed on a cast-iron panel. In the larger size two three-heat switches and a fuse are fitted.

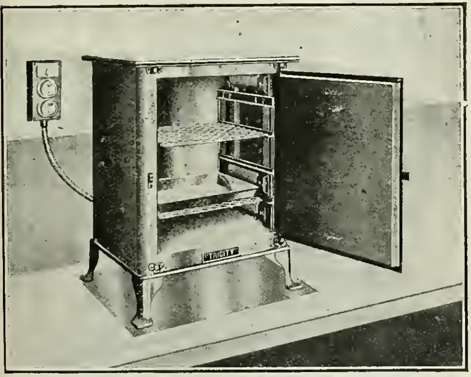


Fig. 1.—A "Tricity" Oven.

The elements are of the firm's standard "gilled" type, and there are six in the smaller oven and eight in the other. Higher loadings can be supplied if required.

A Universal Current Limiter.

A universal current limiter, sold by Messrs. Marshall and Plumtree, 20, High Holborn, W.C. 1, consists of a two-pole electro-magnet having a balanced centrally pivoted armature rocking between the poles. Should an excess current flow the armature lifts the flicker switch lever (which is normally detached from the armature), thus giving a quick make and break. This operation is repeated until the current in the lamp circuit falls to its contract value.

Amongst the advantages claimed for the device (fig. 2) are: The same limiter can be used on either d.c. or a.c. circuits; the switch contacts being made of gold-silver alloy remain clean in working for an indefinite period. This method dispenses with the use of mercury, which has been found to be very troublesome for this class of apparatus; the instrument can be set to operate at any current between .4 and 1 amp., the adjustment being spring controlled and regulated by means of a locking screw. The spring being made of nickel silver is non-rusting; the insulation is shellacked mica, and every instrument is tested for insulation at 500 volts pressure after manufacture; sealing is properly provided for at each cover screw, and the limiter is absolutely proof against outside tampering or unauthorised interference when once fixed; the limiter is very simple and accurate, quite sensitive, and will operate with a small load increment over the pre-determined value.

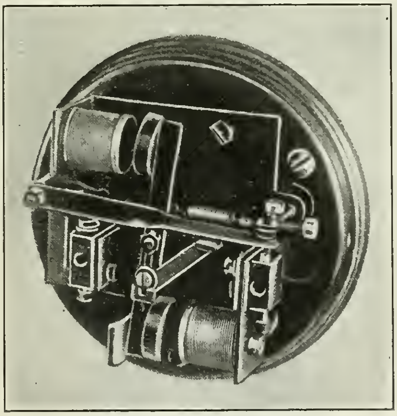


Fig. 2.—A Universal Current Limiter.

Martin's Feedwater Oil Gauge.

It is often important to be able to ascertain the amount of oil entering a boiler with the feedwater. Whatever method is used for doing so, means should be provided whereby it would be possible at all times to check the efficiency of the system, and judge the result of any adjustment that might be made in the working arrangements. It was to meet the above-mentioned conditions that the simple "gadget" known as Martin's feedwater oil gauge was introduced whereby the amount of oil mixed up in the feedwater in the finely-divided state that forms an emulsion can be accurately measured in a few seconds. The device consists of a glass tube with a closed bottom of white porcelain; in the centre of the latter is a conspicuous black spot, and on the outside of the tube suitable graduations are engraved. When using the instrument the feedwater to be tested is poured slowly into the tube while the black spot is observed through the liquid; as soon as the spot is on the point of becoming invisible, when held in a good light, the height of the column of liquid is read off on the scale. This gives the number of grains to the gallon, or milligrams to the litre if the decimal scale is preferred. The gauges are made in three sizes: "A" indicates from 1 to 10 grains; with "B," which is about double the length of "A," quantities down to 0.5 grain can be read off, and by using size "C" it is possible to detect as little as 0.25 grain per gallon. The makers of the gauges are Messrs. F. A Pullen & Co., of the Empire Works, Vauxhall, S.E. 11.

The "Baby Paragon" Switch.

The Midland Electric Manufacturing Co., Ltd., Barford Street, Birmingham, has produced, at a very reasonable price, a small but strong and efficient 10-amp. switch. The "Baby Paragon" switch (fig. 3) is designed to take the place of tumbler switches where these are too weak to stand up to the work required of them. It is made on sound engineering lines, each pole is mounted on a separate base of best English porcelain, and the blades are rigidly clamped over mica insulation on to a metal bar. This bar involves no risk of distortion which is often found in fibre bars. A threaded detachable gland can be employed for conduit systems or the switch can be used on ordinary "flexible" circuits. An interlocking arrangement with a side handle prevents opening while the switch is in the "on" position. This little switch will be found very useful on cooking, heating, and small power circuits. The M.E.M. Co. is bringing out a number of variations on this design, both double and triple-pole with arrangements for fuses.

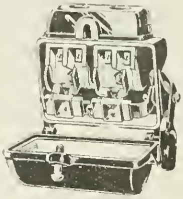


Fig. 3.—The "Baby Paragon" Switch.

The "Lightning" Cooking Oven.

Ten years ago, Mr. Napier Prentice invented the "diving-bell" type of oven, and proved its efficiency; it has since been under continual observation, and has demonstrated its reliability. We recently inspected the latest pattern, which, under the name of the "Lightning" oven, has been developed by Electrical & Engineering Development, Ltd., and can be obtained from the manufacturers, Messrs. Electrical Utilities, Ltd., 1 to 3, Shelgate Road, Battersea Rise, S.W. 11.

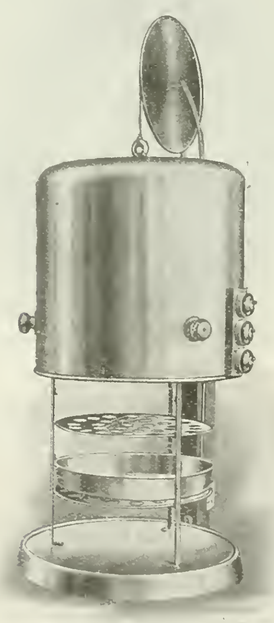


Fig. 4. The "Lightning" Oven.

As shown in fig. 4, the oven consists of a double-walled sheet metal dome (with lagging between the walls), suspended from a pulley which is carried by a standard attached to the metal base, a counterweight being provided so that the dome can be raised with ease. Inside the dome is the heating element, which consists of a simple spiral of resistance wire wound on a frame, as shown in fig. 5, the whole, with the switches, being attached to the dome, but readily removable. The connections are made through a flexible conductor, leading to a terminal box on the standard. A light framework attached to the base carries shelves for baking-dishes, &c. This type of oven has the advantage that the heating element surrounds the food, and can be run red-hot; when the dome is raised, the hot air remains inside it without much loss of heat; with three switches, five heats are obtainable; there is little metal to heat up, so that the oven quickly attains a cooking temperature; and the efficiency is very high, as shown by tests which we reported in our issue of September 19th, 1913, when Mr. W. H. Alabaster, in Melbourne, tested 12 types of oven, and found that an oven of this type reached the working temperature in five minutes, and was maintained at that temperature with 300 to 230 watts, whilst the majority of the ovens tested required 750 to 600 watts to maintain the temperature. Hence it is claimed that this oven will effect a great economy. It is finished either with a spun aluminium or enamelled steel dome.

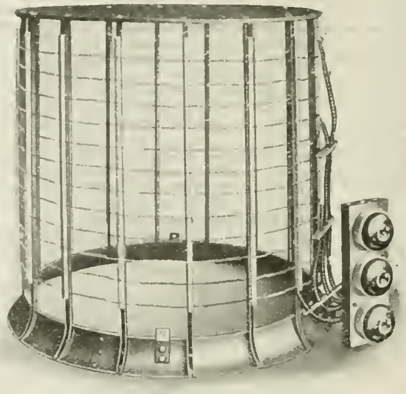


Fig. 5.—Frame and Heating Element.

A New Voltmeter Switch.

The Park Royal Engineering Works, Ltd., of Cumberland Avenue, Park Royal, London, N.W. 10, has put on the market a new voltmeter switch which has distinctive and attractive features. Users of voltmeter switches know that the most common and most troublesome failures of these switches arise from imperfect contact due to dust or damp; to overcome these troubles the "P.R." switch, fig. 6, is totally enclosed in a steel case, with an external operating handle. The case is finished in black and nickel to match the P.R. instruments, and has a handsome appearance. The operating handle has a pointer which comes to rest sharply and definitely at each number. The switches are made in two sizes—3-way and 5-way—and are double-pole. The contacts are embedded in "Hightensite" insulation, thus ensuring an excellent pressure test. The movement is controlled by a combination of ball, socket, and spring, which gives a smart definite action. From a sample which we have before us, we should class this device as A1 in quality.

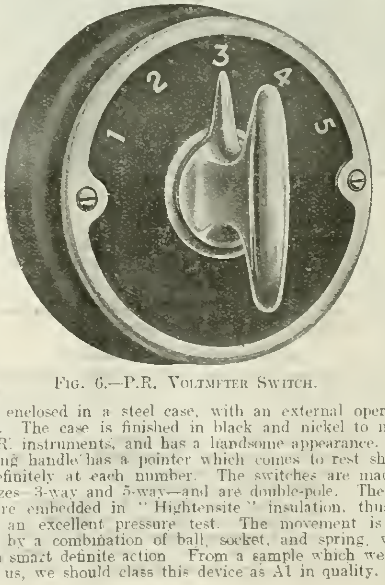


Fig. 6.—P.R. Voltmeter Switch.

THE STABILITY OF CONTRACTS.

Mr. Hugo Hirst, of the General Electric Co., Ltd., in speaking on the subject of "Stability of Contracts a Necessary Factor in Industry," at a conference organised by the Industrial League and Council, and recently held at his residence, Fox Hill, Reading, said:—

Most of them refused to take part in discussions on economic subjects before the war. Now they had got to learn all there was to be known, and the only way to learn was by contributing to the common pool the results of their experiences. Such facts as he would be able to put into the pool were still open to doubt in his mind, because he had not heard everything that was to be said on the subject.

He did not quite know whether the real title of the paper submitted by Mr. Petter was sanctity of contracts or stability of contracts. Both words had been used. He would rather proceed on the lines which he would describe as stability of contracts. If he recollected aright, his friend Mr. McKenna said what they wanted was stability of prices. They had also heard it said that food was the basic value of all things. How could they stabilise prices if prices depended on the supply of nature's produce? In the first instance they could not stabilise the price of food, and therefore they could not possibly stabilise the price of other products. This was his opinion as an amateur, and it seemed to him that the only thing they could stabilise was the relations between employer and employed. They could then talk to each other, and in so meeting adjust things.

With regard to the production of any commodity, they had got to realise they could not stabilise the raw material. It was always a question of supply and demand. He knew of nothing that would so easily bring about stability in industry as stability of conditions. This was the only thing, to his mind, which could regulate or act as a stabiliser. If an employer knew he had a fixed sliding scale to work upon he could go ahead and make estimates, but if he did not know he could not make estimates, and just as a practical example, he would like to tell the meeting how a few weeks ago his firm lost an order worth £150,000 from a Sheffield firm because that firm only had a certain amount of money available, and could not hope to get credit from the bank if it exceeded its expenditure. It could only get a fixed and firm tender from a German firm, as, under present conditions, no English firm could give a firm tender as regarded price and delivery. As a result, no English firm obtained the order. It had gone abroad. He did not blame the Sheffield firm. As employer and employed, they had got to realise this thing was happening, and they had got to find a means to overcome it.

Various phrases had been used—and it was difficult to keep them apart from the subject—relative to higher wages, unemployment, profits, bonuses, &c. He was aware that all these things were interdependent, and that they could not discuss one without having the whole picture presented. All people engaged in industry had got to realise they must produce cheaply, and jointly concentrate on how they could do it. It was essential, and he was firmly of the opinion that the more articles they could bring within the reach of the largest number of buyers the less likely were they to suffer from unemployment. If a motor car cost £2,000—to give one example—the people who could afford to give £2,000 for it were quickly supplied, but if that motor car were to cost only £400, then the demand for motor cars would be so great that active employment in that trade would proceed for a goodly number of years. Under the latter conditions, each single worker might not earn more or less, but so many more workers at the same wages would find employment which would probably prove continuous. The same thing applied to all other industries.

If employment continued there were always men at work economising and introducing new inventions which made new industries spring up and create further employment. It was only by applying skill, and producing in such quantities as he had indicated, that prosperity could be obtained. They not only wanted to produce cheaply for the purpose of having a large clientèle, but equally in order to purchase cheaper. It was not commonly understood that the price at which they produced at home was the price at which they could buy abroad. The foreigner did not base his selling price to the English people on his cost of production, but he quoted just a little cheaper than the price ruling in the home market fixed by English producers. The foreigner would not buy off the British firms when he could get the goods cheaper in other markets. That was another reason why they should produce cheaply, and it was essential if this country was ever to get out of its present difficult financial and economic position. It was a matter which was so important that employers, as well as trade unionists, should concentrate their attention upon it. There was one other example which he would like to put before them, and it was in relation to the business in which he was concerned.

They started, twelve months ago, to place a contract for a large telephone works in this country in order to enable them to cope with the big demand that would be world-wide. They placed the contract with a firm of most energetic builders, who promised to finish it in six months, but it was still unfinished. What did it mean? The methods of the building trade might have the effect of keeping a few men a little longer on the job, but, as a consequence, they were keeping thousands of men out of work. Had those new buildings been finished his firm would have been employing 2,500 skilled workers in them, and they would have been securing orders which would have speedily enabled them to employ double that number. In Coventry to-day, they would have been employing that number had those works been ready. While the building trade was thus impeding the development of that work, that number of men in Coventry was being kept idle. The worst feature of the whole matter was that while they in England were standing still, their foreign competitors, Germany and America, were forging ahead.

In six months' time they might find that, as a result of the delay they would have lost the command of the greater percentage of that vast field of foreign trade. Once other standards were fixed in the world, it would be difficult for England to even get in. He only wished to make these few observations in the hope of helping all to realise that this question of stability was a common problem. They no doubt had not all made up their minds as to what was the right thing for the future. The war had brought them into a new world, and there was much for them to learn, so why should not they work, study the position, and learn together, and unitedly do the best they could for each and every human being engaged in industry on which their individual and national prosperity depended?

A GLASGOW TURBO-ALTERNATOR BREAKDOWN.

The following interesting communication has been received from the Metropolitan-Vickers Electrical Co., Ltd.:—

On the morning of December 8th, one of the new 15,000-kW turbo-alternators at the Dalmarnock electricity station, Glasgow, broke down after having been in commercial operation for about 2½ months. The insulation on the windings at one end of the machine took fire, and as the turbine could not be stopped for some twenty minutes, the whole of the insulation on that end of the machine was destroyed. No evidence could be found at the time to indicate the cause of the breakdown; the machine was very heavily insulated, and every precaution had been taken with regard to winding and testing.

As another generator was almost ready for service, it was substituted for the first machine, and although the breakdown occurred on a Wednesday morning, the new machine was put in position, dried out, and put on load the following Wednesday.

After operating on commercial load for about a week, sparks were seen to be issuing from the top of the stator frame, and the machine was shut down. The windings were found to be in perfect condition, and the machine was run up again with its field excited, but sparks were again noticed, and further examination showed that one of the insulated bolts through the core had broken down near the endplate. These bolts pass through the core in an axial direction, and serve to hold the end plates tightly against the laminations. The bolt was removed, and it was found that it had vibrated violently and the insulation had broken down near the centre of the core as well as near one end. The windings were found to be in perfect condition, but an inspection of the other bolts which had not given trouble showed that vibration of a more or less serious nature had occurred on several of them.

A series of tests and investigations were at once undertaken, and it was found that, for the particular length and diameter of bolt used, a relatively slight tension was sufficient to bring the frequency of the bolts to such a value as to synchronise with the frequency of vibration of the whole set, corresponding to a speed of 1,500 r.p.m. A further and more careful inspection of the first machine which had broken down showed that its failure was due to similar trouble, as it was found that one of the bolts had broken down to the core, and molten metal had come into contact with the insulation at one end of the machine, thus setting it on fire.

A third generator was practically ready for running at the time the first breakdown occurred, and it was decided to remove the steel core bolts and replace them with copper bolts of smaller diameter, which would carry heavier insulation. These bolts are stressed to such a low value as to leave their natural frequency very far below the running frequency of the machine. A considerable amount of work was required in order to replace the bolts, but this was done in an exceptionally short time, and before the end of the month the work had been completed, and the machine was under load. Since that time it has carried peak loads up to 21,000 kW. The two machines which broke down are being rewound, and will shortly be in commission.

The use of core bolts has been standard practice on the part of many manufacturers in this country, America, and on the Continent; machines in which this construction has been used have been in operation for 15 years, and the Westinghouse Co. of America has a very large number of machines in operation in which the same construction is used. This is the first case on record where trouble has resulted due to the use of the core bolts, and it is very remarkable that it should have occurred on two machines in such rapid succession, though the fact that they are duplicates and built by the same workmen may explain the fact.

The trouble was due to the fact that a peculiar combination of conditions resulted in the bolt having a frequency equal to that of the machine, and vibration once having been set up, the insulation on the bolts was more or less rapidly disintegrated. While the Metropolitan-Vickers Co. assumes full responsibility for the trouble which has occurred, the following points might be emphasised:

(1) The insulation on the windings of the machines has been in no way responsible for the breakdowns; (2) the voltage between the bolts and the core was approximately 100, and while the damage was due finally to the breakdown of the insulation on the bolt, the cause of the breakdown was purely mechanical; (3) the construction which was responsible for the trouble is not a new or experimental one, the breakdowns being due to a particular combination of conditions, the existence of which could not reasonably have been anticipated.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1

4,181. "Electric arc welding." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. February 4th.

4,193. "Protective systems for turbo-electric, &c., generating sets." J. A. Kuyser and Metropolitan-Vickers Electrical Co., Ltd. February 4th.

4,194. "Electrically heated cooking ranges." Metropolitan-Vickers Electrical Co., Ltd. February 4th. (United States, March 1st, 1920.)

4,195. "Electrically heated cooking ranges." Metropolitan-Vickers Electrical Co., Ltd. February 4th. (United States, March 1st, 1920.)

4,205. "Electric lamps for theatrical purposes." F. C. Davies. February 4th.

4,218. "Discharging devices for electric furnaces." E. C. Beck-Friis and C. J. Thorssell. February 4th.

4,223. "Incandescent electric lamps." W .M. Rogerson and Stella Lamp Co., Ltd. February 4th.

4,226. "Glass filters, &c., for gas-filled electric lamps." E. L. Friedmann and Co. February 4th. (Germany, February 20th, 1920.)

4,228. "High-frequency electrical apparatus." R. Heather and Mitchell's Electrical & Wireless, Ltd. February 4th.

4,233. "Sparking plugs." G. T. Wilson. February 5th.

4,238. "Electric cables." E. S. Seymour. February 5th.

4,239. "Electric welding machines." R. F. Woodburn. February 5th.

4,247. "Electric furnaces." Automatic Telephone Manufacturing Co., Ltd., and P. N. Roseby. February 5th.

4,249. "Electrical measuring instruments." R. F. Hamilton & Co., Ltd., F. S. J. Pile, and G. E. M. Stone. February 5th.

4,253. "Electric switches." G. Winter and R. Winter. February 5th.

4,261. "Electric signal for road transport, &c." E. G. Beynon and A. A. Evans. February 5th.

4,267. "Means for regulating current output of dynamo-electric generators." J. M. Torrance and J. W. Torrance. February 5th.

4,279. "Annunciators for hotels, &c." T. M. Down. February 5th.

4,281. "Electric advertising machine." G. Wallace. February 5th.

4,285. "Dynamo-electric machines." J. W. Burleigh. February 5th.

4,292. "Dynamo-electric machines." A. H. Midgley and C. A. Vandervell and Co., Ltd. February 5th.

4,300. Means for supplying current to valve amplifiers." P. P. Eckersley, T. M. Furnival, J. Stewart, and H. R. C. van de Velde. February 5th.

4,301. "Telephones." T. M. Inman and Relay Automatic Telephone Co., Ltd. February 5th.

4,308. "Burglar alarm." F. Sefcik. February 7th.

4,320. "Dimming device for electric lamps for motor vehicles, &c." Brolt, Ltd., and W. Holt. February 7th.

4,321. "Electric horns." Brolt, Ltd., and W. Holt. February 7th

4,325. "Trolley-pole attachments for electric trams, &c." P. Priestl . February 7th.

4,329. "Electric indicator or movable sign." E. W. Jeffs and H. I. Lancaster February 7th.

4,345. "Combination electric iron and curling tongs heater." E. H. Kinnaro. February 7th.

4,359. "Electrically-heated hair waving or curling apparatus." S. Hargreaves. February 7th.

4,361. "Electric switches." S. J. Thompson. February 7th

4,377. "Manufacture of carbon electrodes." I. Szarvasy. February 7th. (Hungary, November 29th, 1917.)

4,381. "Wireless signalling." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. February 7th.

4,382. "Electrical apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. February 7th.

4,390. "Electrically-heated kettles, &c." F. Robinson. February 7th

4,392. "Sparking plugs." P. A. Pollard. February 7th.

4,394. "Apparatus for collecting electric current for electrically-propelled vehicles by means of carbon brushes." Soc. Anon. le Carbone. February 7th (France, October 15th, 1920.)

4,408. "Mercury vapour jet pumps with light arc." Siemens & Halske Akt.-Ges. February 7th. (Germany, April 24th, 1920.)

4,410. "Electric rotary converter with variable tension." R. de Bruyn. February 7th. (Belgium, February 5th, 1920.)

4,413. "Stripping insulation and armour from cables, &c." C. W. Bailey and A. Weir. February 7th.

4,420. "Platinum anodes." Deutsche Gold and Silber-Scheideanstalt vorm Rössler and O. Liebknecht. February 7th.

4,432. "Electric furnaces for non-ferrous metals." D. F. Campbell, W. S. Gifford, and H. S. Waite. February 7th.

4,446. "Pulleys for trolley-poles of electric tramcars, &c." G. A. Bishop and R. A. Chadwick. February 8th.

4,454. "Electric toasters, &c." Credenda Conduits Co., Ltd., and F. F. D. Davidson. February 8th.

4,459. "Automatic, &c., telephone systems." W. Aitken. February 8th.

4,474/5. "Locking devices for electric incandescent lamps." C. Dunglinson and H. Francis. February 8th.

4,482. "Electric cooking devices." L. S. Dalgleish, Electrical Utilities, Ltd., N. Prentice, and E. Schattner. February 8th.

4,491. "Electric safety lock for railway coaches, &c." T. Pickersgill. February 8th.

4,495. "Telephone repeater monitoring system." Western Electric Co., Ltd. (Western Electric Co., Inc.). February 8th.

4,506. "Electric lighting apparatus." A. Gladstone. February 8th.

4,513. "Signalling systems." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. February 8th.

4,516. "Rotors for electric generators." A. B. Field and Metropolitan-Vickers Electrical Co., Ltd., and S. Neville. February 8th.

4,536. "Wireless telephone transmitters." Ges. Fur Drahtlose Telegraphie February 8th. (Germany, February 9th, 1920.)

4,538. "Switches for electric circuits." A. Gerhold. February 8th.

4,588. "Electric cable junction boxes." F. H. Morris, T. Taylor, and S. D. White. February 9th.

4,617. "Electric lamp discharge devices." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. February 9th.

4,619. "Electric circuit interrupters." Metropolitan-Vickers Electrical Co., Ltd. February 9th. (United States, April 23rd, 1920.

4,650. "Electric light adaptors for acetylene lamps." A. H. Lindley Jones. February 9th.

4,663. "Heavy current transmitter for telephony." P. J. Walsh February 9th.

4,664. "Wireless signalling in mines." Ges. fur Drahtlose Telegraphie. February 9th (Germany, February 9th, 1920.)

4,667. "Automatic cut-out for receiving gear in wireless telegraphy and telephony." H. Morris-Airey, C. R. Evershed, and I. G. Preston February 9th.

4,684. "Steering indicating means for railless trams, &c." R. H. Wilkinson. February 10th.

4,695. "Apparatus for synchronising electrically the application of indications to a plurality of charts, &c., in different localities." B. Holliday February 10th.

4,698. "Electric conductors for telegraphy, telephony, &c." W. E. Hitch. February 10th.

4,700. "Radio receiving systems, signalling systems, &c." N. Lea, Radio Communication Co., Ltd., and J. Scott-Taggart. February 10th.

4,720. "Internal galvanisation of insulators." Soc Materiale Elettro Trazione. February 10th. (Italy, February 12th, 1920.)

4,723. "Magneto-electric machines for engine ignition." G. I. Neighbour. February 10th.

4,737. "Telephones." G. B. Riley. February 10th.

4,743. "Electric heaters for liquids." W. Weekes. February 10th

4,745. "Dynamo-electric machines." J. H. Cochrane and J. Gordon-Hall February 10th.

4,747. "Travelling carriage with automatic steering device for passing through junctions on a single-joint overhead runway track." J. Hill & Sons February 10th.

4,749. "Magnetic fields of electric machines." J. W. Howard. February 10th.

4,750. "Electric switches." H. D. Pyne. February 10th

4,753. "Electric switchgear." H. W. Clothier, F. N. Linstow, and Reyrolle & Co., Ltd. February 10th.

4,754/5. "Electric terminals." G. W. Bayley and F. N. Linstow. February 10th.

4,761. "Arrangements for recovery of energy in electric railway systems employing series-connected direct-current motors." E. Santuari. February 10th. (Germany, March 12th, 1920.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1914.

12,158. "Electric gas-filled glow discharge lamps." Lederer. May 19th, 1913

13,759. "Electric lamps with luminous discharge." British Thomson-Houston Co. (General Electric Co.). June 6th, 1914.

24,343. "Telephone systems." Automatic Telephone Manufacturing Co. and Savin (partly communicated by Automatic Electric Co.). December 19th, 1914.

1917.

3,719. "Electro-magnetic clutch." Vulcan Maschinenfabriks Akt.-Ges. October 22nd, 1913. (104,876.)

3,720. "Electro-magnetic friction clutch." Vulkan Maschinenfabriks Akt.-Ges. October 22nd, 1913. (104,877.)

1918.

7,729. "Fixing of electric insulators." P. J. Pairaud. May 8th, 1918 (157,470.)

1919.

3,702. "Means for controlling the flow of electrons in electric-discharge devices." Marconi's Wireless Telegraph Co., Ltd. (E Berry). February 14th, 1919. (157,477.)

7,464. "Means for controlling searchlights from a distant station." P. W. Willans. March 25th, 1919. (157,481.)

20,260. "Intercommunication telephone systems." W. P. Thompson (F. Hames). August 18th, 1919. (157,496.)

20,513. "Electrical indicators for railways and the like." J. Gardner August 21st, 1919. (Cognate application 3,647, 1920.). (157,498.)

20,676. "Electric fuses." B. C. Candee, F. Moeser, and W. N. Pierce August 22nd, 1919. (157,499.)

23,613. "Electrical systems of power transmission." British Thomson-Houston Co., Ltd. (General Electric Co.). September 25th, 1919. (157,508.)

23,919. "Electrode for use in depositing molten metal and process or method of making same." W. H. Boorne. September 30th, 1919. (157,509.)

24,470. "Electric traction systems having one or more conductor rails." R Pattison. October 7th, 1919. (157,516.)

24,732. "Electric transformers and other stationary electric induction apparatus. British Thomson-Houston Co., Ltd. (General Electric Co.) October 9th, 1919. (157,521.)

25,182. "Electrodes, welding rods, and soldering sticks." E. H. Jones and Alloy Welding Processes, Ltd. October 14th, 1919 (157,534.)

25,230. "Magneto hand lamps." A. H. Railing and A. E. Angold October 15th, 1919. (157,536.)

25,277. "Means for connecting two axially-arranged poles." E. Schultz. February 6th, 1918. (133,938.)

25,661. "Signalling arrangements, applicable to telegraph, telephone, and like purposes." Automatic Telephone Manufacturing Co., Ltd., and H. H Harrison. October 20th, 1919. (157,556.)

25,826. "Air cooling apparatus particularly applicable to the cooling of electrical machines." K. Baumann and Metropolitan-Vickers Electrical Co. Ltd. October 21st, 1919. (157,562.)

26,980. "Incandescent electric lights." M. C. Caughrean. November 3rd, 1919. (157,585.)

27,223. "Radiating or cooling apparatus." K. Baumann and Metropolitan-Vickers Electrical Co., Ltd. November 5th, 1919. (157,591.)

27,346. "'Ironclad' electrical switches." Midland Electric Manufacturing Co., Ltd., and W. L. Barber. November 6th, 1919. (157,595.)

28,301. "Receivers for wireless telegraphy." C. T. Hughes and L. B. Turner November 14th, 1919. (157,607.)

29,078. "Device for use in disinfecting telephone instruments." R. Cooper. November 22nd, 1919. (157,614.)

30,922. "Protective devices for alternating electric current systems." J. B. Palmer and Metropolitan-Vickers Electrical Co., Ltd. December 10th, 1919. (157,626.)

1920.

25,219. "Signalling apparatus for road vehicles and aeroplanes." H. Fryman. September 17th, 1919. (Divided application on 151,306.) (157,697.)

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REPARATIONS AND BRITISH INDUSTRY.

OUR readers are aware that the Allies have decided upon the indemnity payments which Germany shall be called upon to make in respect of her crimes against civilisation. They begin with a payment of one hundred million pounds, rising by various stages to three hundred millions, the whole being spread over 42 years. The question whether these terms are too severe, or not severe enough, is not one with which we feel specially concerned, but it is worth while to consider the probable effects, not only of the fixed payments, but of the additional tax of 12 per cent. on Germany's export trade, upon British trade in general.

We have already seen that the dumping of two million tons of shipping upon a market in which there was already a surplus, inevitably resulted in further depression in the shipbuilding industry. It now appears probable that the greater part of this tonnage will have to be laid up, and remain idle, the while the British population pays taxes for its upkeep, and the services which this shipping might render are lost to the world.

There is no doubt that the importation of foreign material, of any kind, and for any purpose, renders unnecessary the production of an equal amount of the same material in the country into which the goods are imported. The indemnity payments must be made in goods—raw or manufactured. Therefore, when the Allies say: "We will have a hundred millions from Germany this year," they merely use an alternative phrase for: "We will not manufacture a hundred million pounds' worth of various goods this year." When France demands a million tons of German coal, she refuses, in effect, to buy a million tons of British coal. That is one aspect of the situation, so far as the fixed payments are concerned.

Dealing now with the export duty, we observe that Lord Sheffield, in a letter to the *Manchester Guardian*, considers it "idle to suppose that an export duty of 12 per cent. can be passed on to the purchaser," and "it may be inferred that an export duty of 12 per cent. will kill many of Germany's export trades." We have heard it argued that, while an import duty must be paid by the consumer, yet this is an export tax, and is paid by the manufacturer in the country of origin. Out of what? Clearly, out of the revenue derived from export sales; out of the money paid by the buyer. In short, the consumer pays—there is no one else *to* pay! This export tax will be passed on, and the mark will be kept low, and buyers of German goods will pat themselves on the back as they say: "It is a good thing to buy German goods, as the Germans have to pay twelve per cent. of this money towards the indemnity." Whatever may be said about the fixed payments, there is no doubt that the *ad valorem* tax is bad, and will encourage German competition; while it keeps the exchange in such a state that it will be impracticable for us to export to Germany, and her prices in other countries, such as Holland, are so much lower than British prices as to make it equally impracticable for us to export to those countries.

So far as Germany can be compelled to assist in the cheapening of prices by a large contribution to production, it is good that she should do so, but cheapness will be dearly bought if this policy is overdone, and results in greater, increasing, and permanent unemployment. Production must be maintained here, and the German goods must be of the nature of a surplus, to encourage demand, and so cheapen production here, with resultant benefit all round.

Is this likely to happen? Candidly, we do not think so. The situation in the dyestuffs industry, mentioned in our columns recently, is eloquent and prophetic in this respect. The prospect of heavy importations of dyestuffs and chemical products from Germany proved so alarming, that an elaborate system of licensing was evolved, which has the substantive effect of prohibiting the import of any chemical product that can be made in Great Britain. We deliberately and definitely refused, when it came to the point, to receive what had been hailed as "benefits" when the Treaty of Versailles was in the making.

We mentioned the case of France and the German coal. Let no one be too ready to throw stones in this matter, for, in our view, none are free from blame. Prices for coal for export had reached fantastic levels, yet, with the French mines not yet at their full output, British coal found its market. When the coal strike came, the lighting of Paris, for instance, was immediately curtailed and diminished, and the French bought coal wherever they could get it. At the same time large deliveries of coal were received from Germany under the indemnity, so that there was actually a glut of coal in France. The combination of profiteering and striking has ruined the French market for coal, and none can tell when it will recover. So we are confronted with the prospect of lost export markets, the Government dropping the whole coal question like a hot potato, and the raising of the prices of all coal used in this country. The cynical disregard of the interests of the consumer, displayed by all concerned in the coal question, would have been unbelievable, had we not by this time become hardened to such treatment. The miners demanded more pay because, they said, the money was in the industry. They coupled their demand for increased wages with a demand for a decrease in the price of domestic coal, which sounded very handsome of them, but unfortunately they dropped it almost at once, thereby casting serious doubts upon their own sincerity. The coal owners rioted in the export market, instead of laying the foundation of permanent and satisfactory business relations, with the result that customers are glad to be able to buy elsewhere. So the home user, disappointed of his reduction, is confronted with the likelihood of having to pay still more, while production falls off at the first hint of a drop in wages.

But what of our own industry? Up to the present German competition has not been serious in the home market, though it is already difficult, if not impossible, to meet it in certain European markets. In those markets which are predisposed in our favour, it remains for the British manufacturer to embark on a really serious selling campaign. Publicity methods must be constantly and steadily improved. Catalogues, printed in the language of the country for which they are intended, must attract attention to, and awaken interest in, British goods. Strenuous spade work of every description must be kept up until the customers feel the need for the service which British firms can render. When goods are ordered, delivery must be prompt, and quality high; and there must be a willingness, an anxiety, to do the best thing for, and the right thing by, the customer, not only at the first, but all the time. Any aloofness, any feeling that this is all a great nuisance, must be rigidly repressed. The consumer pays, and he will call the tune. If the British manufacturer gives the service required, a little earlier, and a little better, than his competitor, he will get business and prosper. If he fails, then he will play straight into the hands of Germany, and will lose, finally, all the advantages which, owing to Germany's crippled condition, he is now in a position to use.

Dutch Industries Against State Stations.

The discussion of the Dutch Government Bill which proposes to centralise the production of electricity in the hands of a semi-State company has now commenced in the Second Chamber of the States General. Some particulars regarding the scheme are given elsewhere in this issue. The Bill is meeting with considerable opposition both in the Chamber and outside, and attention may be drawn to that of the Central Industrial Union, which is acting on behalf of approximately 600 of the most well-known undertakings in the metal-working industry, shipbuilding, and the cotton, wood, paper, chemical and other industries, which through the Union have presented a petition to the Second Chamber asking for the rejection of the Bill. If no system of electricity supply in general existed in Holland, the petition points out that there might perhaps be occasion for such a centralisation as is projected by the Bill. But as provincial Government or private central stations are to be found in almost every province or town of any importance, which have hitherto satisfactorily served the interests of consumers in general, the petitioners do not see why the law need be invoked in such a decisive manner as is proposed by the Bill, and they express the opinion that the efforts of the State would suffice if directed towards the establishment of connections between existing stations, the unification of the primary high-pressure networks, and the supply of the more or less important centres which still require such facilities. The petition proceeds to state that it is not decisively demonstrated in any of the official documents that the construction and working of the so-called superstations would be more advantageous than in the case of the stations of medium size such as are managed in Holland by local authorities or private enterprise. On the contrary, it is submitted that it is sufficiently well known from all kinds of statistics and examples available that the stations of average size are more economical to work and are more economically worked than the largest stations existing in Holland at the present time. It is further apprehended that the management of superstations would not be so economical or of a commercial character, while the management would very probably be bureaucratic. The situation in Holland should not be compared with that in other countries where large stations are situated in the vicinity of the collieries, whereas the only economically possible State central station in Holland is in the Limburg coal-mining district. It is further emphasised that the flexibility in the charges made for supply by private works, which are now frequently adapted to the requirements of consumers, would be materially reduced in the case of State undertakings. Under these circumstances the petitioners ask the Second Chamber to reject the Bill or to substitute for it a measure for the supervision of the industry in the directions previously indicated.

Russian Electrical Schemes.

Some time ago great schemes were announced from Moscow concerning the projected electrification of the whole of Soviet Russia, and new proposals representing the splendid situation which that country will occupy when the electrical schemes have been realised are said now to be circulated every week by the Russian wireless system in the form of propaganda reports. In contradistinction to these fantastic statements is a report published by the Moscow *Isvestia* on February 1st from the Bolshevist Wasjkof. The latter states quite openly that at the present moment Russia is confronted with the entire exhaustion of all stocks of raw and other materials which are necessary for the electrical industry, and that the maintenance of the existing electrical installations is only possible on a primitive footing. The electrical industry which numbered 3,200 workmen in the spring of 1920 now has only 700, all the skilled men are foreigners, and not one half of the production contained in the 1920 programme has been carried out. The programme for 1921 has been considerably reduced, but its execution depends upon the requisite raw and other materials being rendered available to the industry.

Electricity Supply Schemes.

The exhaustive inquiry which the Electricity Commissioners have held at Llandudno has elicited many interesting points, and suggests many others. For instance, there is a striking contrast between the attitudes of the promoters of the two schemes. Although the Chester Corporation scheme appears to be more fully thought out and more definitely drawn up than that put forward by the South Lancashire Conference, it is somewhat less concrete and substantial than that of the North Wales Power Co. This is particularly noticeable in the financial and administrative aspects of the schemes. It will be admitted that a scheme prepared for and on behalf of a conference of municipal authorities and supply companies must inherently possess some features of weakness and lack coherence, more especially in view of the neutral and even hostile attitude of some of the local authorities and other interested parties, which has been so regrettably manifest at the inquiries; a scheme drawn up by a power company, on the other hand, with a backing of unanimity, experience, and commercial ability, is practically certain to be a sound and practicable scheme from the very outset. That is the essential difference between the two cases; one is managed by a committee, or a committee of committees, composed of men who are not necessarily experts either in commerce or in engineering, while the other is conducted by a very small number of men whose profession it is to carry on that very class of business. The inevitable result is that the former must always be regarded as being somewhat speculative, or even tentative, whilst the latter has the air of solidity and trustworthiness that arises out of technical competence and financial support.

And this brings us to a very important aspect of the subject. It has been conspicuously evident at these inquiries, as it was at the Barking inquiry, that the municipal authorities have no financial backing. When the time arrives for a Joint Electricity Authority to raise funds to carry out its scheme, it will have to go into the open market for the money; what that means may be inferred from the experience of Birmingham, Rotherham, and other corporations during recent months. Certainly if the authorities look to the Government for capital, they will look in vain. The municipalities no longer occupy that privileged position that they used to hold, of being able to raise capital on exceptionally favourable terms. The companies, however—as witness the statements of the County of London Co., the North Wales Power Co., and others—have capital at their command, and are ready to get to work at once.

The conclusion is plain enough. Financiers have confidence in projects put forward by commercial concerns of proved experience and competence, which can be safely counted upon to make an adequate return on capital invested; they have little confidence in the somewhat uncertain future of the municipal schemes, still less in the shadowy projects of the proposed Joint Electricity Authorities.

That the work would be better done by a company than by any State or Communal organisation we have never doubted, though we realised that in the face of the overwhelming wave of public opinion which followed the Armistice the electricity supply industry must come under national control. The establishment of the Board of Electricity Commissioners was an act of the greatest value to the industry, and a vast amount of useful work has already been accomplished by it. But judging by the inquiries which have been held, the prospect of the formation and efficient operation of Joint Electricity Authorities is receding into the background. The alternative is to authorise the existing power companies to carry on the work for which they were constituted, under the control of the Commissioners, and as time goes on, the probabilities in favour of this course being adopted are strengthening.

Read, Mark, Learn . . .

It would be interesting to know how many of the secretaries and members of the Joint Industrial Councils for the Electricity Supply Industry have taken the trouble to read through the series of Whitley Reports; how many could pass anything like an examination in them? And yet in no other way can anyone get a full knowledge of the theory underlying the Councils and of the principles which are supposed to be adhered to in developing their constitution. The question of a close adherence to the principles laid down in the Reports is not merely a matter of academic concern; its importance is paramount. These Councils were formed at the invitation of the Ministry of Labour, and the form laid down was that outlined in the Whitley Reports. So long, therefore, as the Councils follow the lines of the Reports, so long may they reasonably expect the Ministry of Labour to back them up; but if they depart from the procedure laid down, they must take the inevitable risk.

This is why we insist on the paramount importance of everyone who has anything to do with the Councils being perfectly familiar with the Reports. Here is a case in point, where either through ignorance of the principles laid down in the Reports, or through wilful or unwitting departure from them, a District Council has, it seems to us, made a serious blunder. We refer to the booklet of constitution issued by No. 11 District Council for the South Coast area. In the front is given a list of the names of members of the Council. Those representing the employers read: Councillor H. Ainger, representing Aldershot U.D.C. undertaking; Alderman R. J. Bridle, representing Weymouth Corporation undertaking; and so on. Now, it is entirely wrong to say that any member of a Council represents on it an individual undertaking. It is wrong even to suggest that he is appointed by any individual undertaking. And in the constitution the method of election, namely, that certain undertakings shall elect a member in their own right, is most seriously unconstitutional. Every member of a Council on the employers' side is supposed to be appointed by one of the Employers' Associations, and the whole of the members on any District Council represent each and every undertaking in its area.

The Whitley Report is definite and emphatic on this point. Par. 14 of Cd. 8606 reads: "That District Councils, representative of the Trade Unions and of the Employers' Associations in the industry, should be created." And in the Appendix to the same Report we read: "It is intended that the Councils should be composed only of representatives of Trade Unions and Employers' Associations." Now, referring to No. 11 Council, the booklet taken literally says that 12 undertakings have each a representative on the Council. Suppose one of the other undertakings in the area says: "We will not recognise any of your recommendations, we are not represented on your Council"—what will No. 11 Council reply? On the same grounds, it would seem that No. 10 District Council (which surely should be a model!) is also indiscreet in its list of members on the employers' side. It does not go so far as to say that any member "represents" an individual undertaking, but it prints the name of each member's company alongside of the member's name, which to any ordinary reader would imply much the same thing. It certainly is out of keeping with the quotations we have made from the Whitley Report.

Parenthetically and anticipating the obvious reply that in practice the Employers' Associations did not in all cases nominate the members on the District Councils, we reply that this makes no difference. All it means is that the four Employers' Associations were willing for the sake of convenience that the choice of the actual names should be arranged locally, but they had always the right of intervening if they thought fit. We are rather surprised that the National Council, which set out its own list of members in the correct form, should have passed irregularities of this kind in the case of District Councils, involving as they do such a serious principle.

NEW DISTRICT RAILWAY ROLLING STOCK.

It will be remembered that at the new year we illustrated and described the first of the new rolling stock that is being delivered for service on the Metropolitan District Railway system.* The article, however, only dealt with the trailer cars, but we are now able to publish some details of the motor cars, which were subjected to a short demonstration run last week. The new steel rolling stock is built to conform in general appearance to that of the trailer cars described in the above-mentioned article, and is designed for working 8-car trains during the busy hours, and 5-car trains during the slack service periods. Each 8-car train consists of three motor and five trailer cars; the motor coaches are of higher power than their predecessors of the older stock, and this will increase running speed—the new trains being capable of attaining a speed of 45 m.p.h. on "non-stop" runs—and will also accelerate starting. Improved braking equipment has been adopted to secure more rapid, yet more even, stopping. These are all points of importance, as the problem of getting more trains through the tunnel sections depends not only on the time spent between stations or in station stops, but also upon the time occupied in the process of stopping and starting.

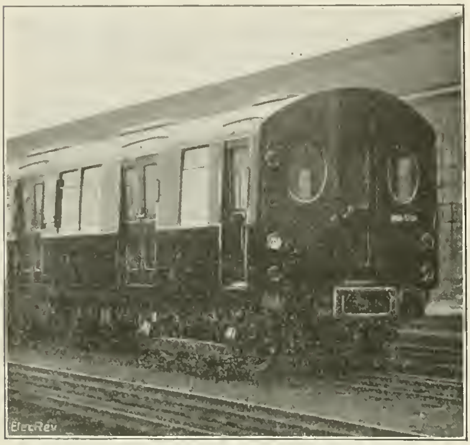

Fig. 1.—New District Motor Car.

The general dimensions of the cars are: Length, 49 ft. 2 in. over headstocks; width, 9 ft. 6 3/16 in. over sole bars; height, 11 ft. 11.5 in. rail to roof; centres of bogies, 34 ft.; and wheel base centres, 7 ft. 10 in. (trailer bogies 7 ft. 3 in.). The total weights are: Motor car, 44 tons 10 cwt.; trailer car, 24 tons 10 cwt.; and control trailer car, 25 tons 16 cwt.

A train comprises eight cars of three types, viz.:—Motor, control trailer, and trailer cars, and the seating capacity of the trailer car is 48, that of the control trailer 44, and that of the motor car 40, the variation being due to the control and motor end compartments taking up a little space.

On the motor, fig. 1, and control trailer cars, in addition to the three double doors, single doors are fitted at the ends of the cars, and the latter ones will also be available for the use of passengers when not occupied by the operating staff of the train. An 8-car train of the new stock will give the equivalent of 52 single doors throughout its length for the use of passengers, which provision will reduce the time taken in loading and unloading at stations, and will thus accelerate the operation of individual trains and so enable more trains to be run.

The interior fittings are generally similar to those of the trailer cars, and to ensure absence of vibration and drumming, the steelwork has been covered with canvas so that a maximum of quietness and sweet running is expected, which object will also be assisted by considerable attention having been given to the subject of car springing.

A new feature of interest to the travelling public is the provision of two sets of train indicators, one on either side of the centre doors, showing "non-stop" stations both in the east and west end of London.

The cars are equipped with Westinghouse brakes on the double block standard system, and provided with automatic adjustment for taking up any slackness. Calculating the cylinder pressure with full application at 50 lb. to the sq. in., and taking the leverage at 4.4 to 1, gives 39.6 tons total block pressure on the motor cars. The gauge pressure on the train line is 60, and that on the main line 70/85 lb. per sq. in. A hand brake is fitted to all motor cars and control trailers; main reservoirs are fitted to each motor car.

The underframes are constructed entirely of steel bulb angles untrussed, but cambered up to form the sole bars, and the centre longitudinals are rolled steel channel sections running the whole length of the frame between bogie centres. The extension to headstocks is made up of pressed-steel channel section. The cross bearers at the bogies are pressed channel sections tapering at the sides with flanges stiffened above and below. The floor plates are stiffened with short angles and pressings across from the sole bars to the centre longitudinals, and the whole is stiffened up with four gusset plates between the bogie centres.

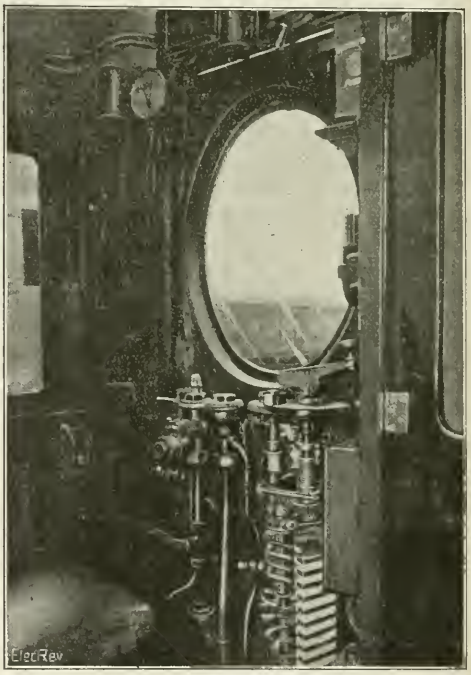

Fig. 2.—Interior of Driver's Cab.

Each motor bogie is equipped with two motors hung on the axles and supported by brackets extending from the housing plates. The driving wheels are 36 in. in diameter. The motor bogie side frames are of channel section running the whole length to the headstocks, but are cut away on the bottom flange to receive the axle boxes. The bolsters are built up of channels, and are supported on nests of concentric coil springs mounted on the spring plate, which is a channel pressing with the upper edge turned over to form a flange; this in turn is supported by heavy steel forgings pivoted to cast-iron brackets fastened to the housing plates.

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* Electrical Review, December 31st, 1920, p. 838.

The centre bearing is a ball bearing, and the journal boxes slide on horn plates of heavy cast steel, bearing on laminated centres composed of ten plates, eye bolts taking up the load through auxiliary rubber springs *via* steel eye-bolt brackets riveted to the side frame channels. The trailer bogies follow similar but lighter construction.

The motor cars are each equipped with four G.E.260 motors of the interpole tapped-field self-ventilated type, and are rated at 198 h.p. for one hour, and 182 amperes continuously. The motors are fitted with 20-tooth pinions gearing with 63-tooth gear wheels and provided with bolted type axle caps and dust shields for the axle, and the suspension bearing brasses are keyed to prevent rotation.

Each pair of motors with its control gear constitutes a complete unit equipment. The control gear (mounted under the car) consists of a circuit breaker, main switch, fuses, reverser, 15 contactors, resistances, and tapped-field relay. The contactors are of an improved type. The contact tips are provided with arcing horns and a moulded arc shoot, and the interlocks are of the disk type mounted on the back of the contactor. The contactor box with all contactors, resistances, &c., is a unit complete with wiring, and has its own terminal base. The reverser connected to the motor fields is of a drum type operated by a pair of opposed solenoid coils. Other apparatus is substantially the same as previously used.

Master controllers of an improved type are fitted at each end of each motor car, fig. 2, and at one end of the control trailer car, together with the necessary control and compressor switches, circuit-breaker, switch, fuses and control cut-out switch; the control is non-automatic except that the motor field is weakened automatically by the tapped-field relay on the current decreasing on the last controller point in parallel.

The 8-car train has an acceleration of $1\frac{1}{2}$ m.p.h. per second and a balancing speed of 45 m.p.h. attained after travelling one mile on the level. The time for a section 0.51 mile in length is eighty seconds excluding stops.

The stock was constructed by the Metropolitan Carriage, Wagon & Finance Co. at its works at Oldbury, Saltley.

CHIMNEY DRAUGHT TROUBLES.

By **EDWARD INGHAM, A.M.I.Mech.E.**

In order that the fuel in a boiler furnace may be burned to the best advantage, it is essential that there should be a good draught, since otherwise the amount of air passing through the furnace, and consequently the oxygen required for combustion, will be restricted, with the result that the fuel will be only partly consumed. Hence every steam user who wishes to avoid unnecessary waste of fuel must not only provide the required means of producing a good draught in the first instance, but must take care that the draught is maintained. Troubles in connection with draught are not by any means infrequent; in the majority of cases they are due to simple causes, and to find the remedy is, therefore, usually not a difficult matter. We shall in this article consider some common causes of bad draught, and incidentally refer to one or two troubles which are more or less the result of impaired draught.

The common method of producing a draught is to build a chimney of suitable height. The chimney contains a column of heated and rarefied gas, and the difference in weight of this column and that of a similar column of cold air outside causes the air to move, and so produces the draught. The draught will, of course, depend upon the height of the chimney, the temperature of the gases in the chimney, and the temperature of the outside air. It is useful to remember that when the temperature of the air is 62 deg. F., and that of the chimney gases 552 deg. F., a chimney 140 ft. high will produce a draught of one inch of water, which is ample for the burning of most fuels; in fact, many coals can be satisfactorily burned with a draught of $\frac{3}{4}$ in., so that from the draught point of view, a chimney considerably less in height than 140 ft. will be satisfactory in most cases. Chimney heights, however, are fixed more by the sanitary requirements of the neighbourhood than by the draught they will produce, because it is necessary that the products of combustion should be discharged at a height considerably above that of the surrounding buildings. In general, if the height is satisfactory from this point of view, it will usually be satisfactory with regard to the draught.

A rough rule for determining the height of the chimney required to produce a given draught is: $H = 137D$, where H is the height in feet, and D is the draught required in inches of water. When the height has been fixed, the next consideration is the sectional area of the chimney. This, of course, will depend upon the total grate area of the boilers as well as upon the height of the chimney; the following formula may be used:—$A = WG/14\sqrt{H}$, where W = the number of pounds of coal burned per square foot of fire-grate per hour; G = the total fire-grate area in square feet; and H = height of the chimney in feet, measured above the fire-grate. If there is only a single boiler, the constant may be increased to 1/12 or 1/10.

It will be obvious that the first thing to do when inquiring into the cause of a bad draught is to see that the height and the sectional area of the chimney are satisfactory, since otherwise constant trouble will be experienced. As already explained, it will seldom be found that the height of the chimney is at fault, but if so, the chimney can perhaps be built higher, or the draught assisted by means of a fan. If the chimney area is restricted, nothing can be done to enlarge the area, except by entire rebuilding, and some other means must, therefore, be adopted.

A bad draught is sometimes the result of installing one or more additional boilers, the sectional area of the chimney being insufficient to discharge freely the gases from the original and the new boilers combined. This will illustrate the importance of making the sectional area of a chimney of ample size in cases where future extensions are likely to be made.

We remember one instance where a very high chimney failed to produce a good draught. So far as the height was concerned, a chimney of only three-quarters of the actual height would have been ample. The chimney in question had a keen taper, being very much smaller at the top than at the base, and an expert who was called in to investigate the trouble suggested that by reducing the height the sectional area of the outlet would be considerably increased, because the diameter increased gradually towards the base, and the area varies not simply as the diameter, but as the square of the diameter. The suggestion was acted upon and the increased outlet area thus obtained proved to be sufficient, no further trouble being experienced.

When additional boilers are installed and the existing chimney is not large enough for the increased duty, there are two principal ways of meeting the difficulty: One is to install an induced-draught fan, driven either by an electric motor or a small steam engine, whichever is the more convenient. The other is to divide the whole range of boilers into two equal sections, allowing the existing chimney to deal with one section, and building a new chimney, perhaps of steel for cheapness, to cope with the remaining boilers. Which of the two methods would be the better one would depend upon circumstances, and the matter would require careful consideration of all the conditions.

In some instances, trouble with the draught is the result of restriction in some part of the flues. As a general rule, no part of the flues should be less in sectional area than the throat of the chimney. In one instance, where the draught was so poor that the firemen could not keep up the steam pressure, it was found that the fire-bridges had been built too high, *i.e.*, to within about 9 in. of the top of the furnace crowns. The simple act of removing two courses of bricks entirely overcame the trouble.

Sudden bends and changes of section in the flues will sometimes be responsible for impaired draught. As far as practicable all bends should be smooth and of large radius, and the course of the flues to the chimney should be as direct as possible. When the chimney is at a great distance from the boilers, both it and the main flue should be made of considerably larger area than would be necessary in a normal case. For example, it is recommended that the area in the case of a main flue 1,000 ft. long should be twice as great as would be necessary in a case where the boilers and the chimney were close together, as determined by the ordinary rules.

We have seen that the draught produced by a chimney depends upon the temperature of the gases passing up the chimney. If from any cause this temperature should be reduced, the draught will be impaired, a fact which is commonly overlooked. Hence it is important that leakages of cold air into the flues should be carefully avoided, and to this end all the brickwork surrounding the boiler should be maintained in good order. Since there is reason to believe that a considerable quantity of cold air sometimes passes through the solid brickwork, owing to the porosity of the bricks, the coating over of the external surfaces of the walls with tar is worthy of consideration. It is not difficult to realise that when the brickwork either of the flues or the chimney is allowed to become defective, as it frequently is, particularly at the back end of Lancashire and similar boilers, the quantity of cold air rushing into the flues is so great that the hot gases are cooled down to such an extent that the draught may be entirely spoiled. We have in mind a peculiar instance of this.

At a certain works, a new boiler of the Lancashire type had been installed as a substitute for a similar boiler. Arrangements had been made for a number of influential shareholders to visit the works on the day of starting up the new boiler, and accordingly, the engineer-in-charge carried out a general "spring-cleaning." On lighting the fires in the new boiler, however, he found to his dismay that the chimney would not "draw," and the boiler house was soon filled with smoke. So far as was known, no change whatever in the conditions of working had taken place, and for the time being, those concerned were at a loss to know what to do. A careful examination of the brickwork setting showed the brickwork to be in good order, but on going to examine the chimney, the engineer-in-charge found a large fracture at the base of the chimney extending for several feet. Through this rent the cold air rushed in large volumes, cooling the chimney gases to such an extent that the draught was almost entirely spoiled. The fracture had existed previously, but had been covered up by dirt and refuse until the day in question, when the rubbish had been removed, thus revealing the defect. The rent was quickly made good, after which no further trouble was experienced.

The serious effects which the installation of a fuel economiser may have in impairing chimney draught are not always realised as they should be. Such an apparatus will generally extract so much heat from the products of combustion that the temperature of the gases is reduced about 300 deg. F. Since, as we have seen, the draught depends largely upon the temperature of the gases, it will be realised that such a reduction of temperature may entirely spoil the draught produced by a chimney which was originally designed on the assumption that there was to be no economiser. If, indeed, the outlet temperature of the gases is low to commence with, the installation of an economiser is out of the question. The economiser may also prove a serious obstruction in the flues unless care be taken to avoid this difficulty.

In starting up a boiler connected with a cold chimney, trouble in creating the draught is liable to be experienced for the obvious reason that, to commence with, the chimney contains a column of air at approximately the same temperature as that of the outside air, so that there is no difference in weight of the two columns to set the gases in motion. When this trouble is met with, it may generally be overcome by lighting a fire at the base of the chimney.

Trouble with the draught is sometimes experienced in hilly districts when the surrounding hills are in close proximity to the chimney. The difficulty is frequently in the nature of a down draught, and would appear to be brought about through the wind blowing downwards from the hills and descending the chimney shaft. Strangely enough, the trouble may only occur when the wind is blowing in a certain direction; there is a belief that when the wind is a northerly one, the trouble is far less liable to occur than when it is in any other direction, but why this should be so is not easy to explain.

A down draught is often attended with very unpleasant results. For instance, the smoke is blown into the boiler house, flames and sparks issue from the furnace mouths, and the boiler may vibrate more or less violently owing to the descending currents of cold air meeting the ascending currents of hot gas. A down draught will sometimes be caused by the choking of the spaces between the firebars. The flow of air upwards through the grate is checked, with the result that air flows downwards from the outside. This applies more particularly to vertical boilers, and the remedy is obvious.

In Lancashire boilers, a trouble closely akin to down or back draught is occasionally caused through the baffling of the two streams of gas as they issue from the flue tubes, and meet in the downtake; this trouble may be accompanied by the most violent vibration. The remedy is to prevent the two streams of gas mixing together until they have passed a distance of a few feet under the boiler towards the front end, by building a mid-feather wall.

Australian Industrial Developments.—A Beama Protest.—The Sydney correspondent of the *Daily Telegraph* reports that, speaking at the opening of Messrs. Chubbs's new safe works, Sir Joseph Cook referred to the growing tendency of British firms to establish factories in Australia. He said he was recently advised that it was proposed to spend £10,000,000 in new enterprises. Since last March, 22 important new undertakings had been registered with an aggregate capital of £3,500,000, besides £1,500,000 in the wool and textile industries alone. Bearing on the same subject, "the Australian Overseas Committee of the British Electrical Manufacturers' Association has protested against the decision of the Sydney City Council to accept the tender of an Australian firm at a price 20 per cent. higher than that of British firms. The Association states that the duty, freight, insurance, exchange, and other charges afford Australian firms a protection of 45 per cent. Thus the total burden on British manufacturers in this instance is 65 per cent. It is urged that no preference should be given to local firms over British goods."

High-Speed Kinematograph.—A golfer's strokes were used by Dr. Gustave Monod, of Vichy, during a lecture he gave at the Royal Society of Medicine, on February 23rd, to demonstrate the "ultra-kinema," a French apparatus which Dr. Monod has brought with him from France. According to the *Daily Mail*, the film is made at the rate of 300 exposures per second, and the picture is thrown on to the screen at the rate of 16 to the second, showing the action, Dr. Monod explained, about 20 times more slowly than the speed at which it took place.

ELECTRICAL DECISIONS IN 1920—1.

The Law Reports for 1920 do not contain many cases relating directly to the supply of electricity. Either the lawyers have been too busy with other matters, or those connected with the industry have been careful enough, or fortunate enough, to keep out of the way of litigation.

There are, however, a few cases relating to tramways and other matters to which it is desirable to draw attention.

First with regard to tramways: those who run these vehicles in public streets seem to be fair game for claims for compensation for alleged personal injuries; though to people who have a due sense of proportion, the number of accidents which can possibly give a cause of action is extraordinarily small when compared with the number of persons carried.

Two cases have been decided, one in Ireland and the other in England, in which the duty of a conductor in relation to passengers was considered. In the Irish case (*Steele v. Belfast Corporation* (1920) 2 I.R. 125), an action for negligence was brought. The evidence for the plaintiff was to the effect that, while a tramcar was at a standstill at a compulsory stopping place, indicated by a red signal post, the plaintiff proceeded to enter, but just as she had put her foot on the step, a passenger on the platform rang the conductor's starting bell, and the driver put the car in motion, with the result that the plaintiff was thrown to the ground and sustained serious injuries; that during all this time the conductor was on the top of the car collecting fares, and that during the earlier part of the same journey the bell had been rung by passengers on at least three occasions. The fact that the Irish Court of Appeal held, on these facts, that the jury were entitled to find a verdict seems to indicate that according to the judges in Ireland a conductor is bound to prevent the misuse of the starting bell at all costs; but that this is not the view of English judges appears from *Wagner v. West Ham Corporation* (37 T.L.R. 86), where an attempt was made to make a tramway company liable for an accident to a passenger in somewhat unusual circumstances. When the plaintiff was entering a car of the defendants at an optional stopping place, the vehicle moved forward, with the result that the plaintiff was injured. It was shown that the starting bell was rung by someone other than the conductor. In these circumstances the Corporation was sued, it being asserted that the conductor was negligent. A County Court judge having found that there was no negligence, gave judgment for the Corporation, and his decision was affirmed by two judges of the King's Bench Division, who laid it down that the mere fact that a tramway car has been started from an optional stopping place through the bell being rung by a passenger in the absence of the conductor does not render the tramway owners responsible for injury thereby occasioned, unless it is shown that in the circumstances the non-control of the bell by the conductor amounted to negligence. This decision accords with common sense. A conductor has many functions to perform besides watching the ingress and egress of passengers, and in the absence of negligence his employers ought not to be held responsible.

Apart from those who suffer actual physical injury, people whose nerves are affected sometimes attempt to recover damages from tramway authorities. Thus in a Scotch case, *Ross v. Glasgow Corporation* (1919 S.C. 174) a lady averred that she was occupying a front seat on the top of an east-bound car, which was standing 30 feet from a set of points; that she saw the driver of a west-bound car, which was standing on the same line of rails, but on the other side of the points, start his car without changing the points, and drive at considerable speed towards her car, stopping only at a distance of 3 feet from it; and that, through fear of a collision, she sustained a nervous shock which resulted in permanent injury to her health. It was held that such a serious fright as that alleged was not a natural and probable consequence of the occurrence, and the action was dismissed as irrelevant. It will be observed that the action was dismissed not because the claim was for damages for nervous shock, but because, in the opinion of the Court, the shock was not the necessary result of the accident. Claims for mere shock have more than once been held good—at any rate in English courts.

In the case of the *Postmaster General v. Blackpool and Fleetwood Tramroad Co., Ltd.* ((1920) 37 T.L.R. 20), the Postmaster-General sought to recover damages from the defendant company, alleging that certain telegraph cables which he had laid near their tramline had been injured by electrolytic corrosion. He was held entitled to recover, notwithstanding that the tramline had been constructed by the defendants under their powers in 1898, and the lines of the Postmaster-General were not laid until 1914. This remarkable decision requires some explanation. The company were bound by S. 65 (1) of their private Act (Blackpool and Fleetwood Tramroad Act, 1896) to work their undertaking in all respects with due regard to the telegraphic lines from time to time used by the Postmaster-General and the currents in such telegraphic lines; and "Shall use every reasonable means in the construction of their electric lines . . . to prevent injurious affection." S. 65 (2) imposes upon the company an obligation to pay the expense of all such alterations in the telegraphic lines of the Postmaster-General as may be necessary to remedy injurious affection. It appeared that the telegraphic line was laid in 1914 within 7 feet of the company's electric lines, and without any notice to the tramway company. A breakdown, which occurred in 1916, was found to be due to corrosion, and the difficulty was overcome by bonding. A County Court judge before whom the case came in the first instance, held that the Postmaster-General, in order to succeed, was bound to show that the company had failed to lay their cables in the proper way, and that, as he had failed to do this, the company could not be blamed. The Court of Appeal, however, held that this argument was untenable. Counsel for the company then attempted to argue that as the Postmaster-General had been negligent in laying his telegraphic cable so near to the tramway cables, the company could not be held responsible. The Court of Appeal refused to allow this point to be raised, as it had not been taken before the County Court judge. They made it quite plain, however, that this was a defence which might have been put forward, and the fact that they did so is a matter which ought to be borne in mind by tramway and other companies who have claims for "injurious affection" preferred against them by the Postmaster-General.

SUPPLY LEGISLATION IN HOLLAND.

The question of the creation of a public authority in Holland for the concentration of the generation and transmission of electricity, to which reference was made in this journal about a year ago, has not yet been settled, although a somewhat modified Bill is at present receiving the consideration of the Second Chamber of the States-General. This Bill has for several months past been under the examination of a departmental committee, some of the members of which have raised objections to the scheme. In their opinion, the adoption of the project would not promote the supply of electricity throughout the country, but would hinder it, as the existing central stations would be hampered in their development on the measure becoming law. On the other hand, the Minister of Public Works, in the course of a lengthy reply to the objections in general, states that the fact is overlooked that the greater part of the country—in eight of the eleven provinces—is already supplied, and will continue to be supplied to a large extent in the near future, according to concessions granted by the Crown; and it is intended to issue concessions to provinces and communes in the remainder of the country. It is calculated that the scheme will permit of the delivery of electricity to consumers at a lower price than would otherwise be possible. But although the Minister expects great advantages to result from the centralisation of production, or at least from the use of large sets, he expresses the opinion that the importance of the proposed regulation of the industry lies less in the circumstance that it would render this concentration possible than in the advantage which it will confer on the country by the production and transmission of electricity at high pressure.

The Minister proceeds to state that with the exception of a few central stations all the electricity supply works are in the possession of the provincial and communal authorities. In so far as the bringing into operation of the scheme will cause any change for these bodies, it is that they will be relieved in the first place by the State (the public authority as a company) taking over the central stations and high-pressure network, and secondly, new generating stations and high-pressure networks which appear necessary will be established by the State, and not by the provinces or communes. In general, the centralisation will not proceed further than the production and transmission at high pressure, and will, except in special cases, not extend to the distribution of electricity. As to the purchase price to be paid for works, it is impossible to agree that more shall be paid than the value of the plant for the carrying on of the business. Proposals exist for the conversion to electric traction of certain of the railways which have to deal with a large volume of traffic, and in this connection the committee has reported that the source of production and distribution of energy for this purpose is independent of the system to be adopted for the working of the railways.

According to the alterations made in the original Bill, the public authority (company) to be formed bears the title of the Nederlandsch Electriciteits Bedrijf. The object is to establish and work stations for the production of electricity which is to be placed at the disposal of other parties, the transmission of the power by primary high-pressure mains and its transformation in sub-stations connected directly with the primary network; in special cases also to establish and carry on distributing works according to concessions to be granted by the Crown, and to purchase and take over generating works and equipment, as well as to buy energy in so far as may be necessary. Authority is conferred upon the company to take every action in accordance with the foregoing objects or which is connected with them to the fullest extent, even if this implies participation in other undertakings. The company is forbidden to dispose of the whole or part of any works or rights acquired, without the consent of the Minister of Public Works, and the sanction of the latter is also required to the raising of loans and the conclusion of important contracts for the sale or purchase of energy, the Electricity Board being heard before the Minister decides what are important contracts.

The company, which is to be formed for a period of 99 years dating from the Royal approval of the law, will have an ordinary share capital of 15,000,000 fl. divided into 100 shares of 150,000 fl. each. It is further provided that both consumers and workmen shall be represented on the Electricity Board, which will be established under the law to act as an advisory council to the Minister of Public Works.

JOINT ELECTRICITY AUTHORITIES.

The Chester and North Wales Inquiry.

(*Continued from p. 236.*)

Continuing the cross-examination of Mr. S. E. Britton on February 17th, Mr. Jones closely questioned the witness as to figures given in the scheme which showed discrepancies, and an adjournment was granted for the town clerk of Chester to go into the matter; on resuming, the latter stated that owing to the hurry of the revision of the scheme certain figures were put in which were inaccurate, and the total should read £29,800 instead of £35,850 in regard to the cost of transmission lines. Questioned as to the Vale of Clwyd scheme, the witness stated it was proposed to put a dam across the river Clwyd and construct two channels across the river Elwy; the cost of £65,000 included £18,000 for cable, and it was proposed to submerge 28 acres of land which would cost about £4,600, and include water rights and compensation. The dam would be about 40 to 50 ft. high, and be made of stone. The dam would form a lake about a mile long and half a mile wide; the flow of the Elwy had been measured up to 14,000 cu. ft. a minute.

Mr. Jones: What I want to know is how are you going to construct a lake of that size on 28 acres of land?

Mr. Britton: I have not got the figures here; of course I have overstated it, a square mile is over 400 acres, and obviously that is wrong.

Mr. Jones: I am very concerned as to whether these figures you are putting before the Commissioners are really reliable.

Mr. Tyldesley Jones, in concluding his cross-examination, said he reserved for a later time some points in the clauses containing obligations which had been put there for the supply of railways, and if the order went any further he would ask for it to be materially extended, because it was limited to haulage on the railways.

The witness was then cross-examined by Mr. Moon, for the Dee Fisheries Board, who questioned the witness as to his report to the Board of Agriculture, in which he stated: "The Dee was prominent among British rivers for the cultivation of salmon, and in utilising the river for the generation of electricity special attention should be given to fishing interests."

In reply to further questions, the witness stated they had no intention of taking off the foot from the weir put on under the Defence of the Realm Act. He also said he had seen salmon use the "fish pass."

Witness said it was proposed to construct two new weirs at first; eight in all were to be constructed, but at what period he could not say. Since the first proposal was made four of the proposed dams had been cut out, reducing the 50,000,000 units. He estimated that up to 60,000 cu. ft. per minute would pass through the turbine intake at full load.

Mr. Bruce cross-examined witness as to the Vale of Clwyd scheme and the proposal to erect a dam on the Elwy, and the chairman remarked that before a hydro-electric station could be constructed the Commissioners would see that proper notices would be given to the authorities concerned, and any important interests such as the Fisheries would be fully consulted.

Mr. A. E. Morris, cross-examining on behalf of the Carnarvon C.C., asked "If no public authorities, say, in Carnarvonshire came into your scheme owing to the financial responsibilities which clause 78 puts upon them, where do you hope to get that money to develop or to make transmission lines during the first five years?

Mr. Britton: The Joint Electricity Authority must have powers to raise the money, otherwise it could not operate, and it would raise money under such powers.

Sir Harry Haward: Is it the intention that the Joint Electricity Authority should not construct any works in the area of a district, the urban or rural council of which declines to become a constituent authority?

Mr. Britton: No. I do not think that is the idea. I do not think it restricts itself to the areas of authorities who have undertaken financial responsibility only. I think it must operate in the whole area.

Sir Harry Haward: Then there will be advantages to be gained by consumers in areas the councils of which do not become constituent authorities, and the money for carrying out those works would be raised on the security of the whole of the district which is represented on the Joint Electricity Authority.

Cross-examined by Mr. Walter Jones (Anglesey C.C.), witness said that the resources of the Power Co. as regards the western area were the primary and only source, and that the areas in that district should have preferential appropriation of an adequate development to the local and national advantage.

Mr. H. S. K. Feltham (town clerk of Crewe) then cross-examined the witness as to what the scheme intended to do for Crewe.

The town clerk of Chester, before the adjournment for the day, asked for the production by the Power Co. of details so as to show the financial result year by year, including capital charges and revenue, up to 1925.

There was again a large attendance when the inquiry re-opened on Friday, February 18th. At the outset the chairman asked Mr. Dickson, the town clerk of Chester, whether the statement showing the approximate composition of the Joint Electricity Authority as promised by him was yet prepared.

Mr. Dickson expressed regret that it was not ready, and put in a statement showing how the £27.5 per kW capacity of the steam generating station was arrived at, the figures given being the estimates of the contractors. The figures given under wages, stores and repairs, and rents, rates, and taxes, management and establishment charges, had been altered, the total being £28,875.

Sir John Snell remarked that the Commissioners were getting rather concerned as to the length of the inquiry. All who desired to cross-examine the witnesses should avoid repetition.

Mr. Feltham (town clerk of Crewe) continued his cross-examination of Mr. Britton. Mr. Feltham said there were something like 20 generating stations in the area at present; would it be more economical if they were to be extended or for the scheme to go through?

Mr. Britton: I think it is essential that the scheme should go through.

Cross-examined by Mr. Allen (Denbigh C.C.), he said it was absolutely essential for industrial purposes that a constant supply of energy should be maintained, especially with respect to the water in some of the mines.

Asked whether he proposed to charge the same price for industrial purposes as for lighting purposes, Mr. Britton said a Joint Electricity Authority would not provide tariffs for lighting only; it would provide tariffs to supply authorised distributors and large consumers. The price to the authorised distributors mentioned on Thursday, about 1½d., was merely an average figure.

Mr. Allen: Do you know that energy is supplied to the collieries in Lancashire at under 1d. per unit?

Mr. Britton: I do not know that. In answer to the chairman, the witness said that taking the load factor into account, it should be possible to get a figure of under 1d. per unit. Asked by Mr. Allen whether the enlargement of the existing Wrexham station or the erection of a generating station in the heart of a coalfield would give greater confidence to the industries of the district rather than the water power scheme, Mr. Britton said No. The proper place to put the steam station was on the Dee, having regard to the volume of water available for condensing purposes. It was proposed to erect the transmission lines overhead.

In answer to Mr. Cowley (Northwich U.D.C.), the witness said the promoters of the scheme could give no assurance when the scheme would be carried out; it was a matter for the Commissioners and the Joint Electricity Authority.

Mr. Cowley: Suppose the whole of the urban authorities within a defined area could not see their way to come within the scheme, to become, as it were, constituent authorities in the scheme, it would be difficult to work the scheme.

Mr. Britton: If they took the line you suggest they would be neglecting their duty under the new Act.

In answer to Mr. Fennell (Northwich Electricity Supply Co.), the witness said that he had not had any further information to enable him to form an opinion as to whether the Dee water power or the Welsh water power would be the best in the central and eastern areas.

Mr. Amos Jones (Rhyl U.D.C.): Have you applications from anyone in the district for energy

Mr. Britton: It has not been part of our work to do that.

Mr. Jones: The facts establish that only 356,000 units were consumed by Rhyl, but you put forward a proposal that 3,000,000 units will be taken in the next ten years. Rhyl is the only town in the area that at present consumes electricity.

The Chairman: May not that be because your cost of production is so high?

Mr. Jones pointed out that there was a belief prevailing amongst various undertakers that should they refuse to participate in any scheme that might be set up, the Commissioners in whom the power of sanctioning loans was now vested would refuse them any expenditure upon their undertaking until such time as they agreed to come within the scheme.

The Chairman: For the benefit of those who have got that mistaken idea, I might perhaps say at once that I am quite sure that it would not be the attitude of the Commissioners. If after the establishment of a Joint Electricity Authority there is a particular undertaker in the district whose undertaking can be extended at a cheaper rate, and with a greater benefit to the people in the area than the alternative course of taking it from some distant supply, I am perfectly certain the Commissioners under those circumstances would not refuse to sanction the extension of that undertaker's station, taking, of course, all the necessary points into consideration.

Cross-examined by Mr. H. J. Owen (Merioneth County Council), the witness said he was aware that Merionethshire was anxious to obtain an adequate supply at an early date, subject to some form of public control, and that Merioneth was within the area of the North Wales Power Co.

Mr. Owen: Why has Merioneth been left out of your scheme?

Mr. Britton: It is stated that so far as Merioneth and Montgomery are concerned it should be the first duty of a Joint Electricity Authority thoroughly to survey those areas, and find out the sources available for development.

Mr. Owen: I take it the whole area will benefit by the erection of a station at Maentwrog, and that you will admit the resources of Merionethshire are being made available and diverted to services outside the county?

Mr. Britton: Well, the county generally, as far as practicable.

The witness was then cross-examined by Mr. Leigh (Flintshire County Council) concerning the figures given for the cost per mile of the transmission lines, and the route of the line.

Sir Harry Haward: What figures ought I to take for the purposes of comparison with the generating costs of existing stations in order to show whether it would pay the authorised undertakers to take a bulk supply from your new station?

Mr. Britton: The figure is 1.135d. including transmission; at Northwich the figure is 1.161d.

Sir Harry Haward: It is not clear that the whole of those costs would be saved if Northwich took a supply in bulk, and there would be certain wages still to be paid, so that the generating costs of Northwich were something less than 1.161d.

Mr. Britton: That would be so.

Sir Harry Haward: Could you afford to supply Northwich at a figure which would induce them to take your supply?

Mr. Britton: Not on the average cost per unit.

The witness, in reply to further questions, said he was expecting 20 existing stations to be discarded on the assumption that a supply would be available at a cost below their present cost.

In reply to Mr. Page, the witness said he had not been able, through lack of information, to come to any conclusion as to what would be the diversity factor in the event of the stations being supplied from a common source. He agreed that if any other source or method of supplying electricity could be shown to be economical, the low-fall water power should remain in abeyance until some future time.

In arriving at the figure of 2d. per unit he had assumed the calorific value of the fuel at 11,000 B.th.u.

Mr. Page: What would be the ratio between steam supplied load and water supplied load in a total load of 10,000 kW?

Mr. Britton: I should think anything between 30 and 50 per cent. would be ample.

In reply to further questions as to the many steps between the turbine and consumer on the proposed low-fall water-power development, the witness said it was proposed to adopt the Thury system, which he considered was the most suitable.

Mr. Page: Have you considered the Highfield method? Perhaps you do not know of that—it is quite recent; it is a new type of, shall we call it, "converter."

The Chairman: Supposing, when the details of the Power Co.'s scheme are unfolded, that it be found that energy can be supplied by them into the eastern district more cheaply than you estimate you can generate from a steam station on the Dee, in spite of what you have said, do you seriously, as an engineer, say that it would not be better and the more proper thing to take the energy from the Power Co.'s district for use in the eastern districts rather than incur the expense of a scheme on the Dee Estuary?

Mr. Britton: I quite agree, sir; if, as you say, such a result can be shown it would be quite the proper thing to develop in the west and leave the other development.

The witness also agreed that with reasonable duplication there would not be any real difficulty in maintaining intact a properly designed system of transmission.

Before Mr. Britton left the witness chair, which he had occupied for nine hours, the chairman remarked that the Commissioners recognised that he had done valuable pioneer work in connection with the matter, and they wished to thank him and his colleagues for it.

The next witness called was Mr. W. H. Armistead, a consulting fish culturist. He said that the dams to be constructed would cease to be an obstruction to salmon if suitable fish passes were constructed.

Lieut.-Col. W. A. Churton, deputy chairman of the Chester City Council Electricity Committee, gave evidence, and was followed by Sir Henry Robertson, chairman of the Dee Fishery Board, who stated that with the formation of the lagoons pike would congregate and destroy the salmon fry. He estimated the value of the salmon caught yearly in the river at £10,000.

In answer to Mr. Allen, the witness stated that his company, the Brymbo Steel Co., generated and consumed 5,000,000 units of electricity a year. In answer to Mr. Miller, he said that they were prepared to purchase energy from the North Wales Power Co. if it were offered at a price which would pay them to buy it—say, in the neighbourhood of ½d. a unit.

Mr. Moon (Dee Fishery Board) addressed the Commissioners, asking them to reject the scheme on the ground that the proposal involved compulsory powers, which ought not to have been included. His Board also took the view that if there was an urgent demand for electricity in the district there was obviously an alternative supply which should be considered, and the scheme, as far as concerned the water portions of it, was completely irrelevant and could have no force whatever.

Mr. Bruce then made a statement on behalf of the Ministry of Agriculture and Fisheries, and said it was the considered opinion of the Board that the fisheries would be not absolutely ruined, but next door to it. The fishery interests would be prepared to stand aside in the common interest if this were necessary, but the alternative scheme did not affect the fisheries in the least.

The North Wales Power Co.'s Scheme.

Mr. Miller was then called upon to open the case for the North Wales Power & Traction Co.'s scheme (abstracted in the Electrical Review of February 11th). He said that the basis of the scheme was the proper development of the high-level water power of the western area; they wanted to develop that power, and they could do it to everybody's advantage. In 1903 the company was formed, and in 1904 it applied for Parliamentary powers, and in due course received them. The company was constituted for the purposes of the Act undertakers in the counties of Carnarvon, Denbigh (exclusive of the borough of Wrexham and the rural district of Wrexham), Merioneth, and Anglesey. By Section 9 of the Act there were transferred to the company powers with respect to generating and supplying electricity which had previously been vested in the Portmadoc, Beddgelert, and South Snowdon Railway Co., which had acquired those powers under an earlier Act of 1901. The company proceeded to carry on the work at Cwm Dyli, and got transmission lines, he thought, to Blaenau Festiniog, and to Llanberis, in connection with that station. In 1907 the first Aluminium Corporation came into existence; in 1909 the present Aluminium Corporation was formed with strong financial backing, and took over the business of the 1907 Corporation, which had in its own day taken over from the North Wales Power Co., the watershed known as the Ergian Watershed, now in use and developed at the Dolgarrog Power station. The Aluminium Corporation at once proceeded to develop the important water power in the Llewelyn Range, and its power station was at Dolgarrog in the Vale of Conway.

In 1916 the Corporation, in conjunction with the Conway and Colwyn Bay Joint Water Supply Board, obtained a special Act under which the Corporation was given authority to enlarge and extend Lake Cowlyd and to have the use of the lake, after the necessary water supply had gone to the Board.

In answer to the Chairman, Mr. Miller said that the North Wales Power Co. was the statutory company carrying on under the Act the business of supplying power, and the Aluminium Corporation since 1918 had worked with it under one chairman, Mr. Kenneth M. Clarke and the same managing director, Mr. Jack; all the directors of the North Wales Power Company had seats on the board of the Aluminium Corporation. There were additional directors of the latter who supported the present scheme. The North Wales Power Company owned the Cwm Dyli power station and the transmission lines of the company, and the Aluminium Corporation constructed the Dolgarrog power stations. The two stations were now linked up and a transmission line passed from Dolgarrog to Cwm Dyli. The business of supply took place from Cwm Dyli.

Mr. Howell (Town Clerk of Wolverhampton) said he appeared for the authorised undertakers for the North-West Midlands areas, which comprises the Midland Electric Corporation for Power Distribution, the Corporations of Stoke-on-Trent, West Bromwich, Shrewsbury, Leek, Newcastle-under-Lyme, Wolverhampton, and Market Drayton Electric Light and Power Company; the area as provisionally determined by the Commissioners in the county of Chester, the municipal borough of Congleton, Macclesfield, and the urban districts of Alsager, Bollington, Buglawton, Sandbach, and the rural districts of Yeardsley, Congleton, Disley and Macclesfield; in the county of Derby, New Mills and Hayfield. Those were areas roughly in the north and north-west which the conference wished to be excluded from the district as provisionally determined by the Commissioners, and if those areas were to be excluded they must be placed in districts which the Commissioners were now considering.

Mr. S. T. Allen (Wolverhampton electrical engineer and chairman of the Engineers' Committee representing the West Midlands district) gave evidence in support of the application, and stated the distances of the places they asked to be excluded from the stations they proposed to construct, one at Ironbridge, on the Severn, with a capacity of 150,000 kW and another near Rugeley, on the Trent, of 80,000 kW, and a third at Stoke, on the Trent, of 30,000 kW.

Mr. Allen was cross-examined by several representatives of adjacent authorities, and Mr. Proctor, for the promoters of Scheme A, said he had no objection to the areas being included in his scheme.

The Chairman said they would have due regard to the representation made by the North-West Midlands authorities.

On Saturday, resuming his statement on behalf of the North Wales Power Co.'s scheme, Mr. A. T. Miller, K.C., said to make the best use of the hydraulic power at the disposal of the Power Co. it was essential that the company should have a market in the industrial area on each side of the eastern border of Wales, and during the next ten years, which would form the interim period of development, it was proposed to supply energy at 1¼d. a unit average price, and when the development reached maturity this figure would be very considerable reduced. The erection of the transmission lines would be proceeded with as soon as the necessary powers were obtained or reasonably in sight. With the approval of the Commissioners these powers would be asked for by means of a Bill before Parliament.

Counsel went on to refer to various objections raised against the Power Co.'s scheme. One objection was that if the scheme were approved, there would not be sufficient public control over the undertaking. He would have thought that the appointment of the Electricity Commissioners themselves would to a very great extent meet such an objection as that, but the promoters were most anxious in every way to meet reasonable criticisms or objections, and they proposed to provide for the formation of an advisory committee of the consumers, including representatives of the distributors, the railway companies, and the large consumers. This committee could consider all complaints and advise as to proposed extensions of mains and so forth, and could make representations to the Electricity Commissioners, whose quasi-compulsory powers would be sufficient to secure attention to any reasonable requirements.

The objection that this private company might extort unreasonable profits from the consumers was met by clauses in the Power Company's Act limiting the profits to 10 per cent., and limitations as to the prices to be charged. The company was subject to a Board of Trade audit already. As to the suggestion that the Electricity Act contemplated administration by public authorities, Mr. Miller pointed out that the provision for the setting-up of a Joint Electricity Authority in the Act was to be acted upon where necessary, and he submitted that such a body was not necessary in this district, and would, owing to the exceptional character of the district, be undesirable.

The "deficiency clause" was put in to enable the company to pay the debenture interest in the event of the income from power sold not being sufficient to do so. Should another war break out, or some unforeseen dislocation of trade conditions arise which would embarrass the company—which would, owing to the nature of its business, have to make contracts ahead for many years—the clause would enable it to make up any deficiency of the debenture interest by a call upon the consumers in respect of the preceding year; or, if preferred, it could be made in the form of an increase of price for the coming years. The promoters were quite willing that the operation of the clause should be rendered subject to the approval of the Commissioners.

Mr. H. J. Jack, managing director of the Power Co., gave evidence. He explained the various works, and indicated the various watersheds by exhibiting a model on which the mountain ranges and valleys were shown to scale. He said that the heaviest rainfall was on the Snowdon area, which caught the rain clouds coming in from the Atlantic, and the lowest at the western side. In addition to the existing resources the company proposed to construct a dam near Maentwrog, which would give an enormous storage, and there were many further plans for increasing the supply of hydraulic power. It was proposed that the North Wales Power Co. should take £250,000 of the debenture issue of the Aluminium Corporation, and should finance the corporation to the extent of another £250,000, and in consideration the corporation would agree to give the Power Co. as much or as little electrical energy as the Power Co. might desire from year to year at the rate of ¾d. per unit.

It was at first intended that the companies should be merged, but that proposal bristled with difficulties, and this solution was worked out as the simplest way of dealing with the problem. A considerable amount of further capital would be required, and he thought that by issuing a bond that was certain to obtain its interest at a reasonable rate the money could be obtained from the public. Through his experience of the transmission of electricity by overhead mains he found that the system worked effectively and was extremely satisfactory, as he thought the company's customers would testify. The longest transmission line was that to Trevor, in South Carnarvonshire, a distance of 26 miles.

The witness was questioned by Mr. Dickson (Chester Corporation) as to the terms of the agreement with the Aluminium Corporation. The agreement, Mr. Jack explained, had not been drawn up, but, at the suggestion of the chairman, he promised to give the heads of it at the resumed sitting of the Commission.

Mr. Booth, a Commissioner, drew attention to a clause in the Power Co.'s Act, under which the company was required, on being served with notice to supply energy to a district, to deliver that energy at a specified point within that district.

In reply to Mr. T. E. Morris (Carnarvonshire County Council), Mr. Jack declined to commit himself to the principle of giving preferential treatment to consumers who were near the power stations in the matter of price. To Mr. J. Amphlett (Colwyn Bay),) who supported the Power Co.'s scheme generally, Mr. Jack said he would not object to some clause being inserted in the proposed Act under which, if the Power Co. at any time found itself unable to carry out its obligations, the proposed advisory committee would carry on the works. In fact, at the back of his mind was the thought that the advisory committee would, when it had learnt its business, become the Joint Authority for the area.

At this stage the Commission adjourned till Monday.

(*To be concluded.*)

NOTES FROM CANADA.

(FROM OUR SPECIAL CORRESPONDENT.)

Some months ago the Provincial Government of Ontario appointed a special committee to report on the possibility of devising a more equitable system of distribution of power by the Hydro-Electric Power Commission and a more uniform price. The former question was raised apparently by the rural portions of the province, where the people evidently feel that the cities and towns are getting all the benefits of cheap power while they themselves are left out except in those cases where the transmission and distribution lines pass sufficiently near to the hamlets and the farms to make it practicable to supply them; the latter question no doubt emanated both from rural districts and from small towns and villages, where it has been found possible to give a supply of electric energy, but only at high rates, owing to the smallness of the demand or to the remoteness of the particular town, &c., from the source of supply.

It is believed that this latter question was the one which was actually responsible for the appointment of a committee as, for some time, there has been an agitation in certain quarters that there should be one uniform rate throughout all the Commission's systems for electric energy, no matter how close to or remote from the source of supply any spot might be.

The committee referred to have just issued their report, which is unfavourable to the proposed "flat" rate for the entire province, but advocates a "zone" system instead, the rates to be uniform throughout any particular zone, of course.

Several other matters are dealt with in the report, which may be of interest.

The committee recommend the creation of a "Department of Power," to be a department of the Provisional Government with a "Minister of Power" at its head; they also recommend that a yearly rental for all power developed be charged at the rate of $2.00 per h.p., which would yield about $2,000,000. The report points out that of about 337,000 h.p. being supplied by the Hydro-Electric Power Commission, only about 2,500 h.p. is supplied to the agricultural industry; this being the case, the committee recommend that the Government should give financial assistance to rural districts by paying a certain proportion of the cost per h.p. supplied to such districts, the small and more remote municipalities should also, it is stated, receive some measure of assistance, and suggested figures are given.

For power costing more than $30.00 per h.p.-year for any municipality or power zone, the Government should assist to the extent of 50 per cent. of the excess over $30.00 up to a maximum figure (for the Government) of $25.00.

For power supplied to the agricultural industries, the assistance given may amount to "a sum sufficient to meet 80 per cent. of the annual charge necessary to pay for the cost of building and maintaining in rural districts the low-pressure transmission lines that are necessary for rural distribution, but that such assistance shall not exceed 50 per cent. of the revenue derived from power rentals, and that one of the conditions upon which such assistance may be given is that there must be an average of three services per mile of transmission line in all rural districts served."

It will be very interesting to note whether these proposals are acted upon, as they will form something of a new departure in electricity supply even in connection with public ownership. That there will be strong opposition to some of them is certain. The consideration of such questions is explained by the fact that Ontario at present has a "Farmers'" Government in power.

In December the Hydro-Electric Power Commission put into operation two sets of 12,500 h.p. each at the power site developed at Nipigon, near Port Arthur, which is at the Western end of Lake Superior, and about 800 miles N.W. of Toronto. At present there is a temporary dam which gives only about half the head which will be available when the permanent dam is completed so that the power now obtainable is only about 12,500 h.p. Altogether about 75,000 h.p. can be developed at Nipigon when the local demands warrant it. Power is being supplied now to Port Arthur, and in time large pulp and paper interests as well as the City of Fort William will be using power developed on the Nipigon river.

According to a recent article in the *Canadian Engineer*, the Union of Municipalities, in the Province of Quebec (the stronghold of private enterprise so far as electrical engineering in Canada is concerned), is urging that the question of the development of water power by the Government receive consideration. Up to the present time the Provincial Government in Quebec, through the agency of the Quebec Streams Commission, has attended to the proper regulation and storage of water powers leaving actual development of water-power sites to private undertakings. If the proposals of the Union of Municipalities be adopted it will mean a very decided change of policy.

Extensions totalling approximately 130,000 h.p. are said to be in progress at several of the large hydro-electric plants in Quebec Province, and a new project for a 150,000-h.p. development on the St. Maurice river is being considered; in addition a number of smaller schemes are proposed.

As already reported in these Notes, there is a Power Commission in Nova Scotia, and though the available water powers are not very large when compared with others in this country, a 15,000-h.p. hydro-electric development is under construction which will probably be supplying power in the near future.

In New Brunswick there is a Hydro-Electric Power Commission which, however, has not been in existence very long, but which seems already to be making headway.

There is a considerable amount of activity in the Prairie Provinces, more especially with regard to the transmission of power developed on the Winnipeg river, in Manitoba.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Domestic Supply from 500-volt Generators.

I have two 500-volt, 150-amp. d.c. generators running in parallel and supplying lighting and power on the two-wire system. It is desired to obtain a lower pressure for domestic purposes, preferably 120 to 150 volts. The machines have each one positive and one negative set of brushes.

It would be very interesting to have criticisms of the practicability of obtaining this reduced pressure by fitting another set of brushes at some position between the existing brushes, whose potential will be that required, viz., 120 to 150 volts.

Further, what are the disadvantages or alternatives to converting to a 3-wire system and using the 250 volts for the above-mentioned purposes, and so limiting the pressure to earth to the safer figure of 250 volts?

Inquirer.

February 25th, 1921.

Charging Batteries for Motor Cars.

We have been interested in the correspondence in your columns which has been going on for several weeks under the above heading. As up to the present discussion has been confined to d.c. circuits we have not intervened.

Mr. D. V. Tustain's letter, however, in your issue of February 18th deals with the question of battery charging from a.c. mains. We have recently placed on the market the Tungar battery charger for this purpose, and a large number of types and sizes are available, suitable for all a.c. circuits in this country, and of capacities to suit most requirements.

The Tungar battery charger was illustrated and described in the electrical Press recently. The smallest size has an output of 2 amps. at 7.5/15 volts, and the largest 12 amps. at 0/75 volts. The efficiency of the larger size on full load is in the neighbourhood of 75 per cent.

A large number of Tungars are in use and giving every satisfaction, and we shall be pleased to give full data and information to any of your readers who may be interested.

J. W. Stephens,
Manager, Wiring Supplies Sales.
The British Thomson-Houston Co., Ltd.

London.
February 25th, 1921.

A Post Office Error.

Supplementing our advertisements by the sending of price lists, accompanied by letters in imitation typewriting, handed over the Post Office counter in batches in accordance with regulations, we have been surprised and annoyed to find a considerable number come back, due to the addressees not wishing to pay surcharges, amounting in some cases to 3d.

Inquiry at the receiving Post Office has made it clear that they failed to attach the triangular cancelling stamp to the envelopes that denotes the acceptance of the packet at the proper reduced rate, and so we fear many of our prospective customers have been unjustly mulcted of hard-earned money.

The object of this letter is to ask you to make the necessity of the triangular stamping more widely known, and to get back from the addressees the envelopes with the overcharge stamping, so that we may obtain the refund which we will make to them.

Photector Co., Ltd.

Southall.
February 26th, 1921.

Wiring in Ferro-concrete Factories.

Having had considerable experience in this class of construction, my few remarks may help "Inquirer." In the U.S.A., where ferro-concrete buildings are almost the rule in large cities, there is one generally accepted form of electrical installation, this being screwed steel tubing of the Sherardised or galvanised variety. The mode of procedure is as follows: The owner or architect engages an electrical engineer to prepare a complete wiring plan, showing light and power outlets or points, and sizes of conduits, with the number and size of wires they are to contain. Tenders are invited and accepted on this plan. As the building of the wooden forms proceeds the electrician installs the tubing system according to the engineer's plan. The concrete is then poured, completely embedding the tubing. When the building is practically finished, the wires are drawn in. Very few draw-in boxes are used, the lighting outlet boxes and distribution boxes generally proving sufficient for this purpose. Personally, I do not think this system can be improved upon, for this class of building, provided that the owner or architect knows what he wants beforehand, and the services of a capable engineer are engaged.

P. Davis.

Portsmouth.
February 28th, 1921.

With regard to the use of a concentric wiring system, the writer had the opportunity of viewing some premises in which a fire had taken place—through no fault of the electrical installation—and the only material left on the wall was the copper-covered wires put up ten years ago and manufactured by Siemens Bros. The rubber had doubtless perished inside the copper tube, but had the wires been sunk in concrete there would have been a possibility of their escaping injury.

The writer also knows of other buildings which have been wired with this wire ("Stannos," I think it is called), and which have required no attention since the wire was installed ten years ago.

J. K. G.

Hamilton.
February 27th, 1921.

The Rating of Motors.

Your report of Hartley *v.* Lancaster Corporation (February 18th, p. 200) is of great interest in view of the possibility of wider use of multi-part charges for electric supply.

In many cases it is convenient to base the fixed charge under such systems upon the reputed or marked horse-power or kilowatt capacity of the motors or apparatus installed, and although I have not heard of such a case before, there is always room for argument about this feature.

In introducing systems of this kind, it might be worth while for engineers to consider the advisability of inserting in the agreements a "capacity agreed clause," something like the "age agreed clause" which one finds in life insurance policies. This would mean that at the time of making the arrangement the supplier and the consumer had agreed the capacity of the apparatus and the basis of the fixed charge, and then it would not be competent for any question to be raised upon it in the future.

British Electrical Development Association, Inc.,
J. W. Beauchamp,
Director and Secretary.
London.
February 23rd, 1921.

The Cost of Wiring New Houses.

Having read with interest several accounts of the cost of wiring new houses and the erecting of mains to them, I thought the following statement of the cost of wiring and running mains to 22 new houses erected in this town might interest you.

The installation consisted of eight points per house, carried out in slip-joint conduit at the cost of 35s. per point, making a total of £308 for 22 houses.

The method of distribution to the houses was by overhead mains consisting of No. 4 gauge hard-drawn copper wire, the 2-wire system being used and the run of the wire 300 yards.

One chimney on each house was utilised for supporting the wires, the chimney being timbered with 3 in. by 3 in. oak clamped on the chimney by $\frac{5}{8}$ in. bolts, and the wire supported by G.E.C. insulators; the cost of mains and the erecting of them was £60, making a total for the complete job of £368.

The above, I think you will agree, makes a cheap and efficient method of supplying houses erected on the outskirts of a town.

G. W. Leggett.
Stowmarket.

The Reduction in the Price of Lamps.

I read with interest Mr. C. Culmer Hodges' letter in last week's Electrical Review. I quite agree with him, and I also wrote demanding a rebate on February 1st, but have only just received the reply that "owing to the pressure of work, special claims must wait." Meantime I am compelled to sell and stand to pay out for the honour of selling their lamps. E.L.M.A. members' lamps are chronic enough without this additional agony. When lamps were raised some time ago I was "busy elsewhere," and did not reap any benefit from this rise in price as doubtless a good many other contractors, &c., did. The best way to bring the E.L.M.A. to their senses is to refuse to handle their members' lamps. Continental makers and other English makers will be glad to supply, and in these days of strikes I propose we strike against handling lamps of the E.L.M.A. Such combined action would have but one result. Finally, what are the E.C.A. doing in the matter?

Harold L. Smith.
London.
February 28th, 1921.

Induction-Generator Installations.

I have read with considerable interest the article in your issue of February 18th, on the electrification of Messrs. Rouse Bros.' woollen mill, as I have thought for some time that there is a wide field in which the induction generator can be used.

Could not an electrical transmission scheme on a big scale be worked up on the lines indicated in your article? that is, with induction generators, driven by water turbines, generating at a moderate voltage; the energy required near the power house being used at that voltage, and any surplus being fed at a high voltage with overhead cables into a general transmission system. The magnetising current for the generators would have, of course, to be supplied by synchronous generators, but the system seems to afford a means of utilising the water power of the United Kingdom without the disadvantages of schemes like the Severn barrage.

Waterfalls with a large head of water practically do not exist in this country, but there are, especially in the hilly districts in the north and west of England, as well as in Scotland, large numbers of streams which, though individually small, will give in the aggregate a large quantity of energy, provided that there is electrical apparatus available by which the energy can profitably be utilised in small quantities. In the induction-generator system, the alternators, water turbines, and switchgear are much simpler both in design and operation than the usual pattern, and this should considerably cheapen the capital cost per kW of output, and make it a commercial proposition for small powers.

Secondly, it can be commenced on a small scale, and the area and plant increased as time goes on, whereas, in the Severn and similar schemes, an enormous quantity of capital must be sunk to produce any result. It must be on a big scale or not at all.

The scheme outlined above is something like a banking system whereby the surplus credit is collected in small quantities from a large number of people until the total makes a huge sum, which can be used as desired. The analogy is still further useful as, in practice, a considerable amount of the credit is used at the place of origin, and the difference only is transmitted any distance.

It is obvious that any solution of our present difficulties can only come by mechanical means, that is, by the use of a method by which energy can be made available at a much less expenditure of labour and material than at present.

The Severn scheme offers at the best only a small decrease in the cost of energy, whereas to be of any avail we must have an improvement like the application of steam in the early part of the nineteenth century, which increased the result of labour many times over the manual methods that had previously been used.

C. E. A.
February 24th, 1921.

[In our issue of September 19th, 1919, we reproduced in abstract an article by Dr. C. P. Steinmetz which had appeared in the *General Electric Review*, in which this proposition was discussed. Dr. Steinmetz then said: "There are already a number of such hydro-electric induction-generator installations throughout the country (U.S.A.), some in successful operation for years, and the field thus opened up is very large, larger possibly than all the electrical development which has taken place hitherto; and one of the features of this development is that no new type of apparatus requires to be developed, but the standard induction motor can be used as an induction generator, and has been used successfully for years in some cases." The article in our issue of February 18th was inserted because it afforded a concrete instance of the successful application of this principle, to which, in common with our correspondent, we attach much importance. Not only small water powers, but also small waste-heat installations can be utilised in this way. The plant and its operation are, as he says, quite simple. The Thury system can be similarly applied, as proposed by Mr. S. E. Britton for the Chester scheme.—Eds. Elec. Rev.]

The "Hotpoint" Trade Mark.

With reference to the report in your issue of February 18th under the heading "Legal," we do not think this makes it clear that we were successful in our opposition to the application by the American Hotpoint Co. for the registration of their trade mark so far as our goods are concerned. The Court will allow the American Co. to use the word "Hotpoint" as a distinctive mark on their manufactures, *excluding irons for industrial, domestic, and laundry use, and soldering and branding irons.* These are the goods which we have manufactured for many years under the Eastman and Warne patent, and known as "Hotpoint Irons." We shall therefore continue to use the name which we have all along claimed as distinctive of our manufactures as above.

We may add that we think it is most unreasonable for a foreign company to make application for a registration which, if it had been granted, would have prevented our using the term under which thousands of our appliances have been manufactured for many years past; in fact, ever since the granting of the patent. The American Co. was ordered to pay the respondents' costs.

The Dowsing Radiant Heat Co., Ltd.,
H. J. Dowsing,
Managing Director.
London.
February 22nd, 1921.

The Life of Metallic-filament Lamps.

Referring to the correspondence on the above subject, I should like to give a few more particulars as regards the behaviour of lamps under my supervision.

As the E.L.E. Co. remark, temperature plays an important part in the life of a lamp. I have noticed this, as in certain departments in this factory the temperature is considerably higher than that of the surrounding air. The gasfilled lamps, in this instance, are not enclosed in fittings of any sort. Even the shade has been removed, to give them as much ventilation as possible. Yet their life is somewhat less than that of lamps burning in atmospheric temperature. I presume this is unavoidable under the existing conditions.

Several of the fittings I have seen for enclosing half-watt lamps have inadequate ventilation, to my mind.

Like "Maintenance," I also had to employ lamps of a higher voltage than the supply voltage. This prolongs the life to a certain extent, but one cannot introduce such a system for the vacuum lamp, as it causes such a decrease in the candle power.

I have inquired about the present quality of lamps, and am told by the travellers that it is owing partly to the poor tungsten wire obtainable.

Occasionally I have had lamps (not frequently, I am glad to say) which burst immediately the current was switched on. On examination, some of these exhibit signs of being short-circuited at the inner leads where the connections for the filament leave the glass. I have always been under the impression that all lamps are tested before leaving the works. If this is the case, how can one account for such defects (vacuum type only)?

This is, I hold, rather dangerous, as one is frequently compelled to insert lamps into live holders, and at such close quarters the eyes are liable to receive a share of the glass splinters.

A section of the works in question has two-factors militating against lamps, viz., heat and vibration. But apart from this, there is usually a fierce static discharge. As the lamps have to be very close to the structure, would this in any way affect their life? Personally, I cannot find a reason, but should any readers have any ideas to put forward, I should be pleased to hear them.

J. W. H.

February 18th, 1921.

"A Regular Reader."—Your letter is interesting, but we cannot publish it unless we have your name and address, not for publication.—Eds. Elec. Rev.

LEGAL.

Phœnix Dynamo Manufacturing Co., Ltd., *v.* Mountain.

In the King's Bench Division on February 23rd, Mr. Justice Rowlatt, sitting as Commercial Judge, heard an action brought by the Phœnix Dynamo Manufacturing Co., Ltd., of Thornbury Works, Bradford, against Mr. H. S. Mountain, a Lloyd's underwriter, to recover a loss under a policy of insurance on a flying boat. The policy was dated October, 1918, and was between plaintiffs and defendant with other persons, and plaintiffs asked that defendant should contribute his share of the loss which subsequently took place.

Mr. Wright, K.C., in the course of his opening for the plaintiffs, said the policy was one covering all risks, except was risk, during construction, assembling, packing for transit, and transit of every kind to any naval air station in England and until the boat was taken over by the Government. Each boat cost about £10,000. Up to the armistice 100 of these boats were ordered from the plaintiffs, but after all 21 were cancelled. The boat which was the subject of the present action had been examined on behalf of the Air Ministry at Bradford and was then dismantled and placed on a trolley and drawn by road to Calshot Air Station on October 29th, 1919. When near its destination the locomotive drawing the trolley swung round and the hull of the boat caught in some trees and was very badly damaged, so much so that the Air Ministry would not accept delivery. The plaintiffs then had to replace it at a cost of £1,979, and they now asked that defendant should pay his share of the loss.

Defendant denied liability, and pleaded that the policy only covered flying boats after construction, assemblage, and packing for transit. Further, the defendant said the hull was not a flying boat, and was not packed for transit. He also argued that plaintiffs' interest ceased in the matter after the boat was handed over to the Government, and that the hull had not been so damaged as to necessitate replacement.

His Lordship, after having heard the evidence and arguments of counsel, held that the accident came within the risk undertaken by the policy of insurance, and therefore entered judgment for the plaintiffs with costs, for an amount to be agreed upon between the parties.

Quain *v.* Spink.

At Lambeth County Court, on Friday last, John Robert Quain, electrical engineer and inventor, of 17, Victoria Street, Westminster, brought an action against Joseph Ronald Spink, electrical works manager, of Effra Road, Brixton, claiming £20 money paid to defendant for manufacturing and dispatching to Canada two electric heating geysers. Defendant entered a counter-claim for £15, being balance due for wages, when he left plaintiff's employment in May, 1918, £35 arrears of salary being due, and in an affidavit he held that the £20 now claimed was paid him on account of the arrears of salary, leaving £15 still owing. Without calling on defendant, his Honour gave judgment for defendant on the claim and counter-claim, with costs.

North Metropolitan Electric Supply Co., Ltd., *v.* Mayor, &c., of Stoke Newington.

The summons in this case, in which a considered judgment was reported in our issue of December 24th, was mentioned to Mr. Justice P. O. Lawrence in the Chancery Division on Friday last.

Mr. C. E. E. Jenkins, K.C., for the defendants, said the order was not to operate pending notice of appeal if it was given by January 31st, and in any case its operation should be stayed over the first day of the Easter Sittings. The order also stated that the plaintiffs were to supply the defendants with power on the footing of the agreement modified by the coal clause.

Mr. Tyldesley Jones, K.C., for the plaintiffs, submitted that the defendants had lost their right of appeal because they had not given notice before January 31st. The arrangement was that the plaintiffs were to go on supplying the defendants with power if notice was given by that date, and it was vital to the plaintiffs to know whether the agreement was going to stand or not. They had proceeded on the basis that the agreement was dead, but that the temporary stay was in operation.

His Lordship: What do you want me to do—to preclude the defendants from appealing?

Mr Jones: Yes

His Lordship: I cannot do that, although I think you are entitled to every indulgence.

Mr. Jenkins, replying to a question whether the defendants could definitely say whether they were going to appeal, said that at present they could not because that depended rather upon certain negotiations now in process.

His Lordship said he could do nothing to prevent the defendants taking advantage of the stay over the Easter Sittings. The order would be drawn up and everything cut out except the stay.

Oldham, Ashton & Hyde Electric Tramway, Ltd., v. Corporation of Ashton-under-Lyne and Others.—Arbitration Appeal.

The Court of Appeal, consisting of Lords Justices Bankes, Scrutton, and Atkin, on Friday, reserved judgment in this case upon the appeal of the Tramway Co. from the decision of Mr. Justice Rowlatt upon the items in the arbitration between the parties as to the purchase price to be paid to the Tramway Co. by the Ashton Corporation, the Hyde Corporation, and the Audenshaw and Denton Urban District Councils. The arbitrator awarded the company £142,000. The purchasing authorities said he ought not to have allowed certain items in his valuation, and that other items ought to be depreciated. They appealed to Mr. Justice Rowlatt, and he came to a conclusion favourable to the Tramway Co. on certain items; but on the four items in question, he decided against the company. These items were as follows: The engineering fees, cost of raising capital, interest on capital during construction, and the expenses incurred by the company in respect of alterations to the Guide Bridge.

A Non-union Installation at Pretoria.

In the Supreme Court in Pretoria, a case was heard in which the Transvaal Property & Investment Co., Ltd., asked for an order calling on the Municipality of Pretoria to connect an electric light installation in a certain building. It appeared that non-union labour had been employed on the installation and the premises were black-listed. The Municipality said that it was unable at present to concede the demand for a connection, and that if the result of supplying electricity were to jeopardise the interests of the ratepayers the Municipality was justified in refusing the supply. Judgment was reserved.

Informing the Uninitiated.—Critics of the Hackney electricity undertaking have pointed out with great indignation that, although the average cost per unit generated is 1·78d., the Council has been selling electricity in bulk to other authorities at the ridiculously low price of ·6d. per unit. It has been necessary, therefore for the borough electrical engineer, Mr. L. L. Robinson, to explain how this can be done without incurring an apparent loss of 1·18d. per unit. He points out that the bulk supply unit and the average unit sold are not identical in character. The e.h.p. bulk supply unit is delivered straight from the station bus-bars; it improves the load factor; it is often an additional load involving no extra overhead charges; and continuity of supply is not compulsory. On the other hand the average unit sold commences as an e.h.p. unit but is not finished with at this stage. It is first transmitted to a sub-station, then transformed to a lower pressure and converted to d.c. It is then transmitted through l.p. feeders and distributed by distributors and services. Then selling, metering, and administrative charges are incurred, while it is necessary to ensure continuity by maintaining reserve plant, &c. In addition to this, it is to be remembered that the losses between the power station and the ordinary consumer's premises amount to about 20 per cent. The engineer also points out the benefits derived from a linking-up scheme, and, to force his point home, adopts a very homely simile relating to the cooking of a pie by a certain Mrs. Jones, and showing how the average cost per pie falls when Mrs. Jones cooks her neighbour's pie at the same time. The initiated will fail to see the use of these comparisons, but we consider them quite valuable in bringing home to the non-technical some points of great importance, and they might prove of some advantage to many of our readers who find it difficult to explain these things to their customers in other than technical terms.

Electrical Trades Benevolent Institution.—The Local Advisory Committee of Newcastle and District organised a dance in aid of the funds of the Institution, which was held at the Grand Assembly Rooms, Newcastle-on-Tyne, on Friday last. The Committee, owing chiefly to the energy of Mr. T. W. Anns, secretary of the Local Committee, Mr. Robson, Mr. Fletcher, and Mr. Spence, attained a most successful result, more than 350 tickets having been sold and about 270 guests being present at the ball. It is hoped that, as a result, about £100 will be added to the funds of the Institution. The guests were received by Mr. W. C. Mountain, chairman of the Local Committee, and Mrs. Mountain. Among those present were the Lord Mayor and Lady Mayoress of Newcastle, Mr. and Mrs. Stephen Holmes, Mr. H. W. Clothier, Mr. and Mrs. Pragnell, Major Steele, and Mr. F. B. O. Hawes, secretary of the Institution. The electric lighting had been specially arranged by the General Electric Co., Messrs. Fletcher Bros., and Messrs. Robson & Coleman, and in the course of the evening various effects, probably novel in a ballroom, were produced by means of searchlights, one of the best of these being that of falling snow.

BUSINESS NOTES.

Bankruptcy Proceedings.—J. Jones and J. R. Jones (J. Jones & Son), electrical engineers, of Chapel Street, Penzance.—First meeting, March 4th; public examination, March 15th: both at Truro.

Mr. T. B. Gordon, electrician and general merchant, 20, Western Broadway, King Street, Hammersmith, W.—Receiving order made February 22nd, on debtor's own petition. First meeting, March 7th; public examination, April 22nd; both at Carey Street, W.C.

Company Liquidations.—Bat Motor Manufacturing Co., Ltd.—A petition for the winding up has been presented to the Croydon County Court by Fellows Magneto Co., Ltd., and will be heard at Croydon on March 17th.

Bat Meter Co., Ltd.—Winding up voluntarily. Liquidator, Mr. J. E. Denney, 123-4, Finsbury Pavement House, E.C. 2. Meeting of creditors to-day at 3, Eden Street, Hampstead, N.W.

British Electro Chemists.—Winding up voluntarily; Mr. H. J. Gully, 1, Broad Street Place, E.C., liquidator. Meeting of creditors, March 9th, at Broad Street Place.

Mutual Electric Trust, Ltd.—Particulars of claims must be sent to the liquidator, Mr. A. E. Wake, Norfolk House, Laurence Pountney Hill, E.C., by March 31st.

Electrical Power Storage Co., Ltd.—Meeting of members is called for March 31st at 3, Fenchurch Street, E.C., to hear an account of the winding up from the liquidators, Mr. J. Gray and Mr. W. A. Reed.

Metric Engines, Ltd.—Winding up voluntarily. Liquidator, Mr. T. D. Cooke, 44, Gresham Street, E.C. Meeting of creditors, March 10th, at the Institute of Chartered Accountants, Moorgate Place, E.C.

Grimsby Electric Welding Co., Ltd.—Meeting of creditors, at the offices of the company, Fish Docks, Grimsby.

E.I.C. Magnetos, Ltd.—A meeting of members is called for April 4th, at 12, Cherry Street, Birmingham, to hear an account of the winding-up from the liquidator, Mr. E. H. Sherrey.

Electrical Industries, Ltd.—First meeting of creditors and contributories, March 9th, at Carey Street, W.C.

F. Hudson & Co., Ltd., 88-90, Chancery Lane, London, W.C. 2.—Mr. W. E. Harris has been appointed receiver and manager for the debenture-holders.

Dissolution of Partnership.—H. Nuttall & Co., electrical engineers, 28a, Bury Old Road, Crumpsall, Manchester.—Mr. H. Nuttall and Mr. D. E. Whittaker have dissolved partnership. Mr. D. E. Whittaker will attend to debts.

Trade Announcements.—Messrs. J. G. Ellis & Co., Western Mail Chambers, Cardiff (Telephone, Cardiff 2892), will act as agents for the whole of South Wales for Messrs. A. Verey & Co., Ltd., for the supply of wiring accessories generally.

Messrs. J. E Lester & Folwell, Ltd., have removed into their new premises at 60, London Road, Leicester. Telephone number, 3698.

Messrs. Albert Lee & Co., Ltd., have opened new showrooms at 8 & 9, New Zealand Avenue, E.C. 1. for the display of glassware for electric lighting and other purposes.

Messrs. Brown, Boveri & Co., Ltd., and their associated companies, are to-day removing to Trafalgar House, Waterloo Place, London, S.W. 1.

Catalogues and Lists.—The Elco Manufacturing Co., Colston Street, Bristol.—An illustrated pamphlet, giving particulars of switchboards for private electrical installations.

Messrs. Marconi's Wireless Telegraph Co., Ltd., Marconi House, Strand, W.C. 2.—Pamphlets L. 164 describing a 1½-kW quenched-spark transmitter for ship installations; L. 166, marine pattern wireless direction finder (Type 11a); L. 168, 3-kW continuous-wave transmitter for telegraphy and telephony; and L. 169, portable wireless telephone-telegraph set. All of these are fully detailed and illustrated by photographs and diagrams.

Messrs. Isaacson & Brown, Ltd., 39, Furnival Street, Holborn, E.C. 4.—A priced and illustrated leaflet of "Bettalite" bowl fittings of various types.

Metropolitan-Vickers Electrical Co., Ltd., 20, Brazennose Street, Manchester.—Special Publication No. 7,855/1b. An illustrated booklet showing installations of Metropolitan-Vickers buffing motors. Also Special Publication No. 7,974/2a, dealing with the electrical equipment of the modern kinematograph theatre with a copy of the rules and orders relating thereto.

Messrs. Tredegars, Ltd., 7, Brook Street, W. 1.—A set of about 30 photographic reproductions of carved wood fittings for electric lighting. These, which include pendant fittings, lamp standards and brackets, are very beautifully executed. Also a small brochure illustrated in black and white and colour, dealing with flower bowls of clear glass, onyx alabaster, &c.

The Edison Swan Electric Co., Ltd., Ponders End, Middlesex.—Leaflet No. a.a. 214 dealing with "Ediswan" circuit breakers.

Messrs. Dexter Bros., Bassishaw House, Basinghall Street, E.C. 2.—A description and price-list of rubber-tanned leather for belting and other purposes.

The Screwless Grip Fitting Co., 4, Lower George Yard, Halifax.—A small illustrated pamphlet dealing with conduit fittings, and an anti-vibration fitting for electric lamps.

Messrs. Wright & Son, Edgware, Middlesex.—An illustrated and priced leaflet dealing with polished aluminium holders for the new motor-car and cycle licences. Also a folder illustrating embossed aluminium number plates for cars and cycles.

X-Rays, Ltd., 11, Torrington Place, Gower Street, W.C. 1.—Sectional catalogue No. 6 (44 pp.), giving illustrations and full details of all kinds of X-ray apparatus: fully priced. Also two price lists of X-ray photographic plates.

Messrs. Johann Wolff & Co., Gouda, Holland.—A list illustrated in black and white and colour giving descriptions in English, French and German of majolica wall and ceiling lighting fittings. Priced in Dutch florins.

Messrs. Henry Ford & Son, Ltd., Cork, Ireland.—"Fordson Worker," Vol. 1, No. 4. This is a news-sheet dealing with events at the firm's factory, and includes a number of humorous and other items.

Messrs. Spauldings, Ltd., 40, Gloucester Street, Clerkenwell, E.C. 1.—A well-illustrated leaflet showing a number of forms of vulcanised fibre, including bushes, washers, switch-handles, armature parts, &c.

The British Thomsom-Houston Co., Ltd., Rugby.—Descriptive list No. 5,600 (52 pp.). An illustrated and detailed description of automatic contactor gear for a.c. and d.c. circuits.

Superlamp, Ltd., 11, Great Eastern Street, E.C. 2.—A price list of vacuum and "half-watt pattern" lamps.

Messrs. Alfred Herbert, Ltd., Coventry.—Catalogue sheets (illustrated) Nos. FST 49. "Prestwich" fluid gauges; 182, "Leonard" plug and ring gauges; 189, Wickman patent adjustable thread snap gauge, and 190, hardened plug and ring screw gauges.

Igranic Electric Co. Ltd., 147, Queen Victoria Street, E.C. 4.—Pamphlet No. 6,017/460, illustrating and describing the "Igranic" patent distant stop push-button system of controlling electrical machinery. Priced. Also an application post-card for a sample of the device.

Messrs. Higgs Bros., Sand Pits, Birmingham.—Monthly Magazine for March. Price lists of motors and dynamos appear as usual, as well as notes on the choice of electricity supply, and humorous items.

Messrs. H. W. Smith & Co. (1920), Ltd., Central House, Kingsway, W.C. 2.—A four-page price list of single V.I.R. cables, cotton-covered wires, &c.

Book Notices.—"The Magnet Magazine." Vol. VI. No. 23. January, 1921 (124 pp.). Price 6d. General Electric Co., Ltd.—This number of the magazine is excellently produced, and contains numerous notes and articles of great interest. The Witton Works extensions are fully described and illustrated, and "Thermionic Valves," "Fractional h.p. Motors," "The Electrification of a North Country Colliery," are some of the subjects dealt with.

"A Practical Guide for the Water Supply of Towns, Estates, Villages, Houses, &c." (120 pp.). London: Hayward, Tyler & Co., Ltd., 99, Queen Victoria Street, E.C. 4. Price 3s. 6d.—This volume has been designed for the use of architects, estate agents, district surveyors, and others interested in water supply. It illustrates the firm's manufactures, and gives hints on the best type of plant to be adopted in particular circumstances.

"Touring by Motor Coach"—Season 1921 (pp. 79). Atherton: The Lancashire United Tramways, Ltd. Price 1s. 6d. This is a beautifully-illustrated guide-book describing the places and scenery which lie within range of the company's motor-coach services. The booklet includes a number of appreciations from last year's clients, conditions of hiring, &c.

"The Queen's Engineering Works Magazine." No. 18. January, 1921 (pp. 106). Bedford: W. H. Allen, Sons & Co., Ltd.—Among a number of interesting notes and articles appearing in this issue are a description of H.R.H. the Duke of York's visit to the works (with a portrait), "The Development of the Steam Turbine," "Salvage," "A Modern Fighting Aeroplane," and "The Telemotor System of Steering-Gear Control."

"Central Electric Stations in Canada" (Census of Industry, 1918). Pp. xxiii + 29 + xxi. Ottawa: Dominion Bureau of Statistics. Price 10 cents.—This volume consists of a summary and introduction in English and French, and exhaustive details in both languages of all undertakings, both generating and distributing, in the Dominion.

"Welfare Work." Vol. II, No. 14. February, 1921. London: Welfare Workers' Institute. 5s. per annum.—Includes articles on "Welfare Work from the Employers' Point of View: Does the Need for it Exist To-day?" and "Factory Welfare Work: Its Principles and Possibilities."

"*Journal* of the Institution of Electrical Engineers," Vol. LIX, No. 296. December, 1920. London: E. & F. N. Spon, Ltd. Price 10s. 6d.—This issue contains the following:—Inaugural address by the President (Mr. Ll. B. Atkinson), and the chairmen's addresses to the South Midland, Western, North-Eastern, North-Western, Scottish, North Midland Centres, and the Liverpool and East Midland Sub-Centres; also the inaugural address to the Wireless Section by the chairman, Prof. W. H. Eccles.

"*Journal* of the American Institute of Electrical Engineers." Vol. XL, No. 2. February, 1921. New York: The Institute. Price $1.

"Domestic Fuel Consumption." By A. H. Barker. Pp. x + 160; 11 figs. London: Constable & Co., Ltd. Price 14s.

"Engineering as a Career." By P. & A. W. Marshall. Pp. 56. London: Percival Marshall & Co. Price 9d.

"Quin's Metal Handbook and Statistics, 1921." Compiled by L. H. Quin. London: The Metal Information Bureau, Ltd. 5s. net, post free.—This is the eighth year of publication of a book which contains particulars of world outputs, prices, and imports and exports, and other statistics of all metals, such as readers of our pages are frequently requiring.

"The Mining Electrical Engineer." Vol. I, No. 5. February, 1921. Manchester: Association of Mining Electrical Engineers. Price 1s. net.—This number contains a copy of a Government Order approving certain types of miners' lamps, giving diagrammatic illustrations and detailed descriptions. The papers include "Telephones for Use in Noisy Places, and for Rescue Work in Mines" (illustrated), and "The Choice of a Small Electric Winder" (illustrated).

Sir Isaac Pitman & Sons, Ltd., have now commenced issuing their new Technical Primer Series, which promises to be a very large one. The first eight volumes are now ready, and several others will be published during this month. These little books are in foolscap 8vo, contain about 120 pages, with an attractive cover design, are printed on good paper, and well illustrated. The price is 2s. 6d. net each volume. The series will eventually contain volumes on every phase and branch of technology.

"Standard Measurements Adopted by the Incorporated Association of Kinematograph Manufacturers, Ltd." (Pp. 21.) London: The Association. Price 6d.—This volume deals with the standardisation of films, masks, projector spools and re-winding spindles, focusing jackets, optical attachments, &c.

Publication of the Massachusetts Institute of Technology, No. 24, "The Transient Process of Establishing a Steadily Alternating Current on a Long Line, from Laboratory Measurements on an Artificial Line," by A. E. Kennelly and U. Nabeshima (pp. 46). Boston: The Institute.

"Elementary Telegraphy." By H. W. Pendry. Pp. x + 238; 181 figs. London: Sir I. Pitman & Sons, Ltd. Price 7s. 6d. net.

Copper and Lead Prices.—Messrs. F. Smith & Co. report March 1st:—Copper (electrolytic) bars, £75, £4 decrease; ditto sheets, no change; ditto wire rods, £91, £4 decrease; ditto h.c. wire, 1s. ¼d., ½d. decrease; silicium bronze wire, no change.

Messrs. James & Shakespeare report, March 1st:—Copper bars (best selected), sheet and rod, £118, £2 decrease; English pig lead, £19 10s., 25s. decrease on last week's price.

New Italian Companies.—Among the new companies recently formed in connection with the electrical industry in Italy are the Società Osram, Milan, with a capital of 1,000,000 lire; the Società Fabbrica d'Accumulatore Hemsemberger, Tentori, Ing. Cigolotti, Blanc e Cia., Monza, capital 1,000,000 lire; and La Società Electrometallurgica Sarde, Milan, capital 1,000,000 lire.

A Women's Exhibition.—The Director and Secretary of the Electrical Development Association informs us that an "Indoors and Out" Exhibition is being organised by "The Women's Leader" and "The Women's Institutes" at the Central Hall, Westminster, from May 23rd to 28th this year. One of the sections deals with the heating and lighting of the home, and another with labour-saving devices.

Forthcoming Exhibitions.—The following exhibitions are being organised:—

London.—March and October, Society of Motor Manufacturers and Traders; April 1st to 30th, Building Trades' Exhibition; April 30th to May 14th, Stationers' and Allied Trades' Exhibition; June 3rd to 17th, Rubber Trades' Exhibition; July 4th to 15th, London Fair and Market; September 7th to 28th, Shipping, Engineering, and Machinery Exhibition; November 17th to 25th, Public Works, Roads, and Transport Exhibition. 1923.—British Empire Exhibition.

British Dominions.—June, 1921, Dominions Touring Exhibition (*South Africa, Canada, Australia, and New Zealand*).

France.—(*Lyons*) March 1st to 15th, Metallurgy, Engineering, Building, &c., Fair. (*Bordeaux*) June 15th to 30th, International Samples Exhibition.

Belgium.—(*Brussels*) April 4th to 20th, International Commercial Fair. (*Ghent*) April 16th to June 14th, International Exhibition of Architecture, Building, and Kindred Industries.

Switzerland.—(*Basle*) May 28th to June 8th, International Automobile Exhibition.

Holland.—(*Utrecht*) September 6th to 16th, International Fair.

Italy.—(*Milan*) April 12th to 27th, International General Manufacturers' Fair.

Spain.—(*Barcelona*) April 1st to 10th, International Samples Fair.

Iceland.—(*Reykjavik*) June, World's Fair.

Peru.—(*Lima*) June 1st to October 31st, International Industrial Exhibition.

Argentina.—(*Buenos Aires*) 1922, International Exhibition.

Brazil.—(*Rio de Janeiro*) 1922, International Centenary Exhibition.

Mexico.—September, Commercial and Industrial Fair.

Java.—(*Bandoeng*) September 19th to October 9th, Netherlands East Indies Fair.

An Electrical Exhibition.—An electrical exhibition promoted by the Electrical Contracting and Motor Co., Pontefract Road, Castleford, under the management of Mr. E. Mercer, A.M.I.E.E., was opened last week by Mr. W. B. Woodhouse, engineer and manager of the Yorkshire Electric Power Co., Ltd. The display consists of all kinds of electrical and labour-saving devices. The exhibition was so successful that it was decided to continue it for another week.

Wages Reduction Strike.—A reduction in the wages of cable splicers from $8 to $7 per day, of linesmen from $7 to $6 per day, and of operators from $200 to $175 per month by the Great Western Power Co. of California has been followed by a strike. The company says that less than half of its men have left, that its service has not been impaired, and that new men are rapidly filling the places vacated. The company claims that the increase of $1 per day granted last year was to compensate for increased living costs, which have now materially decreased. The company further states that the last increase put its wage rate above those generally in effect on neighbouring systems. The strikers assert that last year the company received an increase in rates to compensate for the increase in wages, but that with this decrease in wages there has been no corresponding decrease in rates.—*Electrical World.*

Socials.—On February 19th, the directors and combined staff of Messrs. Wood & Cairns, Ltd., Edinburgh, Glasgow, and Dundee, held a successful gathering in the Windsor Rooms, Edinburgh. The company numbered 64, and the proceedings opened with a whist drive. Dinner and dancing followed. At the dinner the chairman (Mr. R. K. Hill) introduced to the staff, Mr. H. Mason, who had joined the directorate.

At the annual dinner of the staff of the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board, last week, Alderman Sykes remarked on the fact that for over a dozen years the Board had held the record for the lowest working costs in the United Kingdom. After the dinner a presentation was made to Mr. H. Cattle, who has taken up a position at Ashton-under-Lyne Electricity Works.

Dinner-time concerts are given every Tuesday at the works of Messrs. Ferguson & Pailin, Openshaw, Manchester, and according to one of the officials, the best results from the employés come on Tuesday afternoons. The firm bears all expenses.

At the ninth annual social of the Blackpool Electricity and Tramways Employés' Institute, last week, there was a record attendance. Over 1,500 people played whist in the lower ballroom, and well over 2,000 participated in the dancing.

Scottish Electricians' Wages.—A serious crisis has arisen in the Scottish electrical trades on the question of wages, and a stoppage is now feared. The Scottish Contractors' Association has intimated to the Electrical Trades Union that on and after March 1st wages will be reduced 3d. an hour. The present minimum is 2s. 3d. About 3,000 men are involved. The Union counterclaimed for a rise of 6d. an hour, which has been refused. It is stated by the Union officials that the employers' decision has come as a surprise, as there was a mutual understanding that a further conference would be arranged before any change was made. The matter has been referred to the National Executive.

Telephone Manufacture in Australia.—A Press report published in Sydney toward the end of December states that an early addition to the numerous new Australian industries then being projected was that of the manufacture of automatic telephones. Mr. R. Mordin, engineer, representing the Relay Automatic Telephone Co., London, was a recent arrival from England in this connection.

French Aluminium Prices.—It is stated that a new reduction in prices has been made by the French producers of aluminium. Ingots are now at 9·36 fr. per kilo for an order for 1,000 kilos, with a rebate of 4½ per cent. to 8·93 per kilo for 10,000 kilos; and sheets are at 12 fr. per kilo, as compared with 14 fr. previously.

Lead.—Messrs. James Forster & Co. reporting under date February 26th, stated:—"Closing prices yesterday were £16 10s. for February, and £17 10s. for June, against £20 and £20 15s. respectively at the end of last week—a fall of £3 10s. per ton. Yesterday's fall on the day was no less than 30s. to 35s. per ton. . . . Imports have been heavy this week, and have come both from Germany and Belgium but in spite of this, at the end there are actually borrowers of February lead who could not get accommodation—a singular commentary on the week's selling, and certainly an indication that all the lead coming in is finding a billet. In such conditions it is quite impossible to say when the turn will come, but such figures as are now current should be tempting to any consumer."

Norway.—The Government, on February 23rd, concluded with the Bergens Privatbank, acting on behalf of a consortium consisting of that bank, the Centralbank, and Den Norske Handelsbank, a contract for a loan of 50,000,000 kr., from which advances will be made to municipalities for the completion of electrical works. The loan, which will be offered for public subscription, will bear interest at the nominal rate of 6½ per cent. For the first five years there will be no redemption, but after that period the loan will be redeemable in 25 years.—*Reuter* (Christiania).

The Japanese Import Duty on Zinc.—It is stated that the Government has practically decided to raise the import duty on zinc from the present rate of 5 per cent. to 15 or 20 per cent. A rebate will be paid to the paint, toilet goods, rubber and electrical goods manufacturers, who are opposed to the increase. The proposal will be submitted to the present session of the Imperial Diet. *Reuter's Trade Service* (Tokio).

For Sale.—Messrs. Davis & Moon will sell by auction, on March 10th, at 13, High Holborn, W.C., an electrical engineer's and contractor's stock-in-trade. For particulars see our advertisement pages to-day.

New French Companies.—There has been formed at Lyons (12, Rue Grôlee) the Energie Electrique du Massif-central, for the utilisation of waterfalls and the erection of hydraulic and hydro-electric installations. The company's capital is 1,800,000 fr.

With the title of Société Grenobloise d'Applications Electriques et Mécaniques, has been formed at Grenoble (13, Rue de Strasbourg), a company for the study, construction and sale of electrical and mechanical material and the institution and working of all kinds of electrical and mechanical processes. The capital is 1,000,000 fr. in 500 fr. shares, of which 284 are allotted to the Société A. Rivoire et Cie. as consideration for its assets.

The Etablissements Hediger is the style of a company embodied at Paris (47, Rue de Paradis), for acquiring a goodwill and business in electric lighting and heating apparatus. The capital is 250,000 fr. in 1,000 fr. shares, of which 175 are allotted to M. Hediger for his assets.

Under the style of G. Crampon et G. Lafont, a company has been constituted at Paris (8, Rue de la Pompe), for the carrying out of electric installations. The capital is 300,000 fr.

Under the designation of Société Française pour l'Exploitation des Brevets Bates, has been formed at Paris (25, Rue de Clichy), a company for the manufacture of cable and conductor standards, and accessory electrical appliances, and also to work in France the patents of the Bates Expanded Steel Trust Co., of Chicago. The capital is 2,500,000 fr., with power of increase to 3,500,000 fr.

Workmen's Compensation Act.—At the meeting of the Institute of Cost and Works Accountants, on Wednesday, March 16th, a lecture is to be delivered by Mr. H. G. Simmons on "Some Observations on the Proposed Amendments of the Workmen's Compensation Act, 1906."

An E.D.A. Pamphlet.—The director and secretary of the Electrical Development Association, Hampden House, 84, Kingsway, W.C. 2, has sent us a copy of a recently-issued pamphlet (E.D.A. 130) giving photographs and a description of a housing colony erected by Messrs. Philips Glow Lamps Works, Ltd., for their employés at Eindhoven, Holland. In every house electricity is used for lighting, heating, and ironing. The wiring is run in a tubing system. From nine to eleven lighting points have been installed in each house, at an average cost of 28s. 4d. per point; electricity is supplied by the municipality at 7¼d. per unit by prepayment meter.

Engineering Wages.—Conferences have been taking place in Birmingham between the employers and the Unions regarding proposed reduced wages for boys and youths under the age of 21 years in the engineering and allied trades. So far, agreement has not been reached.

Key Industries.—The Premier, replying to a question by Mr. G. Terrell, M.P., has expressed the hope that the Bill to safeguard key industries and to regulate imports may be introduced before Easter, so that it may be proceeded with immediately thereafter.

Wages Reduction in Sweden.—The staff of Allmänna Svenska Elektriska Aktiebolaget, at Vaesteraas, were recently informed that their wages would be reduced by 20 per cent. as from February 28th.—*Reuter's Trade Service* (Stockholm).

Liquid Fuels Research.—The British Research Association for Liquid Fuels for the Oil Engine Industry has been approved by the Department of Scientific and Industrial Research. The secretary of the Committee engaged in the establishment of this association is Mr. Percy Still, M.I.E.E., M.I.P.T., 19, Cadogan Gardens, S.W. 1.

Charging for a Switch.—Before the City of Westminster Profiteering Committee, on Wednesday, a complaint was heard against the Edison Swan Electric Co., Ltd., Ponders End, Middlesex, for charging, at its Victoria Street shop, the sum of 4s. 6d. for an electric light switch known as the "Better One," which, it was alleged, could be obtained for 3s. 3d. elsewhere. Mr. Morris, barrister (instructed by Messrs. Nicholson & Graham, solicitors), represented the respondent company. Complainant was Mr. A. Kernan, of the Marine Department of the Board of Trade, and he stated that the purchase was made on November 27th of last year. Subsequent to the purchase he made inquiries at another shop, and found that he could purchase a similar article of apparently better quality at 3s. 3d. In answer to the chairman, complainant said he did not purchase a further switch at the other shop he called at, but was shown one, which was said to be 3s. 3d. Mr. Morris, on behalf of the company, explained that a genuine error had been made in that case, and they admitted an overcharge of 6d. to the purchaser. The Committee accepted respondent firm's explanation that a genuine error had been made, and ordered a refund of 6d., the admitted overcharge.

Electrical Trade Situation at Singapore.—It is anticipated that there will be a great opening for electrical goods in a short time, as the use of electric lighting is still in its infancy here. There is a town supply, but it is limited, and most houses generate their own electricity. A large sale is reported of American self-contained motors and generators suitable for houses and estates.—*Reuter's Trade Service* (Singapore).

Indian Engineering states that the Netherlands Gutta-Percha Co. of Singapore intends opening a branch in Sourabaya (Java), and will manufacture there all sorts of cables and insulated wires. The new factory will be called the "First Neth. Ind. Cable Works," and will have also a wire-drawing installation. It will be the first of its kind in the Archipelago.

Representation in the Argentine Republic.—H.M. Acting Consul General at Buenos Aires emphasises the importance of actual representation by agents on the spot for United Kingdom firms wishing to enter or maintain their position in this market. In commenting on the many admirably produced British directories which have been issued since the war, and which furnish excellent facilities for advertising in South America, he points out that such advertising can only be regarded as supplementary to the work of a competent agent.—*Board of Trade Journal.*

Catalogues Wanted at Amsterdam. — H.M. Consul-General at Amsterdam invites British firms to send copies of their catalogues for filing and use at a Catalogue Reference Library that is being formed at the Consulate. These should be addressed direct to His Britannic Majesty's Consul-General, British Consulate, Amsterdam.

Electrical Demand in the Dutch East Indies.—There is a steady demand for electric-lighting installations up to 40 kW for estates, sugar factories, machine shops, and other industries in the Netherlands East Indies. Small lighting sets of 50 and 100-lamp capacity are also added as rapidly as they can be imported for houses and the smaller plantations. Larger electrical engineering projects are also maturing in this part of the world, and it is believed that a more substantial share of their trade might easily be diverted into British channels. This is particularly the case with regard to electric cables. In 1917, 93 per cent. of the electric cable imports came from the United States, 4 per cent. from the Netherlands, and 2½ per cent. from Great Britain; and in 1918, 45 per cent. from the United States, 53 per cent. from Japan, and one-half of 1 per cent. from the Netherlands. Before the war, electric cable, as well as most other electrical equipment for this colony, came from Germany.—*Indian Engineering.*

LIGHTING AND POWER NOTES.

Amesbury (Wilts).—Proposed Military Supply.—The Parish Council having proposed to have the parish illuminated by electricity supplied from the military station, has asked the Rural District Council to support an order to enable the Council to supply electricity to private consumers. The Rural District Council has referred the matter to a Committee.

Aughton.—Time Extension for Company.—A deputation from the Ormskirk Gas and Electricity Co. has waited on the West Lancashire Rural District Council, with a view to securing its consent to an extension of the company's powers in connection with the supply of electricity to the township of Aughton. The company's agreement, granted under the Act of 1915, expires in June next, and it was the intention, it was explained, to suspend the erection of a plant in Ormskirk pending the result of the inquiry into the Mersey and West Lancashire Electricity Scheme, from which the company hoped to obtain a supply in bulk. It was decided to grant the company an extension of four years to use its best endeavours to obtain a supply of electricity for Aughton as soon as possible, any costs in connection with the agreement being borne by the company.

Bury.—Electricity for Houses.—The Electricity Committee has instructed the electrical engineer to lay a cable to the site of the Walmersley housing scheme.

Continental. — France. — An official decree has authorised the Société des Forces Motrices du Vercors to develop the Falls of Pizançon on the River Isère, and erect a hydroelectric station of a capacity of 25,000 kW, to augment the power supply of that company's network.

The Société Electrique de la Sidérurgie Lorraine has in hand the preparation of plans for a power transmission network which will link up the various central stations of the ironworks of the East (Longwy, Micheville, Homécourt, Pont-à-Mousson, &c.). Several 65,000 and 30,000-volt lines are contemplated to feed this important network, apart from the 120,000-volt line projected by the State which will run from Vincey (Vosges), and end at Hirson (Aisne), which will supply power to the eastern ironwork industries in the districts which it traverses.

The Chemins de Fer du Midi is contemplating setting up three hydroelectric stations for the utilisation of the water power of the Vallée d'Ossau, and the Lac d'Arouste at Laruna. The stations will be of the capacities of 17,000, 20,500, and 16,500 h.p. respectively.

Italy.—A National Electrification Committee is being formed in Italy, to act under the control of a council representing the private electrical undertakings, Government organisations, technical engineers, and electrical workers' unions.—*Daily Telegraph.*

Norway.—According to the Norwegian Press a proposition is to be put before the Storting recommending the purchase by Buskerud County from the State, of the Halli Waterfall for power generating purposes. The purchase price is Kr. 75,000. H.M. Chargé d'Affaires at Christiania reporting this to the Department of Overseas Trade, notes that the conditions of transfer contain a proviso to the effect that as far as possible the work of harnessing the fall shall be carried out by Norwegian workpeople, and that the material to be used shall be Norwegian in all cases where quality and delivery are as satisfactory as can be obtained from abroad, and when the price is not over 10 per cent. dearer than that of foreign material.

Cookham.—Electric Lighting Scheme.—The Parish Council has decided to support an electric lighting scheme submitted by Mr. George Young, who has laid down an installation at Cookham Mill, and offers a supply of electricity to consumers at 10d. per unit.

Coventry. — Electricity for Houses. — The City Council has sanctioned the laying of mains, at an estimated cost of £4,518, for supplying the working-class houses in course of erection by the Corporation. Applications numbering 185 were reported.

Downton. — Public Lighting. — The Wilts County Council has consented to the Parish Council raising a loan of £650 for the purpose of public lighting by electricity.

Eastleigh.—Application for Provisional Order.—The Urban District Council has decided to apply for a provisional order for electric lighting. There is a probability of electricity being supplied in bulk by Southampton Corporation.

Electricity Districts.—West Riding (Aire and Calder) Inquiry.—A further conference of local authorities included in the West Riding (Aire and Calder) Electricity District took place at Bradford on February 24th. The financial, technical, and legal aspects of the position were approved in principle, and sub-committees were appointed to formulate the necessary steps for submitting the scheme when the inquiry is held in Leeds on April 12th.

Mid-Lancashire.—The Electricity Commissioners have extended the time within which objections or representations relating to the above-mentioned area may be made from September 30th, 1920, to May 31st, 1921.

South-East Lancashire.—In the case of this area the time has already been extended once from October 31st, 1920, to March 31st, 1921, but it has now been further extended to July 30th, 1921.

Enniskillen.—Lighting Scheme Consultant Appointed.—The Urban Council has appointed Mr. T. Tomlinson, electrical engineer, Dublin, to advise on a public electric lighting scheme.

Epsom.—Application for Loan.—Replying to the application of the Urban District Council for a loan of £4,000 for mains and services, the Electricity Commissioners ask what steps the Council proposes to take to improve the financial position of the undertaking, in view of the deficiency of £5,937 for the year 1919-20. The Council has decided to point out the causes, and the fact that the deficiency has now been much reduced.

Glasgow.—Inquiry into Breakdowns.—The attention of the Corporation Electricity Committee has been directed to the recent breakdowns in electricity supply, in letters from the Fairfield Shipbuilding and Engineering Company, and Messrs Harland & Wolff, Diesel Engine Works, Finnieston, who complain of the consequent dislocation of work in their establishments. A Sub-Committee has been appointed to inquire into the whole matter.

Hebden Bridge.—Bulk Supply Inquiries.—Inquiries are being made from the Yorkshire Electric Power Co., Ltd., with respect to the terms upon which it would be prepared to supply the Council with electricity.

Herne Bay. — Commissioners and Gas Co. — The Urban District Council has informed the Commissioners that it has no objection to the revocation of the powers of the Gas Co with regard to the supply of electricity, on condition that the words, "and electricity" are deleted from the company's registered name.

Huddersfield.—Application for Order.—The Town Council has confirmed a recommendation of the Electricity Committee that application be made to the Electricity Commissioners for a special order under the Electric Lighting Acts, 1882 to 1919, authorising it to supply electricity for all public and private purposes within the urban district of Marsden. It has also been agreed, in the event of the scheme which has been submitted by the Electricity Committee being approved by the Electricity Commissioners, that, if deemed necessary by the Joint Electricity Authority, the generating plant be transferred to such authority on terms to be arranged.

Ilford.—New Sub-Station.—The electrical engineer recommends the erection of a new sub-station in the Broadway and Ilford Lane district, owing to the increased load in this section. The installation will consist of a 500-kW rotary converter, a step-down transformer and the necessary switchgear. The engineer states that, if possible, the station should be completed in time for the next winter's load.

Invergordon.—Electric Lighting Scheme.—An electric lighting scheme is being taken in hand, and the town gas works is consequently to be permanently closed.

Jedburgh.—Inquiry.—A Ministry of Transport inquiry was held last week by Col. T. C. Ekin relative to the application of the Electric Supply Corporation, Ltd., for power to increase the charges for electricity for power and lighting. The application was opposed by a petition from consumers.

Limerick.—Position of Undertaking.—On the re-election for the year of the Electric Lighting Committee, the Mayor said he was glad to be able to announce that within the past few months a saving of £870 had been effected in connection with the undertaking, while there had been a further saving of £200 by the return of unsuitable goods. It was stated at a recent Corporation meeting that the undertaking was in debt to the extent of £23,000.

London.—St. Pancras.—The Electricity Committee proposes to carry out a re-modelling of the mains system in certain areas. This will involve an expenditure of £23,550.

Hackney.—The Borough Council has decided to borrow the sum of £50,000, repayable in 20 years, from the London County Council, for the purpose of extending the electricity undertaking.

Having considered the question of substituting electricity for the present gas lighting, the Works and Open Spaces Committee reports that the present time is inopportune to effect the change, owing to the cost of laying the necessary mains. A sub-committee has been appointed, however, to consider the possibility of instituting electric lighting at a later date.

Fulham.—The Borough Council has decided to accept the offer of £750 by the Battersea Borough Council in settlement of a claim for an additional £2,500, in view of the increased cost of supplying electricity in bulk under an agreement between the two authorities.

The minimum charge to consumers of electricity of 7s. 6d. per quarter has been varied, so that it now stands at 5s. for each of the two summer quarters, and 10s. for each winter quarter.

Melrose.—Proposed Price Increase.—The Electric Supply Co. has applied for power to increase the price of electricity to 1s. 2d. per unit.

Monasterevan (Co. Kildare).—Public Lighting.—The District Council has accepted the tender of Mr. T. Tynan, for the public lighting of the town by electricity at £100 per annum, about 9d. or 10d. in the £, as against 4½d. in former years.

Navan.—Proposed Sale of Station.—The Urban Council has appointed a Committee of the whole Council to deal with a proposal that Messrs. Spicer, local merchants, should lease or sell their new power house for the purpose of a public electric lighting scheme. The firm had intimated that they were willing to part with the plant at a valuation, but there were certain difficulties upon which they thought consultation necessary.

Loan for Electric Lighting Scheme.—The Urban Council directed the clerk to ascertain from the Irish Board of Public Works whether a loan could be obtained for the proposed electric lighting scheme, which is expected to cost between £7,000 and £10,000.

Nova Scotia. —Water-Power Development. — The Nova Scotia Government is engaged in a programme of water-power development. The work is being carried on through the Nova Scotia Power Commission, which was set up for the purpose. The outlay on construction on the first unit, which is now well forward, is about £350,000, and there will also be the cost of expropriation to be added. The claim amounts to £130,000. The present hydro-electric set is exclusively for the City of Halifax, and when complete will supply 30,000,000 kW-hours per year. The expense of development is estimated to be $125 per h.p. The Miller Bros, who have mills on the rivers, claim £350,000, but will not press this if given navigation rights for their logs. This is being done.—*Times Trade Supplement.*

Oldham.—Price Increase Deferred.—The Corporation Electricity Committee has deferred the question of an increase in electricity charges, several members considering that an increase would have a bad effect upon local industry, which is in a state of depression at present. It is pointed out, however, that next year the Committee will have to provide an additional £15,000 to £20,000 on capital charges alone.

Paisley.—New Plant and Mains.—The Electricity Department has received approval of the installation of plant in sub-stations and the laying of new mains, at a cost of about £34,450.

Preston. — Purchase of Undertaking. — The Town Council, on Feb. 24th agreed to the purchase of the National Electric Supply Co.'s undertaking, the total cost of which, it was stated, would reach £286,000. Alderman Margerison said the undertaking had been valued by a representative of the Electric Power Co., on whose figures they were justified in paying the amount stated. The period of repayment would be such as to make the project self-supporting.

Salford.—New Power Station Commenced.—Work is now proceeding on the preparation of the site at Agecroft for the Corporation's large power station. The scheme is expected to cost over a million pounds. About 200 men are engaged in the excavation work.

Yorkshire (West Riding).—Extension of Supply.—The Electrical Distribution of Yorkshire, Ltd., is applying for powers to generate and supply electricity for public and private purposes within the urban districts of Guiseley, Yeadon, Gildersome and districts, Kirkheaton and districts, the urban districts of Knottingley, Adwick-le-Street, Tickhill Darfield, Mont Bretton, and Royston, the rural districts of Thorne, Hemsworth, Pontefract, Doncaster, Rotherham, Wortley, and Kiveton Park, and the parishes of Woolley, Norton, and Carlton, Mytholmroyd, Colne Valley and district, and to amend special orders granted in respect of the urban district of Selby and the parish of Barlby and the urban districts of Stanley, Featherstone, Garforth, Horbury, Otley, Penistone, and Rawdon.

TRAMWAY AND RAILWAY NOTES.

Belfast.—Increased Fares Necessary.—At a recent meeting of the Tramway Committee the general manager submitted the revenue report of the tramways undertaking for the nine months ending December 31st last. This showed a deficit of £22,007 9s. 7d. The town clerk was instructed to impress upon the Ministry of Transport the urgency of having an order issued immediately authorising an increase in fares.

Bolton.—Fare Increase.—The Tramways Committee has decided to increase the fares from April 4th. Bolton is the last tramway authority in the country to take this step. The borough treasurer estimates that for the next financial year the department will require an additional income of £30,000 to ensure that it shall not be a charge on the rates. After six months' working of the new fares the financial position will be reviewed, and if it is found a surplus is likely to be realised, there will be an alteration in favour of the passenger.

Bradford. — Inspection of Railless System. — The tramway manager has received an intimation from the Glasgow tramway manager that a committee from Glasgow is desirous of visiting Bradford to inspect the railless tramway system. Arrangements are being made accordingly.

Application Refused.—The Ministry of Transport has refused the Corporation's application for an extension of powers, under the Bradford Parliamentary Act, to run railless cars on the Idle, Thackley, and Eccleshill sections of the tramway system. Under the Act the local authority has powers to run such cars on certain roads in the city, but the routes in question are not specified, and, therefore, the powers cannot be extended without promoting a new Parliamentary Bill, which could not come into operation until 1923 at the earliest. The proposal to change over to the railless system on this route was made because of the very heavy cost of track renewals. There was a net loss on the nine months' working ending December last of £8,016, but no provision is made for renewals, and, taking an estimate of 3d. per car-mile, it is stated that the actual loss for the period stated totals £47,616. If the Tramways Committee has to undertake the renewal of the track the position will be made much worse. While the reserve fund of the department is still in the region of £145,000, this amount, and much more, will be quickly swallowed up by the essential renewals if the efficient running of the cars is to be guaranteed. The Bradford electric tramways were instituted in July, 1898, and this is the first loss they have incurred.

Brazil.—Railway Electrification.—At a meeting in December, the Paulista Railway Co. resolved upon an increase in the capital of the company from 100,000 contos of reis to 132,000 contos, the expenditure to be incurred in the electrification of the system.

Caledonian Railway.—Suggested Electrification.—A suggestion that the Caledonian Railway Co. should electrify part of its system in Glasgow was made at the meeting of shareholders, last week. Such a scheme, a shareholder thought, would go far to relieve the excessive traffic on the tramways, and might lead to a big addition to the railway funds. Replying, the chairman said that some years ago estimates were obtained for the electrification of the Central Underground and the Cathcart Railway. It was discovered that there would be advantages from electrification, but even then the cost to be incurred made the Board hesitate. The present-day cost was prohibitive. Although they recognised that electrification might be coming, they did not see their way for the necessary financing.

Chester.—Cars *v.* 'Buses.—The Tramways Committee has been discussing the subject of the future policy of the tramway undertaking. The question of relaying the lines, which is necessary if the tramway system is to be continued, or substituting motor-'buses, has yet to be settled. The Committee, at its last meeting, did not come to any decision, as certain figures were required, and the meeting was adjourned.

Colne.—Fare Increase.—It has been decided that the following increased fares shall come into operation on the tramways from March 1st, viz.:—Half-a-mile, 1d.; one mile, 2d.; two miles, 3d.; three miles, 4d.; full route, 5d.; workmen, two miles, 1½d.; children, any distance, 1d. The parcel rates are increased 100 per cent. over the pre-war charges.

Edinburgh.—Electrification Deferred.—In view of the fact that the tramway manager is preparing a report on the whole question, the Corporation Tramways Committee, on February 24th, decided to delay consideration of the proposal to electrify certain portions of the tramway system.

Halifax.—Proposed New Cars.—A Sub-Committee has been appointed to consider and report upon the proposed purchase of new cars.

Loan.—The Tramways Sub-Committee has recommended that borrowing powers be sought for the re-laying of the track, at an estimated cost of £243,222, the amount being made up as follows:—Causeway Foot section, £72,412; Pellon section, £19,504; Hebden Bridge section, £95,831; and West Vale section, £55,425.

Prevention of Accidents.—At the suggestion of the Ministry of Transport, following a recent accident on the tramways, the Tramways Committee has given instructions that "at the top of every gradient opposite the poles marked with the letters 'SL', the slipper brake must be applied in such manner as to have, and maintain, complete control over the car; that at the bottom of each gradient the slipper brake is to be released; that motormen must always be on the alert to drop sand if there is the slightest tendency for the wheels to skid, and that gradients must always be descended as though the worst conditions of weather prevailed, *i.e.*, foggy weather and greasy rail."

Hoylake and West Kirby.—Protest against Increased Fares.—The Council opposes the proposed increase in fares on the Mersey Electric Railway to 2d. per mile, and it has been suggested that it should only agree to the principle of the increase on condition (1) that if the general cost of living comes down within the next few years; (2) that if a scheme for the producing of electricity more cheaply comes into operation, and the railways benefit by cheaper power, the fares shall be reduced.

India.—Calcutta Strike Settled.—A Reuter message dated February 23rd stated:—The tramway strike has been settled on the following basis:—"The men are to resume work to-morrow, the company will investigate the men's grievances forthwith and announce its decision within a week, and finally, if the men are still dissatisfied, the Government will constitute a committee of investigation."

L. & S.W. Railway.—Electrification Deferred.—Owing to the enormous cost of the work, it has been decided to defer the electrification of the Cobham and Leatherhead lines. The estimated pre-war cost was £250,000, but it is thought that the present-day cost would not be far short of £1,000,000. The attitude of the Government with regard to the railways is stated to be an additional reason for the decision of the directors.

L. & N.W. Railway.—Electrification.—At the general meeting of the shareholders, the chairman of the company said that the work of electrifying the Queen's Park-Chalk Farm section was being carried on day and night, but progress was necessarily slow, owing to the volume of traffic. It was hoped to open the new lines throughout early next year.

Leeds.—Effect of Increased Fares.—The Tramways Committee has discussed the impending deficiency in the undertaking for the financial year ending March 31st next. When the fares were increased, the deficiency for the first nine months of the year was stated to be £30,500. Some reduction of this amount may result when the whole year's figures are forthcoming, but, nevertheless, there will be a substantial deficit. If the fares are increased further, it is felt that the bulk of tramway users (who reside within the two-mile limit) will refuse to use the cars, and the finances of the undertaking will be still more adversely affected.

New Track.—The Corporation's scheme for the laying of a new tramway for a fast-car service between Harehills and Oakwood will cost £26,650, less the amount of the Government grant and plus £10,300, the amount estimated to be expended by the Improvements Committee. It is calculated that there will be an annual saving of about £650 as the result of the greater speed which will be attainable on the new track.

London.—Labour-Saving on the "Tubes."—Labour-saving devices recently introduced on the Underground Railways include lifts which can be controlled from outside, thus obviating the need for an attendant in the lift. Lifts are being operated in this manner at the Waterloo Station of the Bakerloo line. As soon as passengers have entered the lift the attendant outside manipulates the mechanism, which automatically closes the doors and lowers the lift. On arrival the doors automatically open, and the passengers pass out. Thus one or two attendants can take charge of a group of such lifts.—*Morning Post.*

New Plant.—The L.C.C. Highways Committee recommends the expenditure of £240,000 upon new plant for the Greenwich power station, which supplies the L.C.C. tramways. The amount is made up of the following items:—One 8,000-kW turbo-generator, with all necessary auxiliary plant and switchgear, three boiler units, complete with economisers, superheaters, &c., £210,000; engineers' fees, £10,000, and allowance for foundations and dismantling, and completing works in connection with the boilers, £20,000. In addition to this, £160,000 is to be expended on the reconstruction of the Holborn and Streatham sub-stations, and the purchase of new switchgear and high-pressure cables.

Bermondsey.—In 1914 the L.C.C. Highways Committee prepared to undertake the electrification of horse tramways in the Bermondsey area, but the Government ordered the work to be deferred, as it was not of national importance. The cost at that time would have amounted to about £62,600, plus £22,000 for street widening. The question of proceeding with this work has been raised recently by Bermondsey Borough Council, and the Highways Committee, after due consideration, finds that the present-day cost of the work would be £241,950 for a single track with loops, or £329,850 for a double track (inclusive of street widening costs). The Highways Committee, therefore, recommends that the Bermondsey Council be informed that the L.C.C. is unable, at the present time, to see its way to arrange for the electrification of the lines in question.

Oldham.—Application for Time Extension.—The extension of the tramways from Werneth to Chadderton, for which a provisional order was obtained more than 12 months ago, was discussed by the Tramways Committee at its last meeting. The distance is about one and a-half miles, and the original estimate was £25,794. At present it is estimated the cost for track and overhead equipment alone would absorb £48,000. It was also pointed out that motor-'buses were not likely to be a paying proposition. Operating costs per passenger were high compared with 'cars, and 'buses could not be run under a cost of 30d. per car-mile. After discussion it was decided to take steps to extend the time in which to carry out the work authorised by the order.

L. & Y. Railway Electrification.—At the annual meeting of the L & Y. Railway, a suggestion from a shareholder that electrification of a section of the line from Oldham should be carried out as quickly as possible, elicited a reply from the chairman that the directors were satisfied it would be "good business," but money could not be provided for the work at present.

New Zealand. — Municipal Developments. — The *New Zealand Gazette*, No. 99 (January 9th), publishes Orders in Council giving consent to the raising of loans of £1,708,916 by the Wellington City Council for the purposes of water supply, street works, tramways, baths, and general improvements, and a tunnel through Mount Victoria; and £95,000 by the Wanganui Borough Council for the purpose of improving and extending its tramway service.

Gazette No. 102 (December 22nd, 1920) records that Invercargill Borough Council has carried proposals to raise loans including: £25,000 for additions and improvements to railways, and £50,000 for additions and improvements to electric light and power works.

TELEGRAPH AND TELEPHONE NOTES.

France. — Telephone Charges. — In the French Chamber, on February 22nd, M. Paul Laffont foreshadowed the abolition of the present flat rate charge for telephone service in Paris and other large cities, as the French post office had shown a deficit of £20,000,000 on the past year's working.

Italy.—Telegraph Message Tax.—In view of the further adverse rise in the rate of exchange, the present super-tax on telegraphic and wireless messages to foreign countries, when paid in Italian paper money, was raised to 350 per cent. as from March 1st.—*Reuter's Trade Service* (Rome).

Pacific Cable Board.—U.K.-Australia Service.—The Pacific Cable Board announces that it has reinstated the service of week-end telegrams between the United Kingdom and Australia, New Zealand, and the Pacific Islands. The service will be run in conjunction with the Imperial Cable (British Post Office), and telegrams of this class will be accepted at any post and telegraph office as from the 1st inst. The tariffs to Australia and New Zealand are as follows:—Australia, minimum charge covering 20 words, 15s.; each additional word above 20, 9d. New Zealand, minimum charge covering 20 words, 13s. 4d.; each additional word above 20, 8d. Week-end telegrams must have the prefix "TWT" (which is counted and charged for as one word), and the ordinary post-office or Pacific Cable Board's forms may be used.

Press Telegrams.—The Post Office announces that during the International Conferences now being held in London, Press telegrams at reduced rates for the Continent will be accepted at post offices in London at all hours instead of only between the hours of 6 p.m. and 9 a.m. The arrangement took effect from February 24th.

Mr. Illingworth, Postmaster-General, asked in the House of Commons whether he would state how much Press telegrams now cost the country over and above the rate paid for them by the newspapers, and whether, in the interests of economy, he intended to alter the present subsidy system, said that no recent investigation had been made as to the cost of Press as distinct from ordinary telegrams, but the loss was no doubt considerable. The rates for Press telegrams were increased on January 1st, 1920, and he did not contemplate a further increase at the present moment. The rates for private wires leased to the Press and to news agencies were, however, about to be raised.—*The Times.*

Swatow.—Cable Communication.—Attention is being given to the need of cable communication for Swatow and a scheme for providing such communication will probably be taken in hand. As a result of military operations in China, the only telegraphic connection of Swatow with the outside world was recently interrupted for three months. Therefore, telegrams reached Swatow only by post from Hong-Kong. Commenting upon this situation, Consul Myers, of Swatow, calls attention to the effect upon business of such interruption, stating further that Swatow has no cable connection. Three lines of the Chinese Telegraph Administration touch at Swatow, but the service at its best is very poor, the lines are not kept in good condition, and interruptions are frequent in bad weather. The unreliable nature of this service, therefore, points to the laying of a cable to Swatow as the only solution. In view of the commercial future of the port, whose trade is twice that of Amoy and Foochow combined, which ports have cable services, the demand for dependable telegraphic cable communication is apparent.—*Indian Engineering.*

Sweden.—Automatic Telephony.—A short time ago a party of Swedish State telegraph experts returned from a visit paid to Germany in order to investigate the subject of automatic telephone exchanges. According to a Swedish newspaper, the Siemens system, which was studied, is said certainly to "work in its own way." But when the percentage of wrong connections amounts to 14, as compared with 2½ per cent. with the manual system used in Stockholm, there is little inducement for the experts to recommend the introduction of the automatic system before it can be proved to be more reliable in working. In some towns in Germany it is declared that subscribers have lodged mass protests against the automatic telephone service, and demanded the reintroduction of the manual system. The question was previously examined by the Swedish experts in the United States, but it was found difficult to get any real insight into the degree of reliability of the automatic system.

Telephone Service.—Existing Contracts.—In reply to a question in Parliament whether a subscriber to the telephone is to be forced to continue his contract with the Post Office till the end of the period of his contract at the new rates, or if he could give up the use of the telephone, Mr. Illingworth wrote in reply that, unless specially provided for otherwise, a subscriber whose contract under the old rates is still current cannot be required to pay the new rates until the contract has been determined, and he can then decide whether he will enter into an agreement at the new rates, which in the case of an existing subscriber would run from quarter to quarter.

U.S.A.—Cable Dispute.—A decision was given in favour of the company, on February 25th, in the action brought by the Western Union Telegraph Co., against the U.S. Government, to restrain the latter from interfering with the landing of a cable at Miami, Florida.—*Daily Mail.*

Police Use Wireless.—Wireless telegraphic apparatus has been installed at the New York police headquarters as a means of notifying the police of other cities concerning the movements of suspected criminals. The messages will cover a radius of about 300 miles, and transmission will take place every evening from 6 p.m. until midnight.

Wireless D.F. Stations.—An Air Ministry Notice to Airmen (No. 17 of 1921) gives a list of wireless direction finding stations, together with the latitude and longitude of each, the call signal, wave length, and other details. In the British Isles there are nine stations, namely, at Amlwch, Rhyl, Berwick, Carnsore, Croydon, Flamborough, Lizard, Malin Head, and Sea View; in France there are 16, the erection of five others being contemplated; in Germany four; and in Italy one. The notice contains full instructions concerning the procedure to be used when communicating with the stations.—*The Times.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—April 19th. P.M.G. Telephone switchboards (Schedule No. 1,670).* (February 25th.)

April 27th. Victorian Railway Commissioners, Spencer Street. Caustic soda primary cells, complete (Contract No. 33,914).*

Brisbane.—March 30th. P.M.G.'s Department. Switchboard apparatus and parts.*

Ballinrobe.—March 15th. Ballinrobe Electricity Supply Co., Ltd. Erection of poles and overhead line in connection with the electric lighting supply. (See this issue.)

Belgrade. — May 1st. The Commercial Secretary to H.M. Legation at Belgrade has forwarded to the Department of Overseas Trade particulars of a call for tenders by the Serb, Croat, and Slovene Ministry of Public Works, for the erection of a power-station, main conductors and transforming stations in connection with an electrical scheme at Kostolac for the supply of energy to Belgrade, Semlin, &c. Tenders should be addressed to the Director, Ministry of Public Works, Belgrade. A translation of the specification and conditions of tender, together with a plan showing the disposition of the various stations and lines, may be inspected at Room 48, Department of Overseas Trade, 35, Old Queen Street, S.W.1.

Bradford.—Electric lighting installation at Great Horton Wesleyan Schools. Mr. E. Ramsden, Cliffe Mills, Great Horton, Bradford.

Croydon.—March 7th. Electricity Department. Two natural draught cooling towers. (February 18th.)

Dewsbury.—Electric-light installation in branch shops, Brewery Lane, Thornhill Lees, for the Dewsbury Pioneers Industrial Society, Ltd., Union Street, Dewsbury.

Dungarvan.—Co. Waterford. — March 10th. Dungarvan Electric Light and Power Co., Ltd. Wiring of consumers' premises in connection with the electric lighting scheme. J. P. Tierney & Co., consulting engineers, 44, Kildare Street, Dublin.

Edinburgh. — Parish Council. Supply of intercommunication telephone instruments and accessories for Craiglockhart Poorhouse. Mr. R. T. French, Clerk, Parish Council Chambers.

Glasgow.—March 11th. Education Authority. Installation of electric lighting and heating systems in a number of schools. Schedules on application to Property Department, 129, Bath Street.

Johannesburg. — March 30th. Municipal Council. Forty 50-h.p., 500 to 600-V tramcar motors. Tenders to Town Clerk, Municipal Offices, Johannesburg. A copy of the specification may be seen in Room 48 of the Department of Overseas Trade up to to-morrow (Saturday), after which date it will be available for loan to firms in the provinces.

Leeds.—March 8th. Electrical work required in the Education Committee's schools for the year ending March 31st, 1922. Architect, Education Department, Calverley Street.

Macclesfield.—March 14th. Cheshire County Asylum, Parkside. Stores, including electrical goods, for six months. W. G. F. Tingay, Clerk.

Manchester.—April 4th. Electricity Committee. 33,000 and 6,600-V switchgear, induction regulators, &c., for controlling sub-stations of large capacity. (February 18th.)

Perth. — March 21st. Electricity Department. One 1,000-kW, d.c., geared turbo-generator, with condensing plant. (See this issue.)

Plymouth.—March 7th. Electricity Department. Cast-iron pipes. (See this issue.)

Rhondda.—April 5th. Electricity Department. A.c. house service meters, cable, joint boxes, &c. (February 25th.)

Spain.—The War Minister has been authorised to invite tenders for the supply of radio-telegraphic material for the first Regimento de Telegrafos and the Batallon de Radiotelegraphie. The estimated cost is 300,000 and 500,000 pesetas respectively.—*Reuter's Trade Service* (Madrid).

Stockton-on-Tees. — March 9th. Electricity Department. A.c. l.p. switchgear. (February 25th.)

Uruguay.—Monte Video.—March 29th. State Power House. Single and three-phase meters.*

March 31st. A telegram from H.M. Minister at Monte Video (Sir C. C. Mallet, C.M.G.), to the Department of Overseas Trade, states that general tenders are invited until March 31st for the construction of the projected port works at Paysandu, for which an expenditure of $280,457.30 has been sanctioned. The construction of a dyke, the acquisition of electrical handling and lifting apparatus, the extension of the mole and the construction of anchoring grounds, are included in the scheme.

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—Sydney.—Electricity Supply Committee.

Eighteen 400-kVA transformers, £17,082. — English Electric Co. of Australia, Ltd. (recommended). —*Tenders.*

Belgium.—No fewer than twelve firms—Belgian, French, German and British—submitted tenders recently to the municipal authorities of Schaerbeek, Brussels, for the supply of three static three-phase transformers. The lowest tender was that of the representatives of a German manufacturer, the Comptoir Générale d'Electricité d'Allemagne, of Brussels, who quoted 18,753 francs per transformer.

Government Contracts.—The following Government contracts were placed during January, 1921 :—

ADMIRALTY (CONTRACT AND PURCHASE DEPARTMENT).

Battery.—Fuller's United Electric Works, Ltd.
Carbon rods.—Morgan's Crucible Co., Ltd.
Secondary cells.—Fuller's United Electric Works, Ltd.
Electric Lighting at Rosyth.—G. E. Taylor & Co.
Motor generators.—W. H. Allen, Sons & Co., Ltd.
Switchgear.—Whipp & Bourne, Ltd.

WAR OFFICE.

Distributing boards.—General Electric Co., Ltd.; W. Sanders & Co.

AIR MINISTRY.

Storage Battery.—Pritchett & Gold, Ltd.
Electric mains.—Callender's Cable Co., Ltd.
Electrically-driven fire pump.—Allen, Sons & Co.

POST OFFICE.

Telephone apparatus.—Sterling Telephone & Electric Co., Ltd.; Western Electric Co., Ltd.
Telegraph and telephone cable.—British Insulated & Helsby Cables, Ltd.; Callender's Cable & Construction Co., Ltd.; W. T. Glover & Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; London Electric Wire Co. & Smiths, Ltd.; Siemens Bros. & Co., Ltd.; Union Cable Co., Ltd.; Western Electric Co., Ltd.
Lamp caps.—J. Hannan.
Casing and cover.—McGaw & Co.
Secondary cells.—Van Raden & Co., Ltd.
Telephone cords.—British Insulated & Helsby Cables, Ltd.; Phœnix Telephone & Electric Works, Ltd.
Cut-outs.—Johnson & Phillips, Ltd.
Ducts.—Albion Clay Co., Ltd.
Electro-mechanical gate locks, gate contacts, and lattice gates for lifts at various P.O. buildings.—Medway's Safety Lift Co., Ltd.
Insulators.—De la Rue & Co., Ltd.
Electric lamps.—English Electric & Siemens Supplies, Ltd.
Laying conduit.—Grove Road, Burdett Road, and West India Dock Road: Whittaker Ellis, Ltd. Harrow (Pinner Road): G. J. Anderson. Hunton Bridge, Berkhampstead: H. Farrow. Manchester-Hyde-Glossop and Oldham-Huddersfield (section III): W. Turner (Ardwick). Newcastle-Durham (section III): Kettle & Son. Southampton-Totton: W. Dobson.
Manufacture, supply, drawing in, and jointing cable.—London-Barnet: Callender's Cable & Construction Co., Ltd. London-Brighton: Johnson & Phillips, Ltd. Leeds-Harrogate: British Insulated & Helsby Cables, Ltd.
Mouthpieces for telephones.—Crystalate Manufacturing Co., Ltd.
Power plant and electric lighting North Walsham relay station.—G. E. Taylor & Co. Sub-contractors: For battery, Tudor Accumulator Co., Ltd. For engine and generator, R. A. Lister & Co., Ltd.
Power equipment, Dollis Hill Wireless Experimental Station.—Westminster Engineering Co., Ltd. Sub-contractors: For induction motor, Lancashire Dynamo & Motor Co., Ltd. For static transformer, Johnson and Phillips, Ltd. For auto-transformer starter, Electrical Apparatus Co., Ltd.
Electric trucks.—English Electric Co., Ltd.
Bronze wire.—Shropshire Iron Co., Ltd.
Telephone exchange equipment.—Belfast: Western Electric Co., Ltd. Paisley: Automatic Telephone Manufacturing Co., Ltd. New Barnet: Peel-Conner Telephone Works, Ltd. Sub-contractors: For batteries, Tudor Accumulator Co., Ltd. For charging set and ringing dynamotor, Crompton & Co., Ltd.
Annealed copper wire.—T. Bolton & Sons, Ltd.; British Insulated and Helsby Cables, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co., incorporated in the London Electric Wire Co. & Smiths, Ltd.
H.d. copper wire.—T. Bolton & Sons, Ltd.; British Insulated & Helsby Cables, Ltd.; Elliotts Metal Co., Ltd.; R. Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co., incorporated in the London Electric Wire Co. & Smiths, Ltd.; J. Wilkes, Sons & Mapplebeck, Ltd.
Galvanised steel wire.—F. Smith & Co., Wire Manufacturers, Ltd.

HIGH COMMISSIONER FOR INDIA.

Electric battery.—Tudor Accumulator Co., Ltd.
Insulator cups.—Bullers, Ltd.; Edwardes, Bros.; Taylor, Tunnicliffe and Co., Ltd.
Insulators.—Bullers, Ltd.
Electric lamps.—General Electric Co., Ltd.
Meters.—Weston Electrical Co., Ltd.
Motors.—Lancs. Dynamo & Motor Co., Ltd.
Pelaphone plant.—New Pelaphone Engine Co., Ltd.
Power plant.—General Electric Co., Ltd.
Switchboards.—British Thomson-Houston Co., Ltd.; General Electric Co., Ltd.
Telephone apparatus.—Peel-Conner Telephone Works, Ltd.
Copper wire.—T. Bolton & Sons, Ltd.; Elliotts Metal Co., Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co., Ltd.
G.i. wire.—F. Smith & Co., Ltd.

CROWN AGENTS FOR THE COLONIES.

Cable.—British Insulated & Helsby Cables, Ltd; W. T. Glover & Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Western Electric Co., Ltd.
Copper wire cable.—Hooper's Telegraph & I.R. Works, Ltd.
Electric lamps.—Metropolitan-Vickers Electric Export Co., Ltd.
Insulated wire.—Hooper's Telegraph & I.R. Works, Ltd.
Jointing materials.—W. T. Henley's Telegraph Works Co., Ltd.
Switchboard materials.—Siemens Bros. & Co., Ltd.
Switchgear.—Metropolitan-Vickers Electric Export Co., Ltd.
Telegraph line material.—Bullers, Ltd.; Siemens Bros. & Co.
Telephones.—British L. M. Ericsson Manufacturing Co., Ltd.
Transformers.—Metropolitan-Vickers Electric Export Co., Ltd.

H.M. OFFICE OF WORKS.

Engineering services.—Electric lift, National Portrait Gallery: Medway's Safety Lift Co., Ltd.

London. — Stepney.—Electricity Supply Committee. Accepted :—

One 1½-ton Garrett patent electric vehicle, £1,000. — Agricultural and General Engineers, Ltd.
Coal—8,000 tons Seghill/Hastings nutty smalls, 43s. 6d. ton.—E. Foster & Co.
Cable—250 ft. ·3 sq. in., 220 yds. ·25 sq. in. e.h.p. 8-core cable, and 440 yds. ·2 sq. in. t c.l.e. cable.—W. T. Henley's Telegraph Works Co., Ltd.
¼ mile troughs and covers, £126.—Sutton & Co.

Bethnal Green.—Electricity Committee. Accepted :—

60 ·20-amp., 24 ·40-amp. 2·200-amp. meters (total), £345.—Metropolitan-Vickers Electrical Co., Ltd.

Manchester.—Electricity Committee. Accepted :—

Cable—British Insulated & Helsby Cables, Ltd ; Western Electric Co , Ltd.; motor-driven pumping plant for Barton power-station, Mather & Platt, Ltd.; sub-contractors :Valves, Glenfield & Kennedy, Ltd.; oil switches, G. Ellison; switchgear, Metropolitan-Vickers Electrical Co., Ltd.

Nelson.—According to the Manchester *Daily Despatch*, the Town Council on Tuesday discussed the letting of a tender for tram crossings and points to the Anglo-Belgian Improvement Corporation. As chairman of the Tramways Committee, Alderman Cooke said the price was 50 per cent. lower than the tender of any English firm. It appears that the representative of the firm, on submitting the tender, said a deputation of their workpeople had waited on them and agreed to work the full six days a week, including Saturday afternoons, without demanding overtime. This was one reason why Belgian firms were able to undercut.

Portrush.—Urban District Council. Accepted :—

Plant for electricity supply, £13,598.—Messrs. Curran.
Building generating station, £1,653.—Cochrane & Elliott.

Salford.—Electricity Committee. Accepted :—

L.p. single paper-insulated, lead-covered cable, £332; 4-core l.p. cable, £980. - Pirelli-General Cable Works, Ltd.
L.p. twin paper-insulated, lead-covered cable, £249; l.p. concentric paper-insulated, lead-covered cable, £963; e.h.p. 3-core, paper-insulated, lead-covered cable, £347.—W. T. Glover & Co., Ltd.
D.c. switchgear for 1,000-kW rotary converter at Blackfriars sub-station, £444.—Bertram Thomas.

FORTHCOMING EVENTS.

Birmingham and District Electric Club.—Friday, March 4th. At the Grand Hotel, Birmingham. At 6.45 p.m. Annual dinner.

Saturday, March 12th. Paper on "Common-sense Methods of Recording Costing and Progress in Shop Management," by Mr. H. C. Young.

British Electrical Development Association (Inc.).—Friday, March 4th. At the Offices of the British Electrical and Allied Manufacturers' Association, 36, Kingsway, W.C.2. At 12 noon. Adjourned first annual general meeting.

Institution of Mechanical Engineers.—Friday, March 4th. At the Institution, Storey's Gate, S.W. At 6 p.m. Paper on "De-gassing and Purification of Boiler Feed-water," by Mr. P. Kestner.

Royal Institution of Great Britain.—Friday, March 4th. At Albemarle Street, Piccadilly, W. At 9 p.m. Lecture on "Severn Crossings and Tidal Power," by Mr. W. A. Tait.

Saturday, March 5th. At 3 p.m. Lecture on "Electricity and Matter," by Sir E. Rutherford, F.R.S. (Lecture I.)

Royal Society of Arts.—Monday, March 7th. At John Street, Adelphi. At 8 p.m. Cantor Lecture: "X-Rays and their Industrial Applications," by Major G. W. C. Kaye.

Chief Technical Assistants' Association. — Saturday, March 5th. At Anderton's Hotel, Fleet Street, E.C. At 3 p.m. Annual general meeting.

Salford Technical and Engineering Society. — Saturday, March 5th. At the Royal Technical College. At 7 p.m. Paper on "The Barton Electric Power Station," by Mr. S. L. Pearce.

Institution of Post Office Electrical Engineers (London Centre).—Monday, March 7th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 5.30 p.m. Paper on "The Relay System of Automatic Switching," by Mr. H. Dipple

Society of Engineers.—Monday, March 7th. At Burlington House, Piccadilly, W. At 5.30 p.m. Paper on "Some Modern Engineering Practice in America," by Mr. R. W. A. Brewer.

University of London.—Monday, March 7th; Wednesday, March 9th, and Friday, March 11th. At the Institution of Civil Engineers, Great George Street, S.W. At 5.30 p.m. Lectures on "Recent Engineering Works in Italy," by Prof. Luigi Luiggi, Professor of Hydraulic Construction in the University of Rome.

Institution of Civil Engineers.—Tuesday, March 8th. At the Institution, Great George Street, S.W. At 5.30 p.m. Paper on "The Amritsar Hydro-electric Irrigation Installation," by Mr. S. Leggett.

Electricity District Inquiry.—Tuesday, March 8th. At Liverpool. Resumed inquiry by the Electricity Commissioners into the Mersey and West Lancashire District.

Association of Engineers-in-Charge.—Wednesday, March 9th. At St. Bride's Institute, Bride Lane, E.C. At 7.30 p.m. Paper on "The Economic Utilisation of Exhaust Steam," by Mr. A. J. Assheton.

Institute of Cost and Works Accountants.—Wednesday, March 9th. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Lecture on "Economics in Relation to Costing," by Mr. W. Grainger.

Institute of Metals.—Wednesday and Thursday, March 9th and 10th. At the Institution of Mechanical Engineers, Storey's Gate, Westminster. Annual general meeting.

Manchester Wireless Society.—Wednesday, March 9th. At the Manchester College of Technology, Sackville Street. At 7.30 p.m. Lecture on "The Construction of Electric Motors," by Mr. R. Hallam.

National Association of Supervising Electricians.—Wednesday, March 9th. At 6.30 p.m. At St. Bride's Institute, Bride Lane, E.C. Discussion on "Gas *v.* Electricity." Opened by Mr. F. W. Goodenough and Mr. W. A. Gillott.

Association of Engineering and Shipbuilding Draughtsmen (York Technical Section).—Thursday, March 10th. At 7.15 p.m. At the Priory Street Higher Grade School, York. Paper on "Wireless Telegraphy," by Mr. E. Backhouse.

Belfast Association of Engineers.—Thursday, March 10th. At the Municipal Technical Institute. At 6.45 p.m. Paper on "Technical Training for Industry," by Mr. A. P. M. Fleming.

Chelmsford Engineering Society.—Thursday, March 10th. At the East Anglian Institute of Agriculture. At 7.15 p.m. Paper on "Ball and Roller Bearings," by Mr. T. W. Cooper.

Institution of Electrical Engineers.—Thursday, March 10th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Lecture on "Magnetic Susceptibility of Low Order." Lecture III—"Practical Applications," by Prof. E. Wilson.

Students' Section.—Friday, March 11th. At King's College, Strand, W.C. At 6.30 p.m. Paper on "Some Recent Developments in Converting Machinery for Small Sub-stations," by Mr. J. A. Broughall.

Western Centre.—Monday, March 7th. At the South Wales Institute of Engineers, at Cardiff. At 7 p.m. Lecture on "The Prospects of Electricity in Agricultural Centres," by Mr. W. Kerr.

North-Midland Centre.—Tuesday, March 8th. At the Hotel Metropole, Leeds. At 7 p.m. Ordinary meeting.

North-Western Centre.—Tuesday, March 8th. At the Engineers' Club, Manchester. At 7 p.m. Paper on "Electric Driving in the Paper Mill on Heat-economy Lines," by Mr. A. B. Mallinson.

Scottish Centre.—Tuesday, March 8th. At Princes Station Hotel, Edinburgh. At 7 p.m. Lecture on "The Long-distance Telephone System of the United Kingdom," by Sir W. Noble.

Scottish Centre (Students' Section).—Friday, March 11th. At the Royal Technical College, Glasgow. Paper on "Machinery Operations in Automobile Construction," by Mr. R. J. Hird.

Edinburgh Electrical Society.—Friday, March 11th. At the Philosophical Institute. At 8 p.m. Apprentices' night. Short papers on "Every-day Work" for the Society's prize.

Junior Institution of Engineers.—Friday, March 11th. At 39, Victoria Street, S.W. At 8 p.m. Lecturette: "Electrical Drive in the Cotton Trade," by Mr. A. T. McGuire.

Physical Society of London.—Friday, March 11th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Sixth Guthrie Lecture: "Some Recent Applications of Interference Methods," by Prof. A. A. Nicholson, University of Chicago.

NOTES.

The New Sessions House of the L.C.C.—We regret that in our reference to the four-contact suspension of the large fittings, in our last issue, the makers' name was incorrectly stated; it should read "The London Electric Firm."

Summer Time.—Mr. Shortt stated in the House of Commons on February 23rd that the Government proposed to introduce summer time this year from midnight on Saturday-Sunday, April 2nd—3rd, to midnight on Sunday-Monday, October 2nd—3rd.

Summer-time will be re-established in France on the night of March 4th, and all restrictions on the use of electricity will then be removed, says the *Daily Telegraph.*

Twenty-Four Hours' Clock.—Mr. Shortt (Home Secretary) informed the House of Commons on February 22nd that the Government had decided to take no steps at present with reference to the adoption in general use of the 24 hours' clock system.

Service Notes.—Seven mechanist electricians with a knowledge of wireless telegraphy are required for the Indian service—a two years' engagement, 350 rupees per month, free quarters or allowance in lieu thereof, free medical attendance, and free passage outwards.

Warrant-electrician W. G. P. Whiting has been posted to the battleship *Iron Duke*, from the 9th inst. Warrant-telegraphist C. C. France has been posted to the *Iron Duke* for service with the squadron of which she is the flagship.

B.T.H. Wireless Apparatus.—With reference to our notice of the B.T.H. Co.'s stand at the Efficiency Exhibition at Olympia (page 232 of our February 25th issue), we have been asked to correct the statement that the portable wireless telegraphic receiving set that was shown "needed an aerial." The main feature of the set is that messages can be received in any reasonably quiet room without the aid of an aerial.

"A Question of Ethics."—As we go to press the following letter has come to hand:—

"I have read with interest W. A. Moore's letter in your issue of February 25th; but, in view of the fact that the page number of the *write-up* appeared in the *advertisement*, I am afraid your explanation in the footnote does not carry much weight. If there was no connection whatever between the advertisement and the write-up, and no knowledge on the editorial side, I can only congratulate the advertisers on their apparent uncanny foresight in fixing the correct page number in the news columns.

"W. Mahoney."

"*March 2nd*, 1921.

The matter is really very simple. Both the editorial and the advertisement pages pass through the hands of our foreman printer, who, of course, knows the numbers and contents of all of them. We understand that the copy for the advertisement in question was received at the last minute and hurriedly forwarded to him without critical inspection, and he inserted the page number without instructions to do so. The advertisement manager and the editors knew nothing about the matter till after publication.

Electrical Engineers' Reunion.—No. 5 Company London Electrical Royal Engineers (T.F.) will hold their annual dinner at Queen's Hotel, Leicester Square, on Saturday, March 19th. Particulars may be obtained from the Secretary, Mr. G. Pressy, 3, Rugby Road, Chiswick, London, W.4.

The Geo. Montefiore Endowment.—The next awards in connection with the above endowment, details of which were given in our pages some months ago, will be made this year. A prize or prizes not exceeding 20,000 fr. in value will be awarded for the best paper or papers, which must have been prepared within the last three years, and may be in French or English, dealing with scientific developments or improvements in the technical applications of electricity. The closing date for entries is April 30th next, and the offices of M. le Secrétaire Archiviste de la Fondation Geo. Montefiore, are at Rue Saint-Gilles, 31, Liége, Belgium.

A Gas Comedy.—Because of the poor gas supplied, says the *Daily Mail*, Middlesex County Council has agreed to install electric light at the gas-meter testing station at Edmonton to enable the inspector to do his work.

Trains on Fire.—According to the *Daily Mail*, five trains were involved and nine carriages destroyed in a fire at the Caledonian Railway Co.'s cleaning sheds, Glasgow. Several carriages were drawn out of the danger zone by engines. Some of the destroyed carriages had only arrived from London the previous night. The fire spread rapidly owing to the explosion of gas tanks.

The sting is, as often happens, in the tail. Electrically-lighted trains are not liable to explosions.

Appointments Vacant.—Shift engineer (£314), meter fixer (80s. 4d.), for the Eccles Corporation Electricity Department

The Three-Shift System in the Cable-Making Industry.—According to *The Electron*, the National Joint Industrial Council for the Cable-Making Industry has decided to recommend to all factories where overtime is being worked, the introduction of the three-shift system.

Fatality.—While repairs were being carried out to the chimney stack of the Lister Drive Power Station, Liverpool, a steeplejack, supposed to have missed his footing on the scaffolding, fell a distance of from 80 to 100 ft. and was killed instantly.

Educational.—University of London.—A course of six public lectures on "Recent Engineering Works in Italy," will be given at the Institution of Civil Engineers, Great George Street, S.W., by Prof. Luigi Luiggi, D.Sc., M.Inst.C.E., Professor of Hydraulic Construction in the University of Rome, at 5.30 p.m., on March 7th, 9th, 11th, 15th, 16th, and 18th, 1921. The subjects dealt with will be:—Sanitary Engineering and Water Supply; Agricultural Hydraulic Engineering; Industrial Hydraulic Engineering (Hydro-Electrical Power Development in the Alps and Apennines, Applications of Electricity to Steel and Copper Refining Works, Chemical Engineering Works, Utilisation of Volcanic Heat for Steam Raising); Transportation Engineering (Italian Canals, Roads, Railways, and Air Transport).

The lectures, which will be given in English and fully illustrated with lantern slides, are addressed to advanced students of the University and others interested in the subject. Admission will be free, without ticket.

In view of the age-long pre-eminence of Italian engineers in hydraulic engineering, this course is sure to be of the greatest interest and value to British engineers.

An Auto-Pram.—We are informed that the Rev. Percival Mackenzie, of Forest Hill, is responsible for the invention of an auto pram. He has fitted an electric motor, made from a self-starter taken from a motor-car, to his children's perambulator. The motor is fed from a battery of accumulators, and is so geared that while there is, it is stated, no danger of breaking the speed limit for perambulators on the level, it will climb a hill with ease and save nurse having to exert herself unduly. Affixed to the side of the pram in a conspicuous position is a motor licence!

INSTITUTION NOTES.

Institution of Electrical Engineers.—Summer Meeting.—With reference to our last week's note on this subject, we are informed that the first two days will be spent in Glasgow, when visits will be paid to the new power station at Dalmarnock, and to works and other places of interest. There will also be papers on that power station and on the hydro-electric power resources of Scotland. Arrangements have been made for a Clyde trip on June 8th. On the 9th the party will proceed by special train to Fort William or Banavie (Inverness Canal), and on the following day a steamer will take the visitors down Lock Linnhe to Kinlochleven, where the hydro-electric installation of the British Aluminium Co. will be visited. In the afternoon the steamer will continue its journey southwards and land the party at Oban, where the visit will end on Friday evening, June 10th. The journey to Fort William and thence to Oban will give an opportunity of seeing the most magnificent scenery of the Western Highlands.

The December, 1920, issue of the Institution *Journal* contains, *inter alia*, particulars regarding the Membership Advisory Committee for India, of which Mr. J. W. Meares (Simla) is chairman and Mr. C. C. T. Eastgate (Lahore) is secretary. It also contains a complete list of the members of the 12 Committees appointed by the Council for 1920-21, and of the representatives of the Institution on other bodies.

North-Western Centre.—A meeting of the members of this Centre was held on February 22nd, Mr. Julius Frith presiding. Mr. E. A. Watson read his paper on "Magnetos for Ignition Purposes in Internal Combustion Engines," which he freely illustrated with lantern slides. In the discussion, the chairman, Prof. E. H. Crapper, Dr. Garrard, and Messrs. G. A. Cheetham, J. W. Naylor, H. D. Symons, D Paton, and Sills took part.

Wireless Section.—A meeting of the Wireless Section will be held on Wednesday, March 16th, at 6 p.m., at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W., when the following papers will be read and discussed :—"On the Effect of Electron Emission on the Temperature of the Filament and Anode of a Thermionic Valve," by G. Stead, M.A. ; and "On Some Thermionic Tube Circuits for Relaying and Measuring," by Miss W. A. Leyshon and Dr. W. H. Eccles.

Liverpool Sub-Centre of the North-Western Centre.—Mr. G. A. Juhlin read his paper on "Temperature Limits of Large Alternators," before the Liverpool Sub-Centre, on February 28th. In opening the discussion which followed, Mr. Hollingsworth welcomed the paper from the user's point of view, and thought that, in general, supply engineers were not adverse to the installation of temperature detectors, as he was of opinion that they had everything to gain. Also the general installation of detectors would aid both manufacturers and the users.

Mr. Teago thought that the temperatures mentioned were not revolutionary, and suggested that the temperature should be measured on the end windings rather than in the core, since the end windings represented the weakest spot.

Dr. Marchant suggested an interesting device for determining the temperature with the aid of a potentiometer. Mr. Malpas pointed out various difficulties that he had come in contact with, and a few questions were asked by Mr. Rettie ; finally Mr. Juhlin suitably replied.

National Association of Supervising Electricians. — On Wednesday next, March 9th, there will be a discussion on "Heating, Power, Lighting, and Cooking—Gas *v.* Electricity" ; Mr. F. W. Goodenough, nominated by the British Commercial Gas Association, will present the case for gas, and Mr. W. A. Gillott, nominated by the British Electrical Development Association, will be the advocate of electricity. Mr. J. S. Highfield, president, will occupy the chair, and a lively discussion may be anticipated. The address of the Hon. Secretary of the N.A.S.E. is 83, Deodar Road, S.W. 15, and we have no doubt that he would be pleased to send tickets to electrical engineers who would like to hear the debate and who apply to him for them.

The Royal Society.—On February 17th a paper was read by Dr. C. Chree, F.R.S., on "A Comparison of Magnetic Declination Changes at British Observatories." Prof. H. M. Macdonald, F.R S., read a paper on "The Transmission of Electric Waves Around the Earth's Surface."

Portsmouth Rotary Club.—On February 22nd, Captain W. H. Upton-Marshall R.E. (T.), M I.E.E., M.I Mech.E., read a paper to the members of this club on "How Electricity Helped to Run the War, and Its Future Possibilities as a Civilising Agent." Having broadly covered his subject, the speaker referred to the reorganisation of electricity supply. He passed some severe criticism on the Portsmouth Electricity Department, whose generating costs, he said, were double those of any other station of comparable size in this country. He sketched a supply scheme for Portsmouth and its environs, suggesting the erection of a large generating station at Hilsea, which occupies a favourable position as regards coal and water supplies.

Association of Mining Electrical Engineers.—At a meeting of the West of Scotland branch of the Association, at Glasgow, on February 18th, Mr. F. Anslow presiding, a paper was read by Mr. S. Burns, of Newcastle, on "The Choice of a Small Electric Winder." During the discussion which followed the reading of the paper, Mr. F. Anslow, the president, remarked that electric winding was now beyond the realms of speculation. That cleared the way for complete electrification, which was a matter of national importance.

Society of Engineers (Incorporated).—At the meeting in the Apartments of the Geological Society, Burlington House, W., on Monday, March 7th, at 5.30 p.m., a paper will be read on "Some Modern Engineering Practice in America," by Mr. Robert W. A. Brewer, A.M.Inst.C.E. The subjects dealt with will include the construction of large concrete-lined oil reservoirs, the manufacture of vacuum valve amplifiers for wireless telephony, and the Cottrell process of precipitation of smoke and fumes.

A New Wireless Society.—At a recent meeting held at the Wimbledon Technical Institute, at which Mr. H. Nutton, A.M.I.E.E , presided, the formation of a wireless society for Wimbledon and district was decided upon. Mr. W. A. Harwood, Principal of the Institute, was elected president, and Mr. W. G. Marshall, 48, Warren Road, Merton, S.W., as the hon. secretary. Monthly meetings are to be held, and the first will take place to morrow, March 5th, when the President will deliver the opening address.

Edinburgh Electrical Society.—At a meeting held on February 25th, a paper on "Telephone Troubles" was read by Mr. J. McEwan Brown, of the Government telephone service. The paper advocated first a thorough knowledge of the principles and functions of telephonic apparatus, and then a systematic division of an installation with sections for fault tracing. The most common failures and the measures taken to cure them were described. An interesting discussion followed.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

At a conference of the district engineers of East Anglian Electricity, Ltd , Mr. A. E. Iliffe, the district manager for the Waveney Valley, was presented with a silver cigarette case by the directors and staff, on the occasion of his resignation from the company to take up his duties in the Domestic Heating and Cooking Department of the Metropolitan-Vickers Electrical Co., Ltd. Mr. Napier Prentice made the presentation.

Messrs. H. W. Smith & Co. (1920), Ltd., have engaged Mr. D. C. Jewell, who was for a long time with Messrs. Sir W. Armstrong, Whitworth & Co., Ltd., at their Elwick Works, as their representative for the North-Eastern Counties.

Stepney Borough Council General Purposes, Staff, and Education Committee, having further considered the reference from the Electricity Committee that the salary of Mr. A. J. Squire, deputy (commercial) manager be increased to that paid to Mr. Young, the resident electrical manager (excluding the value of Mr. Young's emoluments), entirely concurs in the recommendation. Mr. Young's present salary is at the rate of £777 per annum.

Chesterfield Town Council has increased the salary of Mr. W. A. Toppin, general assistant engineer in the electricity and tramways department, to £547 a year, without prejudice under the Civil Service awards.

Sir Ernest V. Hiley has resigned the chairmanship of the Metropolitan Carriage, Wagon, and Finance Co. He still retains his position as a director of the company, and his resignation as chairman has nothing whatever to do with Messrs. Vickers, Ltd. It is stated to be purely a domestic arrangement in the management of the Metropolitan Co.

Mr. Lincoln Chandler has been re-appointed managing director of the Metropolitan Co., a position which he relinquished 12 months ago.

Mr. H. E. Mortimer has resigned his position as contracts engineer with Messrs. Edmundson's Electricity Corporation, Ltd., and has joined the Board of Messrs. Baxter & Caunter, Ltd., 819, Tottenham Court Road, W. 1.

Prof. William A. Bone, F.R S., Professor of Chemical Technology at the Imperial College of Science and Technology, South Kensington, underwent a serious operation last week, and is at present passing through a critical period of recovery. He has cancelled all his engagements.

Sir John Monash has been appointed chairman of the Electricity Commissioners, under the Australian State Electricity Commission Act, at £3,000 per annum, for seven years. The other Commissioners are :—Prof. T. R. Lyle, Mr. G. Swinburne, and Sir Robert Gibson, for seven years, at £500 per annum each.

Obituary.—Mr. C. Surman.—We regret to record the death of Mr. Charles Surman, who up to his retirement was chief superintendent of telegraphs at the Liverpool General Post Office.

Mr G. R. Peers.—We learn that the death of Mr. G. R. Peers, which we announced a fortnight ago, occurred suddenly from heart-failure in Oxford Street. The deceased gentleman was author of a book "Electricity made Plain."

Mr. R. M. Reid.—The death occurred on February 20th, of Mr. Robert Moffat Reid of the firm of Reid & Co., electricians, of Ayr. He was 74 years of age.

Will.—Referring to the will of the late Dr. C. A. Mercier, of Bournemouth, *The Times* states that in drawing up his will Dr. Mercier believed that considerable sums might accrue to him or to his estate after his death from his share in the "Wolfryn process" for the electrification of seeds for wheat-growing. His estate is now valued for probate at £4,899.

NEW COMPANIES REGISTERED.

Luminor Signs (British), Ltd. (173,368).—Private company. Registered February 25th. Capital, £10,000 in £1 shares. To adopt an agreement with E. Bertron, and to carry on the business of advertising agents and contractors, manufacturers of displayed signs, letters or designs, or the exhibiting, lighting or movement thereof. The first directors are: A. J. Henderson, Henwick, Ray Park Avenue, Maidenhead; Lieut.-Com. H. H. Tatham, R.N. (retd.), 54, Beaufort Mansions, S.W. 3; D. A. Edwards, Northcote House, Minster Road, N.W. (director Kendal Mills & Co., Ltd.). Registered office: 128, Jermyn Street, S.W. 1.

Three Star Accumulators, Ltd. (173,287).—Private company. Registered February 22nd. Capital, £3,000 in 10s. shares. To carry on the business of mechanical and electrical engineers, manufacturers of batteries, cells, accumulators, electrical and magnetic machinery, &c. The subscribers (each with one share) are · L. J. Latey, 8, Serjeant's Inn, E.C. 4, solicitor; W. G. Saville, 8, Serjeant's Inn, E.C. 4, clerk. P. Abrahams signs as "director." Registered office: 54, Redcross Street, E.C. 2.

J. B. Midgley, Ltd. (173,285).—Private company. Registered February 22nd. Capital, £500 in £1 shares. To carry on the business of electricians, electrical and mechanical engineers, manufacturers and workers of and dealers in electricity, &c. The first directors are: J. B. Midgley, 205, Hampton Road, Twickenham, S.W.; J. J. Tanner, 205, Hampton Road, Twickenham, S.W.; F. Johnson, 207, Hampton Road, Twickenham, S.W.; P. E. Gallogher, 207, Hampton Road, Twickenham, S.W. Secretary: P. E. Gallogher. Registered office: 26, Caledonian Road, King's Cross, N. 1.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Wigan Electro-Metallurgical Works, Ltd.—Particulars of £1,500 debentures authorised February 1st, 1921; whole amount issued; charged on company's undertaking and property, including uncalled capital.

Glantawe Electric Supply Co., Ltd. (112,615).—Capital, £15,000 in £10 shares. Return dated September 23rd, 1920. All shares taken up and fully paid in cash. Morgages and charges: Nil.

CITY NOTES.

The Underground Electric Railways Co. of London Ltd. In their report for 1920 the directors give the following particulars relating to the associated operating companies. The dividends, &c., of the various companies have already been announced.

	1920	+ or −
Total passengers carried	1,486,588,772	+110,243,599
Total car and omnibus miles ...	178,735,418	+ 19,208,525
	£	£
Gross earnings of the Railway, Tramway, and Omnibus Companies associated with the undertaking	14,844,707	+ 2,440,077
Expenses, including interest, rentals and other fixed charges and reserves for contingencies and renewals	14,131,370	+ 2,524,933
	713,337	− 84,856
Balances brought forward from last year's accounts	138,518	− 13,052
Balance, being amount available for Dividends and Further Reserves	£851,855	− 97,908

The report states that delivery of the 140 additional cars which were ordered last year by the Metropolitan District and the London Electric Railway Companies has been commenced, and the cars are being put into service. Seventy out of the 72 cars constituting the London Electric and London and North-Western Railway Companies' joint rolling stock for the service to Watford have also been delivered and are being put into service. The electrification of the Ealing and Shepherd's Bush line of the Great Western Railway was completed during the year, and the trains of the Central London Railway commenced running into Ealing Broadway on August 3rd, 1920. The Metropolitan Electric and London United Tramway Companies have reconstructed further portions of their permanent way, and the former company has established additional through running over the tramways of the London County Council to Liverpool Street and Bloomsbury.

The company's issue of 5 per cent. three year secured notes matured during the year. A new issue of £700,000 6 per cent. three year secured notes, was made on March 20th, 1920, and the maturing notes were paid off accordingly. Referring to the increased fares introduced during the year, the report says that the effects of the increases, and of the cancellation on the date on which they were put into operation of the financial arrangements which had existed between the Government and the Metropolitan District Railway Co. during the war, were felt only during the last three months of the year under review, whilst increased working expenses prevailed throughout the year. The directors of the operating companies report that further experience of the result of the new fares is necessary before it will be possible to say definitely whether they will be sufficient to provide for working expenses, efficiently maintaining and renewing the various undertakings, and a reasonable return on the capital of the companies, but that, so far, the results are up to their expectations. Some of the operating companies require additional capital for improvements and additions, and the improved financial position which it is hoped will result from the new fares should make it possible for them to raise the money required for these purposes when a favourable opportunity occurs. To ensure the better working of the undertakings, the directors of the operating companies have completed and brought into being a scheme of reorganisation of the administrative staff. Under this scheme Mr. H. E. Blain, C.B.E., and Mr. Frank Pick have been appointed assistant managing directors to the several operating companies, and Mr. Z. E. Knapp has been appointed director of construction to the four railway companies. These gentlemen have for a number of years been associated with the management of these undertakings. Various consequential changes have been effected, all of which will be to the advantage of the companies concerned, and should result in the more successful operation of the several undertakings.

North London Railway Co. The Hon. A. H. Holland-Hibbert presided at the meeting of the North London Railway Co. on February 14th. In moving the adoption of the report and accounts, he said that the line had held its own, despite competition. They had carried 5,000,000 more passengers, and as a result of increased fares and more passengers they had taken £61,500 more money. That was most encouraging when they compared the position with the black years from 1902 to 1908, when they were faced with a daily falling off in traffic. In a great measure the change was due to the electrifying of the line, which provided a quicker and more attractive service. They were able to declare the same total dividend as last year, were putting £10,000 to the general reserve, bringing that up to £155,000, and were carrying forward £14,500, as compared with £13,000. With regard to the future, anyone who had been misguided enough to think that when Government control was over the path of the railways would be smooth had been rudely undeceived.—*Financial Times.*

Northampton Electric Light and Power Co., Ltd. At the annual meeting, Mr. F. H. Thornton, who presided, said that the working of the new generating station in the first complete financial year had resulted in a saving of no less than 10,700 tons of coal, as compared with the old generating station. In view of the demand for electricity, particularly when they were able to extend to Wellingborough and Rushden, they had decided that it would be necessary to double the capacity of the Hardingstone generating station. The revenue from the sale of energy had increased by £22,171, partly due to a 16 per cent. increase in supplies and partly to the increase in tariff. Referring to the proposed extensions to Wellingborough and Rushden, Mr. Thornton said that in February last, at the suggestion of the Electricity Commissioners, they reopened the original application for powers to supply in Wellingborough and Rushden under the Electric Lighting Act, and they arranged for a meeting between the representatives of the company and those of the Northamptonshire County Council in London in May last, at which both sides were heard, but owing to the continued and persistent opposition of the County Council, when the Commissioners gave their decision later in the year, it was to the effect that it would be necessary for the company to make a fresh application under the new Electricity (Supply) Act, 1919, which gave the Commissioners much greater power to deal with cases of this kind. The application was now proceeding, but it was a much more lengthy process than under the 1909 Act.

Charing Cross, West End and City Electricity Supply Co., Ltd. The report for 1920 shows that the gross earnings of the West End undertakings were £311,045, against £265,856 in 1919, and the expenses, excluding depreciation, were £208,214, against £167,242. The net earnings were £102,830, against £98,614. Including £8,002 brought forward and interest accrued for 1920 £6,387, the total available is £117,220. Debenture interest requires £17,829; to depreciation £22,000; preference dividend £18,000; 8 per cent. on the ordinary shares £32,000; to general reserve (income) account £15,000; carried forward £12,391. Connections to West End mains equivalent of 823,251 (30 watt) lamps (lighting 479,612, heating 94,786, motive power 248,853 (10,007 h.p.).

The gross earnings of the City undertaking were £418,746, against £331,323 for 1919; expenses £355,062, against £273,722; net earnings £63,685, against £57,601. Including £7,218 brought forward there is £70,902 available. Interest on debenture stock, 6½ per cent. five-year secured notes, loans, and advances £38,411; preference dividend £18,000; £10,000 to general reserve; £4,491 carried forward. Connections to City mains equivalent of 913,259 (30 watt) lamps (lighting 347,156, heating 151,003; motive power 413,100 (16,693 h.p.)).

The directors in the early part of the year 1920 decided to carry out certain alterations and improvements at the Bow Station, and for this purpose issued £250,000—6½ per cent. notes, repayable in five years, upon reasonably satisfactory terms. These notes were secured by the issue to the trustees for the note-holders of debenture stocks of the two undertakings. The issue of these debenture stocks has made it advisable to ask the company for further borrowing powers. The new Electricity (Supply) (No. 2) Bill appears to need amendment in certain particulars in the interests of existing undertakers.

The Electricity Commissioners, acting under the Electricity (Supply) Act, 1919, have provisionally determined a London District, and have asked for schemes for the establishment of an Electricity Authority for the district.

The leading London companies, acting in association with the London County Council and the Conference of Local Authorities, have in preparation a technical scheme which they hope to submit for consideration by the Commissioners.

The extremely important administrative and financial conditions which should govern the creation and powers of a Joint Electricity Authority are at present having the careful consideration of the companies in view especially of the necessity of safeguarding the interests of their shareholders.

It is hoped that the scheme ultimately put forward will be such as to secure the best use of existing resources and experience, with the object of producing and selling electricity as widely and as cheaply as possible.

West End: Units generated, 1,469,611; bought, 18,235,363. Total sold, 14,563,403.

City: Units generated, 46,501,930; sold, 38,357,680.

Meeting: March 10th.

Liverpool Overhead Railway Co.

At the annual meeting, held on February 22nd, Mr. H. C. Woodward, who presided, said that Government control of the railway, unless Parliament decided otherwise, would expire on August 15th next. The passengers carried during 1920 totalled 21,020,839, a decrease of 1,419,264. Part of the decrease in traffic was doubtless due to the increase in fares, and it was also due to the depression in trade and to the shipwrights' strike, which caused many ships to be diverted to other ports for repairs and reconditioning. The depression still existed, and with much shipping unemployed, the traffic on the overhead railway still declined. The renewal funds now amounted to £66,597, against £66,236. The reason for so small a net increase was that 11,145 yards of new rails had been laid during the past year, and the cost of the new rails, as in previous years, had been charged to that fund. The necessity for a slight reduction in the dividend was brought about by the high cost of rails and other materials, and it was imperative in the future interests of the company to keep up the renewal fund. The accounts showed an increase in the expenditure on the railway and tramway of £56,880, which was due to the much higher cost of coal and stores, and the enhanced wages of the employés. So long as Government control existed they were guaranteed the same net income as in 1913, and therefore felt entitled to distribute the same dividends as in that year. But they were given to understand that from August 15th next the Government proposed to relinquish their grasp, or at all events to effect some new arrangements as to grouping adjacent lines, although they had no details nor ideas as to how it might affect their company. It was useless to attempt to prophesy, but he thought it right to point out to the shareholders that such a change amounted to a crisis in their affairs, and that unless they could make a very satisfactory settlement with the Government or some other powerful body, they could not guarantee future dividends even on the recent modest scale. They had all noticed the keen criticism of the excess profits duty, yet there was at the same time in some newspapers a suggestion that the railways made too good a bargain with the Government on the outbreak of the war; these critics appeared to ignore the fact that, instead of taking 40, 60, or 80 per cent. of the excess receipts of railways during the war, and subsequently, the Government took the whole of the excess, and that, while they invited the railways to increase their fares, they, at the same time, increased their wages bills fourfold. The extra receipts during the war would have created reserves to meet betterments, then impossible to effect, owing to the scarcity of labour and material, but now badly needed by every railway in the Kingdom. At the same time, he did not want to appear too pessimistic as regarded their own railway. It was now such an integral and necessary part of the dock traffic arrangements that he felt some plans must be devised to ensure its continuance, and, he hoped, its ultimate prosperity.

South Metropolitan Electric Light and Power Co., Ltd.

The ordinary general meeting of the company was held on February 23rd. Mr. Henry St. John Winkworth (the chairman) said the accounts for the past year showed that substantial progress had been made. Not only had the growth of the business been well maintained, but the abnormal cost of fuel and the high rate of wages ruling had been met, with a balance on the right side. The company had difficulty at the power house during the greater part of the year, due to repair work being delayed by labour troubles, which increased the working costs. The result, however, was satisfactory. The total horse power connected at the end of the year was 30,726, as compared with 28,596 at the end of the previous year. Five hundred and thirty-nine new services, representing 56,553 35-watt lamps, were connected during the year, compared with 522 services and 59,410 lamps last year. The total number of consumers connected to the company's system at December 31st was 8,091. The number of units sold was 17,643,122, as compared with 15,642,716 in the previous year, representing an increase of just over two millions, and the average price obtained from all classes of supply increased from 2.39d. to 2.55d. per unit. Only a small addition in the price was charged to the consumer, the higher cost of production being substantially covered by the increased output and a better load factor. The business of the West Kent Co. showed a satisfactory improvement, and a dividend of 10 per cent. on the ordinary shares had been declared. A sum of £8,000 had been placed to the reserve account and £1,742 carried forward to this year. The West Kent Co. made application to the Board of Trade for its approval of the freehold site on the Lower Thames acquired for the erection of a large up-to-date power house, as referred to at the meeting in 1918. The statutory requirements were complied with, and the one and only objector satisfied. The Electricity Commissioners, to whom the application was subsequently referred, however, decided to postpone consideration until after the scheme or schemes asked for had been received. This delay was most regrettable, as it had prevented the company from concluding negotiations for important business which could only be dealt with on comprehensive lines. It was difficult to forecast the prospects of the business for the current year; much depended upon labour settling down and manufacturers finding a market for their productions. While it was probable there would be trade depression, there was reason to hope that this would be only of short duration, and that the works and factories within the company's area would soon resume their activities. A number of substantial new connections had been made during the past year, and it was anticipated that the receipts from these would enable the company to continue to make further progress during the current year.—*Financial Times.*

St. James' & Pall Mall Electric Light Co., Ltd.

The ordinary general meeting of shareholders was held on February 22nd. Mr. Walter Leaf (Chairman), who presided, said that the company's statistics showed a satisfactory growth alike in connections, which had increased by 1,002 kW, or over 5 per cent., and output, which had grown from a little over 12 million units to 13¾ millions, or nearly 11 per cent. The company had found itself able to allow an all-round discount of 5 per cent. on accounts for the first three quarters of 1920 to customers paying standard rates, which was equivalent to returning to them an amount considerably in excess of the extra dividend. Unfortunately the situation at the present moment was not so clear as could be wished, and they had found it necessary to withdraw the discount, at least for a time; they had also taken the opportunity to consolidate in a fresh tariff the various additions that had been made. The increase in charge was hardly more than nominal, and the highest price charged was still below the maximum allowed by their order. There was a large increase in the sum advanced to the Central Company. Last year it stood at £55,000; this year it was no less than £112,000. Regarding the large extensions to the Grove Road Station, there had been further serious delay in the completion of the first of the two 10,000-kW sets on order, but it was now in course of erection, and would be completed within the next few months. In consequence of this delay the available plant at Grove Road, together with the steam plant in the stations of the St. James' and Westminster Companies, was only just sufficient to meet the demand, which, however, throughout the winter was carried on without disturbance or breakdown. Good progress had been made in the manufacture of the second 10,000-kW set and the additional boilers, and this plant should be completed in time for next winter's load. The reorganisation of Carnaby Street Station had been proceeded with, but had been delayed by the non-completion of the new plant at Grove Road. Motor converting plant of the latest type, of 1,000-kW capacity, had, however, already been installed, and the remainder of the necessary machinery had been manufactured and would be brought into commission during the coming summer. There was considerable difficulty in the early part of the year in securing adequate supplies of coal, and reserve stock fell to a very low point. Arrangements were made accordingly to control a certain number of wagons for the last nine months of the year, which ensured full supplies of coal of the right quality, so that stocks were built up to a satisfactory figure and covered the shortage, due to the miners' strike, in October last, without difficulty. The policy of the Central Company had been to keep its station absolutely up to date, and for this purpose it had not hesitated to authorise these extensions alike in buildings and plant, involving from first to last a capital outlay of some £800,000. The work had been carried out with the express sanction of the Electricity Commissioners, and, though this sanction did not import any legal guarantee, it seemed virtually to indicate the intention that if, as seemed probable, the generation of electricity in London was taken over as a public service under a Joint Electricity Authority, the works which had been thus sanctioned would be fully utilised in the future supply of London.

Under these circumstances, the Board of the Central Company had no anxiety as to obtaining the full return of the capital so laid out. But the financing of the expenditure during the period of transition was a difficult problem. The board of the Central Company had decided, with the co-operation of the boards of the parent companies, to make an issue of short-term notes, which would be placed on the market as soon as the moment seemed favourable. The notes would be secured the joint and several guarantees of the parent companies, as well as by a charge on the Grove Road properties, subject to the existing mortgage, and would form a security of the highest class. The company had not the least doubt that, in a comparatively short time, it would be able to recoup itself by the increased efficiency of the new plant.—*The Times.*

London Electric Supply Corporation, Ltd. The ordinary general meeting of shareholders was held on February 21st. Mr. Robert H. Benson (chairman), in the course of his speech, said that the company was on the road to surmounting the losses of the war, and that there was a fair chance of resuming from the point where they left off at the end of 1914, subject only to political conditions, namely, a final settlement by Parliament of the future of the industry and the restoration of its credit on the basis contemplated in Clauses 1 and 13 of the latest Electricity Supply (No. 2) Bill; in other words, that producers of electrical power be authorised to borrow money and get such return for their product as would make them certain of being able to repay the money borrowed. In these clauses might be discerned the first sign of recognition of the part of the legislative mind of the rock upon which the electrical industry had come near to splitting, namely, inability to borrow money for capital purposes. An engineering scheme was being prepared by four engineers (of whom the company's managing director and chief engineer was one), representing the supply companies, the local authorities, and the London County Council. It, therefore, seemed probable that, as all three bodies were working together, a harmonious scheme, so far as engineering was concerned, would be put before the Commissioners, and this was a most important point. Besides the engineering scheme for the whole of the area of Greater London, the difficult question of administration by a Joint Electricity Authority was having the careful consideration of the directors, along with those of other supply companies.—*The Times.*

Metropolitan Electric Supply Co., Ltd. Capital expenditure increased by £72,409 during 1920. Gross revenue was £516,594, an increase of £103,535. Working expenses £318,638, an increase of £76,015. £90,000 has been put to depreciation and reserve account, which now stands at £615,000. Amount carried to net revenue account £107,956, plus amount brought forward and interest on investments, making £130,858. After paying debenture interest, and preference dividend, a total of 7 per cent. is paid on the ordinary shares, leaving £4,514 to be carried forward. New connections 3,374 kW, making 48,800 kW. Owing to the continued increase in demand, particularly in the western area of supply, contracts have been placed for an increased plant capacity at Willesden of 20,000 kW, and for trunk mains to link up with the generating station at Uxbridge, where further plant has already been installed. The Electricity Commissioners have provisionally determined a London District, and have asked for schemes for the establishment of an Electricity Authority for the district. The leading London companies, acting in association with the L.C.C. and the Conference of Local Authorities, have in preparation a technical scheme which they hope to submit for consideration by the Commissioners. The extremely important administrative and financial conditions which should govern the creation and powers of a Joint Electricity Authority are at present having the careful consideration of the companies, in view, especially, of the necessity of safeguarding the interests of their shareholders. It is hoped that the scheme ultimately put forward will be such as to secure the best use of existing resources and experience, with the object of producing and selling electricity as widely and as cheaply as possible. The death has occurred of Mr. J. Carr Saunders, who was a director for 21 years. It is not proposed to fill this vacancy at present.

Meeting: March 8th.

France.—The following companies have increased their capital: Société Electrique de Montjoie, from 310,000 to 500,000 fr.; the Station Electrique de Millery, from 2,500,000 to 5,000,000 fr.; the Electro-Entreprise, to 5,000,000 fr.; and the Société d'Etudes Techniques et d'Entreprises Industrielles, from 500,000 to 1,000,000 fr.

Bruce Peebles & Co., Ltd.—At an extraordinary meeting to-day, it is to be proposed to alter the articles to allow the new shares to be issued carrying dividend as from January 1st last, so that they may be in precisely the same position as the existing ordinary shares.

Brompton & Kensington Electricity Supply Co., Ltd.—Final dividend on the ordinary shares at the rate of 15 per cent. per annum, making 12 per cent. for the year, less tax. Forward, £1,639.

Canadian General Electric Co.—Dividends at the rate of 7 per cent. per annum on the preference stock for the half-year ending at March, and a quarterly dividend of 2 per cent. on the common stock.

Lancashire United Tramways Co.—The report shows that the receipts increased by £50,838 and the expenditure by £60,682 during 1920. Profit £50,852. After deducting interest on prior lien debenture stock and expenses, the full interest of 5 per cent., less tax, is to be paid on the second mortgage debenture stock for 1920, and £2,416 remains to be carried to depreciation.

Oxford Electric Co., Ltd.—Dividend at the rate of 5 per cent. per annum on the ordinary share capital.

The A.E.G.—The board of the Allgemeine Elektrizitäts Gesellschaft has decided, subject to the approval of a shareholders' meeting to be held on March 15th, to double the company's share capital by raising it from 300 million to 600 million marks. This is to be effected by the issue of 50 million marks in ordinary shares and 250 million marks in preference shares. Out of the 50 millions in ordinary shares 30 millions will be devoted to carrying through the fusion of interests with the Linke-Hoffmann-Werke Aktiengesellschaft, and the directors state that the sum represented by the preference shares is required for the purpose of covering necessities arising out of the Linke-Hoffmann transaction, and of increasing the working capital, especially with a view to improving the company's foreign business. The new preference shares will bear a 5 per cent. cumulative dividend, together with a supplementary dividend of ⅜ per cent. for every 1 per cent. dividend over 10 per cent. paid on the ordinary shares. They will be redeemable by the company at any time after 1924 at the rate of 115 per cent.—*Reuter's Trade Service* (Berlin, February 22nd).

Companies to be Struck off the Register.—The following are to be struck off the register within three months unless cause is shown to the contrary:—

Bourne End Electric Installation Co., Ltd.
Cold Light (Dussaud Processes), Ltd.
Indian Railless Traction, Ltd.
International Electric Railways & Water Power Syndicate, Ltd.
International Rotary Motors, Ltd.
Northern Power Syndicate.
Premier Electric & Hardware Co., Ltd.

The Swedish Allmanna Co.—The net profits of the Allmänna Svenska Elektriska A.B. for 1920 amount to 4,000,000 kr., and the surplus available for disposal, including the balance forward, reaches 4,837,000 kr., permitting of the payment of a dividend at the rate of 6 per cent. In 1919, when the net profits were 8,029,000 kr. and the total surplus 8,313,000 kr., the directors recommended a dividend at the rate of 10 per cent., but at the general meeting the rate was increased to 12 per cent. by the appropriation of 1,500,000 kr. from the profits equalisation fund.

Newcastle and District Electric Lighting Co., Ltd.—Net profit for 1920, after charging interest on debentures and loans, &c., allowing £16,000 for depreciation, putting £16,000 to general reserve, is £11,104, plus £13,263 brought forward. A dividend at the rate of 5 per cent. (less income tax) requires £10,412, and £13,955 is to be carried forward. Second mortgage debentures amounting to £5,160 redeemed during the year. Many new consumers have been connected and considerable extensions to existing installations made. £23,065 was expended on capital account during the year.

Bournemouth & Poole Electricity Supply Co., Ltd.—Capital expended during 1920 £31,514. Total amount available, including £4,628 brought forward, £47,104. Debenture and loan interest £9,659; other interest £2,396; written off preliminary expenses £500; to reserve for depreciation £12,000. Preference dividends 4½ per cent. and 6 per cent.; ordinary dividend 6 per cent. for the year, less tax. £6,536 carried forward. Lord Erskine has been appointed a director in place of the late Mr. F. E. Savory. Total applications during 1920 16,233 kW, an increase of 1,942 kW. Units sold 6,198,302.

River Plate Electricity Co.—According to the "Financial Times," the 122,440 ordinary shares of £1 each which were issued to the shareholders in May last have now been converted into ordinary stock, ranking for dividend as from January 1st, 1920, and in all other respects *pari passu* with the existing ordinary stock. The greater part of the company's claim against the German Transoceanic Electric Co. (of Berlin) for arrears of interest and amortisation on the 5 per cent. obligations of that company was received through the Clearing House for Enemy Debts on February 16th.

Rushden & District Supply Co., Ltd.—At the annual meeting, Mr. Thornton said it was hoped shortly to obtain a bulk supply from the Northampton Co., and it would undoubtedly be the most satisfactory way of supplying the demands in the Rushden area for power and light. To generate it themselves would only involve charging a higher rate to the public. The company was anxious to carry the supply to Irthlingborough at the earliest possible moment.

Mackay Companies.—Income from investments for year to February 1st, 1921, $4,868,988; dividends absorbed, $4,230,336; operating expense, including Federal income-tax, transfer agents, registrars, auditors' and trustees' compensation, office rent, salaries, stationery, engraving of certificates, &c., $535,400; carrying forward $103,251.—*Financial Times.*

Stock Exchange Notices.—The Committee has ordered the undermentioned to be officially quoted:—

American Telephone & Telegraph Co.—$61,248,500 capital stock.
River Plate Electricity Co.—£122,440 ordinary stock.

Shanghai Electric Construction Co.—The directors propose to capitalise £80,000 of the reserve account, and to distribute that sum among the shareholders in the form of £10 shares in proportion to their holdings or one share for each four held. The capital is now £320,000, in £10 shares, and the proposed issue will bring it up to £400,000.—*Financial Times.*

Northallerton Electric Light & Power Co., Ltd.—At the annual meeting on February 23rd, the report adopted showed a net profit of £714, against £460 in 1919. Dividend 5 per cent. on the preference shares, and 1s. per ordinary share, both less tax.

National Electric Supply Co., Ltd.—Dividend on the ordinary shares 6s. 6d., making 9s. per share for the year. £5,000 to depreciation reserve, £3,000 to reserve, and £1,367 carried forward.

STOCKS AND SHARES.

TUESDAY EVENING.

ONE week is very like another in the Stock Exchange these times. Excitement has died down. The speculative spirit is profoundly dormant, if not entirely dead. There is still a good deal of money available; money which goes principally into the War Loan and other gilt-edged securities when it comes to the Stock Exchange at all. Nevertheless, industrials of the better sort command a certain amount of interest. Our lists during the past fortnight have shown a revival of demand for electricity supply shares, due to the manner in which dividends are being increased, and further improvements occur in the current list. Jobbers in the market find that brokers are beginning to ask what electricity supply shares are available. The report of the Metropolitan Electric Company is well worth reading, if only from its allusions to the matter of the Electricity Authority which is to be set up in London. As against the improvements in supply shares, further falls have occurred in certain of the manufacturing companies' issues. Optimists argue that E.P.D., now that there is the certainty of the tax coming off before long, constitutes a valuable reserve of the "secret" order, but this is not much immediate consolation to people who want dividends and who see the prospect of such payments being removed out of their reach by crushing taxation, coupled with the slump in trade.

The principal feature in the financial world is the way in which Home Railway stocks have been slumping by reason of the fears that, upon the companies being handed back to their owners next August, the former will not be able to maintain their existing rate of dividends. It was hinted plainly enough at some of the recent meetings that the railways might not even be able to meet their fixed charges. There is an enormous body of railway proprietary throughout the country, composed of classes of people mainly inarticulate. Two associations exist for the protection of railway stockholders' interests, and one of them, the Scottish group, develops a good deal of energy. But the English association cannot be described as a power in the land, although at the present time efforts are being made, partly through its agency, to awaken the country to a sense of the unfair treatment which apparently railway stockholders are to suffer. The Undergrounds are not nearly so much affected as the steam lines, but their prior-charge stocks have fallen considerably with the rest, and it is interesting to observe what yield is offered by the leading stocks at to-day's prices:—

DEBENTURE STOCKS.

	Price.	Yield. £ s. d.
Cent. Lon. 4 %	57½	6 19 2
City and S.L. 4 % ..	52½	7 12 5
Met. 3½ %	53½	6 10 10
District 6 %	81½	7 7 8
do. 4 % p.l. ..	57½	6 19 2
do. 4 %	53½	7 9 7

PREFERENCE STOCKS.

	Price.	Yield. £ s. d.
Cent. Lon. 4½ % ..	58½	7 13 10
City & S.L. 5 % 1891	54½	9 8 6
Lon. Elec. 4 % ..	47	8 11 2
Met. 4 % ..	41½	8 8 8
District 4½ % ..	42	9 7 6

The District preference depends for its dividends upon the income each half-year. Amongst Underground Electric Railway's stocks, the 4½ per cent. bonds of 1933 stand at 90, paying 5 per cent. on the money, while the 6 per cent. first cumulative income debenture stock is quoted 75½. All these debenture and preference issues were recently ex dividend.

The list of home electricity supply shares makes pleasant reading this week. Pleasanter, indeed, than has been the case for a long time past. The market is one of the very few in the Stock Exchange where firmness is exhibited. Advances have occurred in City of London, County ordinary and preference, Kensingtons, Metropolitans and South Metropolitan preference, while several prices are ex dividend without showing any quotable alterations on account of the deductions.

We understand that in certain cases some of the companies are about to arm themselves with power to issue more capital, and it would not be surprising if, within the space of the next few weeks, some of the important concerns appeared in the market asking for more money. In spite of the badness of the times, newcomers make their appeals with persistency, and this week the Armstrong-Whitworth company, amongst others, is about to offer fresh shares. These will be 3½ million 9 per cent. second preference shares at the par price of 20s. Armament shares, incidentally, are heavy, owing to the unexpected jump which has just been announced in the price of coal. Although this may not affect the price of fuel for manufacturing purposes, the step has certainly aroused fresh uneasiness in the minds of shareholders in such concerns.

Manufacturing descriptions are mostly dull. Babcock & Wilcox gave way to 2⅛. Electric Constructions are down to 15s. 9d., Henley's eased off to 1⅜. Nor are other prices so firm as they look in every case. There is no little apprehension felt with regard to maintenance of dividends even by the first-class companies. Brush ordinary shares have fallen to 12s. 6d., Metropolitan-Vickers ordinary gave way to 17s., and the 4 per cent. debentures to 50½.

Marconi's flattened out to 1⅝, a fall of 5s. on the week. Marconi Marines at 1 1/16 and Marconi preference at 33s. 9d. are both easier. Otherwise the cable group is firm, with rises of 5s. each in Eastern Extensions and Globe ordinary, taking the prices to 15⅞. Eastern ordinary hardened to 161½, and in Anglo-Americans there is no change.

The foreign group is inclined to give way, Brazil Tractions going back to 37½ and Mexico Tramway 5 per cent. bonds to 39, the latter being 1½ down. British Columbia stocks are left as they were. Rubber shares are depressed, in consequence of the raw material showing no indication of improvement. Stock Exchange markets lack encouragement from buyers. Nothing can better illustrate the present state of affairs than mention of the fact that this time a year ago a nomination to Stock Exchange membership cost £650, whereas to-day it is possible to buy a nomination for £50, or less.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend 1919.	Dividend 1920.	Price March 1, 1921.	Rise or fall.	Yield p.c.
Brompton Ordinary	12	12	6⅜	+ ⅛	£9 16 0
Charing Cross Ordinary	7	8	3⅞	— ⅛	10 6 6
do. do. do. 4½ Pref. ..	4½	4½	2⅝	—	8 8 8
Chelsea	4	6	3⅛	—	9 10 6
City of London	13	14	25/-	+9d.	11 4 0
do. do. 6 per cent. Pref. ..	6	6	17/6	—	6 17 2
County of London	8	8	7⅝	+ ⅛	10 9 10
do. do. 6 per cent. Pref.	6	6	8¼	+ ⅛	7 5 6
Kensington Ordinary	7	9	4	+ ⅛	11 6 0
London Electric	2½	1½	¾xd	+ 1/16	10 0 0
do. do. 6 per cent. Pref. ..	6	6	2¾xd	+ ⅛	10 18 2
Metropolitan	6	7	3¼	+ ⅛	10 15 4
do. 4½ per cent. Pref. ..	4½	4½	2 9/16	—	8 15 8
St. James' and Pall Mall	12	12	6xd	—	10 0 0
South London	6	—	3⅜	—	9 2 10
South Metropolitan Pref.	7	7	15/9	+ 2/-	8 17 10
Westminster Ordinary	10	10	5xd	—	10 0 0

TELEGRAPHS AND TELEPHONES.

	1918	1919			
Anglo-Am. Tel. Pref.	6	6	80½	—	7 9 1
do. Def.	38/6	1⅛	16¼	—	8 6 6
Chile Telephone	8	6	5⅝	—	*5 6 8
Cuba Sub. Ord.	7	7	6½	—	*10 15 4
Eastern Extension	10	10	15⅞	+ ¼	6 6 0
Eastern Tel. Ord.	8	10	161½	+1	6 3 10
Globe Tel. and T. Ord.	6	10	15⅞	+ ¼	6 6 0
do. do. Pref.	6	6	9	—	6 13 4
Great Northern Tel.	22	22	21¾	—	10 2 4
Indo-European	18	10	80	—	[illegible]
Marconi	25	25	1⅝	— ¼	—
Oriental Telephone Ord.	10	12	2 3/16	—	*5 9 7
United R. Plate Tel.	8	8	6¼	—	*6 8 0
West India and Panama	1/8	Nil	1/16	—	Nil
Western Telegraph	8	10	16⅛	—	*6 5 0

HOME RAILS.

	1919	1920			
Central London Ord. Assented ..	4	4	43¼xd	+1½	9 4 8
Metropolitan	1½	1½	20xd	+ ½	7 10 0
do. District	Nil	Nil	13½	—1⅛	Nil
Underground Electric Ordinary	Nil	Nil	1¼	— ⅛	Nil
do. do. "A" ..	Nil	Nil	5/6	—	Nil
do. do. Income ..	4	2	67½xd	—	2 19 3

FOREIGN TRAMS, &c.

	1918	1919			
Anglo-Arg. Trams, First Pref. ..	Nil	5½	2⅝	—	10 9 6
do. do. 2nd Pref. ..	Nil	Nil	8⅛	—	Nil
do. do. 5 % Deb. ..	5	5	60½	—	8 5 0
Brazil Tractions	Nil	Nil	37½	— ½	Nil
British Columbia Elec. Rly. Pfce.	5	5	56	—	8 18 6
do. do. Preferred	2½	5	58½	—	*8 18 0
do. do. Deferred	Nil	8	48½	—	*12 17
do. do. Deb. ..	4½	4½	57½	—	7 10
Mexico Trams 5 per cent. Bonds ..	Nil	Nil	39	- 1½	Nil
do. 6 per cent. Bonds ..	Nil	Nil	24½	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	18	—	Nil
do. 1st Bonds	Nil	Nil	68½	—	Nil

MANUFACTURING COMPANIES.

Babcock & Wilcox	15	15	2⅛	— ⅛	7 1 2
British Aluminium Ord.	10	10	17/-	—	11 15 4
British Insulated Ord.	12½	15	1⅝	—	9 5 10
Callenders	25	15	1⅜	—	10 18 2
" 6½ Pref.	6½	6½	17/6	—	7 8 7
Castner Kellner	20	17	2¼	—	7 12 9
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	10	10/-	—	—
do. do. 5 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	15/9	- 6d.	12 14 0
English Electric	—	8	13/-	—	10 19 2
Do. Pref.	—	6	13/6	- 6d.	8 17 10
Gen. Elec. Pref.	6½	6½	18/6	—	7 2 6
do. Ord.	10	10	1 3/16	—	*8 8 6
Henley	25	15	1⅜	— 1/16	10 18 2
do. 4½ Pref.	4½	4½	3¼xd	—	6 18 6
India-Rubber	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	1 3/16	—	6 16 4
Siemens Ord.	10	10	3 3/16	—	*10 6 2
Telegraph Con.	20	20	21½	—	*5 11 3

* Dividends paid free of Income Tax.

THE BRITISH INDUSTRIES FAIR.

(*Concluded from page* 232.)

BIRMINGHAM SECTION.

It is difficult at this stage of the Fair to express an opinion as to its success from the exhibitors' point of view. As an exhibition the Birmingham Section leaves very little to be desired; the wares are tastefully displayed, the method of numbering the stands ensures that none is overlooked, and as far as possible the various classes of goods have been grouped to facilitate the buyer's work. The first two days of the Fair witnessed a great influx of sightseers, the buyers apparently having decided to visit the London Section first. Later, however, business commenced to improve, and by the end of the first week affairs assumed a more satisfactory appearance.

On Wednesday, February 23rd, Mr. F. G. Kellaway, M.P., paid a visit to this section, and is reported to have said that in London they had no idea of the representative character of the Birmingham Section of the Fair. This seems to bear out the statement of the publicity manager that an impression has gained ground that the London Section is the whole of the Fair, whereas the truth is that the *staple* industries of the country are displayed at Birmingham. Mr. Kellaway was impressed particularly with the excellent quality of the goods displayed, and also with the general air of optimism which seemed to prevail.

Sir James Allen, High Commissioner for New Zealand, visited the Fair on Thursday, February 24th, and stated that he intended to send a report to the Antipodes upon what he had seen. Among the merchants of New Zealand it was taken for granted that if quality was required the Mother Country was to be relied upon, and the exhibition proved to him (Sir James) that they were not in error.

A description of some of the exhibits follows:—

The General Electric Co., Ltd., have on their stand a representative show of their lighting fittings and accessories, domestic appliances, telephones, bells, &c. A number of motor-starting panels and drum controllers also appear. Among a series of commercial type ironclad gear is a 400-A, 600-V, double-pole switch and fuse set of very robust proportions. A range of "Witton Kramer" portable drills and grinders is shown, as well as a "C.M.I." quick-break magneto which gives a strong spark at any engine speed. The recently-introduced "Klersite" system for lighting commercial motors is on view. This consists of a series-wound dynamo fitted with a special patent pulley, which, through the action of a slipping clutch, maintains the dynamo speed constant, irrespective of the speed of the engine. The dynamo is running at all times when the engine is working, but if the lamps are switched off it is not excited, and so there is no electrical loss. The full pressure of 6 volts is obtained when the engine is running at 350 r.p.m. As the engine speed increases the clutch allows a certain amount of slip, keeping the dynamo speed constant. This fact is demonstrated on the stand by a "Klersite" magneto driven by a motor and connected to a speedometer and voltmeter. It is shown that the voltage is maintained at its proper level when the motor is running as fast as 1,150 r.p.m. The whole mechanism runs in oil. The magneto is illustrated in fig. 1. Photographs of installations carried out by the G.E. Co. form another feature of this exhibit.

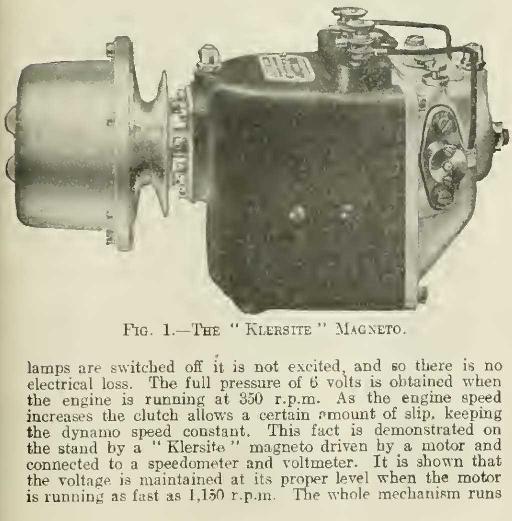


Fig. 1.—The "Klersite" Magneto.

Messrs. J. H. Tucker & Co., Ltd., are showing a very comprehensive range of their products. A complete accumulator switchboard is shown; this is suitable for employment with batteries and lighting sets for country houses, &c. Switches and fuses of various designs with capacities ranging from 15 to 1,000 amps. are also exhibited. These include single, double, and triple-pole, single-throw and change-over types, tandem and parallel-coupled, shunt regulating switches, voltmeter switches, battery regulating switches, automatic battery switches, &c. Fuse and distributing boards for lighting and power installations in teak and iron cases are another feature of the exhibit; the wood cases are made in the firm's own cabinet shops. Among the ironclad switch and fuse gear appears the "Tucker" patent quick "make" and "break" switch in two sizes, 25 and 50A. The design of the case of this switch permits of its being used with either a large central tapped hole at each end for the cables or two smaller holes. This is effected by means of interchangeable adaptors, which can also be provided with recessed bodies and wood bushed holes and with watertight glands. In addition to these switches there is a number of ironclad single and double-pole and multi-way fuses varying in capacity from 15 to 100 A. for voltages up to 500. All types of tumbler switches are shown, including double-pole, ceiling and watertight switches, fitted with plain or ornamental covers, china and locked covers. Another feature is a flat switch of ordinary appearance, in which a quick "make" and "break" action is obtained. Included in the lighting and power accessories section the firm shows samples of lampholders, counterweights, ceiling roses, wall sockets, porcelain connectors, cut-outs, adaptors, bell pushes, &c. One or two samples are shown of a new type of tumbler switch and plug combination shortly to be placed upon the market. If the switch is in the "on" position, the plug cannot be driven home, while if once fixed the removal of the plug brings the switch to the "off" position. A great deal of artistic metal work in the form of wall plates and switch covers is also exhibited. Photographs of the works appear on the stand as well as views of special orders carried out by the firm.

Fuller's United Electric Works, Ltd., are exhibiting representative selections from their products, including plate and block type accumulators suitable for electric lighting installations and similar purposes. The plate type cells are constructed with hanging type semi-planté plates consisting of pure lead grids pasted with specially hardened active material in glass containers. The negative plates are of the lattice type, pasted under pressure, a method which ensures high and constant capacity. The block type cell is immune from the inherent weaknesses of the plate type, and is fitted with non-corrosive terminals and insulators. A complete electric miner's lamp equipment is exhibited. This consists of a charging rack and lampstand, each accommodating 160 lamps, an opening magnet and a pedal switch. The Fuller miner's lamp gives a light of high candle-power, weighs only 5 lb. 2 oz., and a charge lasts for at least 20 hours. The lamp is switched on and off by turning the top; it can be supplied with either magnetic or lead lock. Other exhibits are dry and inert cells, carbons for arc lamps, ebonite rods, sheets, tubes and mouldings, and rubber and bitumen insulated cables.

Messrs. W. Canning & Co., Ltd., have a comprehensive range of machines, plant and material for electro-plating, polishing, bronzing, lacquering and enamelling. Among the exhibits are low-voltage dynamos and motor generators, plating vats and barrels, and metal salts. Belt-driven polishing lathes and polishing motors, grinding machines, lapping lathes, &c., are shown.

Messrs. Donovan & Co. display a large selection of their well-known "Safuse" and "Donlok" gear, comprising distribution boards and switchgear for lighting and power purposes. The contacts of the "Safuse" unit are protected by an insulating shield, the blades passing through a narrow slot. This renders it impossible to touch the "live" parts accidentally. The fuses are "staggered" to permit of easy wiring, and ample space is allowed for wires at the back of the box. Factory and domestic electrical apparatus is also on view, as well as lamps, bells, and other accessories.

Messrs. Siemens Bros. & Co., Ltd., have as their main attraction a 30-line "Autophone" board, by means of which various stands are kept in communication with one another. The "Stannos" wiring system is shown, as well as a number of cable sections of the firm's manufacture. Ebonite rods and moulded parts for magnetos, telephones, and other electrical apparatus form another feature of the stand. Part of the stand is devoted to Siemens's signalling apparatus for use in mines. This equipment provides for signals, which are sent from the pit bottom, being received on bells both at the pit top and in the engine room. In addition, the signals are indicated visually on a dial indicator in the engine room. Provision is made also for signalling from the pit bank to the pit bottom by means of a push switch and a bell. Signals sent from either the pit bank or the bottom are indicated on a dial in the engine room. The apparatus may be adapted to more complicated situations, and the dial indicators may be fitted to existing bell circuits. Messrs. Siemens are also showing samples of their dry and inert cells and a dry battery cycle-lighting set.

Berry's Electric, Ltd., have, in addition to several "Magicoal" fires, a very good display of switchgear, both of the open and flame-proof ironclad types. An "Ironsafe" switchboard is displayed prominently. The example shown is a d.c., 3-wire, board, with an ample bus-bar chamber, in which everything is accessible from the front. This type of gear is easily extended and very safe, the bus-bar chamber being locked by a bar and padlock device. The "Adanac" switches shown, which are simple but strong in construction, were manufactured for the Canadian market, and were used for two years prior to their becoming known in this country, the whole output being absorbed by the Dominion. The "Firadanac" is an adaptation of this type constructed entirely of iron, copper, and mica; it is flame- and explosion-proof. One or two examples are being shown of a new "Midget" d.p. switch or switch-fuse, which is a triumph of strong construction at a low price. Among the smaller exhibits is the "Asku" shade tilter, a simple device for fixing a lamp shade in any desired position. "Xcel" domestic products are in evidence, there being a number of cookers, irons, kettles, &c., on view. Messrs. Berry's are agents for Messrs. Nalder Bros. & Thompson, and a variety of the latter firm's instruments occupy one side of the stand. These include voltmeters, ammeters, power factor meters, wattmeters, reverse power relays, &c.

Messrs. Simplex Conduits, Ltd., show samples of their "household word" conduit and the new "Diaduct" distribution board, which is fitted with a removable trough which can be drilled to suit the purpose for which the box is to be employed. Every part is made to gauge, assuring interchangability. The bus-bars are of heavy section, high conductivity copper and provided with heavy cable sockets. A colliery lighting box is also shown. This can be adapted for any arrangement of cables and to any type of light, *i.e.*, well-glass, bulkhead, &c. The cables are taken through a brass cone and the armouring is clamped by a malleable iron grip. The interior can be removed entirely for wiring and re-inserted in the box. A watertight tumbler switch exhibited has the actuating knob out of centre, giving a smoother action and a larger break. In addition to these there are lighting fittings, ships' fittings, illuminated signs, domestic appliances, including "Plexsim" vacuum cleaners, irons, kettles, bowl-fires, &c.

The Vincent Switchgear Manufacturing Co. have a small but effective display of ironclad switches and fuse gear fitted with cartridge and Vincent patent replacement fuses. In addition to these, unmounted fuse elements are shown as well as ironclad distribution boards. A number of "B.K.B." motors, ranging from 1/100 to 2 h.p., appear on the stand.

The Excelsior Shade Manufacturing Co. have a brilliant and many-coloured show of shades of all kinds for gas and electric lights. There are also other lighting fittings, pendants, &c.

Messrs. David Shanks & Co., Ltd., also exhibit artistic shades and bowl fittings. A number of examples of Crooke's "daylight" glassware are shown.

Messrs. F. & C. Osler, Ltd., and Messrs. Faraday and Son, Ltd., have an imposing array of alabaster bowls, art shades, art metal wall brackets, pendants, and standards. Candelabra fittings and wall plates are also exhibited.

Electrical Conduits, Ltd., show a number of tubes and fittings for the protection of electrical circuits in buildings and ships; both screwed and slip type conduit are shown. Interchangeable and standard switch boxes and junction boxes, plain and mounted, appear on the stand.

Messrs. C. H. Parsons, Ltd., are displaying a number of their tumbler switches and lampholders in various styles and finishes in which they specialise. Examples of their "Britmac" switches are also on view. The main feature of these switches is the rigid insulating bar upon which the contact blades are mounted.

Messrs. Pinchin, Johnson, Ltd., exhibit a number of samples of "Formite," a synthetic resin, which possesses high insulating properties and is non-inflammable. The material is easy to turn and drill, and is acid-resisting. Compressed paper insulation and impregnated silk and cotton materials are also displayed.

Messrs. Best & Lloyd show ceiling fittings of all types, including alabaster and clear glass bowls, shades, and lanterns. There are also electric candle lamps and fires displayed.

The Etna Lighting & Heating Co., Ltd., show all kinds of lighting accessories, including wall and ceiling fittings, bowl fittings, &c. A number of soldering irons and flat irons are also displayed.

The Telephone Manufacturing Co., Ltd., have a number of automatic intercommunicating telephone sets for offices, factories, and ships. Many are fitted with secrecy keys to eliminate overhearing and interruption. A large display of accessories such as bells, terminal and junction boxes, also appears. The sets shown have a maximum number of connections up to 50, but additional lines can be provided for one-way communication. Decorative styles of metrphone sets form another feature of the stand. In addition to the foregoing several types of indicators are shown.

Messrs. Gent & Co., Ltd., show their well-known "Pulsynetic" time standardising system in various forms. A marine transmitter is exhibited which, by a simple movement, will advance or retard the whole of a ship's clocks to meet the changes due to longitude. Another exhibit is a waiting train movement for a turret clock. In this the master clock is situated in a convenient position to control the gear mounted in the top of a tower. If the hands of any of the dials are retarded by snow or other obstruction the waiting train receives an impulse which carries it forward. A water level indicator and recorder similar to a set supplied to the Lincoln Corporation is shown. In addition to these, a wireless time-receiving set is shown in operation. This set is supplied with the "Pulsynetic" system if desired. The Parsons-Sloper secret telephone system is also given space on the stand as well as a "tell-tale" indicator for checking the movements of watchmen, &c.

Messrs. Balmford & Salt represent a number of firms and show the British "R.B." electric lighting plant. This is in operation supplying light to a number of points on the stand. Although of only .75 kW capacity, the set supplies a battery capable of running 15 lights for ten hours on one charge. The switchboard and starting gear are mounted on the set, and the method of starting up is simplicity itself. The set is provided with an automatic cut-out which operates when the battery has received its full charge, shutting the engine down. The plant occupies an extremely small space. On this stand is also shown the Tofield & Robinson "Triple-Auto" D.C. circuit breaker, a solenoid-operated device which automatically resets when the cause of an overload is removed. In this circuit breaker there are very few working parts and, therefore, little to get out of order. The apparatus is made in all sizes up to 50 A capacity. The "Scot" lampholder is exhibited; this has a one-piece casing and a simple method of fixing the shade. An "Imperial" electric toaster, complete with "flex" and adaptor, is also shown. The "V.C." lighting system for "Ford" cars which is exhibited consists of a small rectifier or converter, driven from the fan shaft, which converts the alternating current from the magneto to d.c. for charging a 10-volt accumulator with a capacity of 15 Ah. The rectifier consists of a metal case carrying a commutator switch and a slip ring. The switch is driven at twice the engine speed, and is built up of sixteen copper bars with mica insulation in between. Eight of these bars are active, while the remainder act as spacers. Alternate "live" bars are connected to a slip ring, which is in turn connected to the magneto. The other "live" bars are connected to an earthed ring. There are five brushes, one of which is in contact with the slip ring, the others being arranged in two pairs for taking up the rectified current, so that when one pair is upon the slip ring bars the other pair is earthed. An automatic mercury cut-out switches the accumulator in when the engine is started, and cuts it out when the engine stops.

The B.E. Co. (of London and Birmingham), Ltd., has a very comprehensive display of electrical accessories. Included in the show is the "Classic" desk light described in our columns a short time ago. This is now produced in a variety of finishes. Cables and wires, ceiling roses, tumbler switches, wall plates, &c., occupy a large part of the stand. The "Beco" fire is displayed, as well as a range of "Hendon" lamps of various shapes and sizes. The wood blocks and cases in which the firm excels are present in large numbers. Other exhibits are bells and indicators for various purposes, wall plugs, and dry cells.

Messrs. Thos. R. Carpenter, Ltd., exhibit lighting fittings, including shades, bowls, brackets, and standards.

Mr. John A. Harry Hunt has a similar display.

Messrs. William Sanders & Co.—This firm shows many examples of ironclad switch and fusegear. A set of unit-type switchgear is mounted on the stand. Battery switchboards for country house lighting sets are also exhibited.

The Falkirk Iron Co., Ltd., have a wide display of cooking apparatus, &c., among which are "Falco" cookers, heaters, and irons.

Messrs. Mark Webber, Ltd., exhibit several of their vertical engines, suitable for running on town gas, petrol, paraffin, naphtha, or benzole. These range from 2 to 18 b.h.p. A 5-b.h.p. engine, complete with dynamo and battery for country house or farm lighting, is shown in operation supplying a number of lights. A pumping set is exhibited.

The Austin Motor Co., Ltd., show one of their four-cylinder petrol engines coupled to a 3.1-kW English Electric generator, and a small .75-kW lighting set.

The Federation of British Industries has a large stand upon which are displayed numerous trade publications. This is a general information bureau for the assistance of members of the Federation, and for foreign and British buyers. Full information is given regarding British products and producers.

The Semaphore Engineering Co., Ltd., show dry cells for bells, telephones, ignition purposes, &c., and also complete electric lighting sets for motor cars and cycles.

British Brass Fittings, Ltd., exhibit a great variety of lighting fittings and accessories for all purposes, including tumbler switches, cut-outs, and main switches. Electric fires and radiators are also on view.

Premier Electric Heaters, Ltd., have a most brilliant display of electrical heating and cooking apparatus, all of which is very highly finished. A small electric cooker is shown, as well as fires, kettles, irons, hot plates, glue-pots, &c. A notable exhibit is a small 600-watt radiator which has a frame so constructed as to permit of its being turned over and used for boiling small quantities of water. This is very suitable for standing on a desk or table.

Messrs. Parker, Winder & Achurch, Ltd., show examples of concrete mixing machinery, in addition to dynamos and small electric lighting plants. Switchgear and battery charging boards for small electrical installations also appear. Among the smaller exhibits are "Imperial" vacuum cleaners, electric light fittings, lanterns, &c. An electrically-driven floor polishing machine was on view the first day, but as this was of American manufacture it had to be removed. The firm has obtained a licence from the American makers to enable the machine to be manufactured in this country.

A large amount of space is occupied by examples of the work executed by disabled ex-Service men in the various training centres in and around Birmingham. Everything displayed is an eloquent testimonial both to the men and their instructors, and indicated very clearly how much can be accomplished in a short time by means of intensive instruction. The trades represented include armature winding, pattern making, turning and fitting, plumbing, cabinet making, watch and clock making, &c. The West Midlands scheme is providing instruction for about 2,500 men, and centres have been established at Birmingham (where 1,211 men are in training), Coventry, Dudley, West Bromwich, Ludlow, and Worcester.

Messrs. H. C. Slingsby, among a number of mechanical trucks, extension ladders, &c., exhibit an electrically-driven hoist. This is designed for a load of 15 cwt. The motor of this machine starts at no load, and an adjustable automatic stop is fitted which enables the load to be held at any desired height. This is specially designed for electrical operation, but electric drive can be applied to other hand-power types shown.

Messrs. W. Goodyear & Sons, Ltd., exhibit, among other trucks and small transporters, a "Greenbat" electric truck for industrial purposes. This is a 2-ton vehicle driven by a totally-enclosed, series wound motor, arranged for series parallel control, and supplied with power by a battery of 14 "Ironclad-Exide" cells. A pedal controls both the battery circuit and the brake so that the pedal must be depressed during the whole time the vehicle is in use. Should the driver fall off the pedal is released, cutting off the current and applying the brake. In addition to its 2-ton load the truck is capable of towing a trailing load of 2 tons on the level.

The M.P. Electric Welding Machine Co. exhibits a standard spot welding machine designed to obviate the use of rivets in jointing wrought iron or mild steel from the smallest gauge up to ½ in. total thickness. The machine is fitted with a regulating device enabling several different welding temperatures to be obtained. The electrodes are of hard-drawn copper and easily replaceable. A water circulating system keeps the machine cool during operation, preventing excessive heating in the secondary winding of the transformer embodied in the machine. This transformer can be wound to suit single-phase circuits with frequencies ranging between 40 and 60 cycles and with voltages from 100 to 500.

The Midland Electric Supply Co. display Rayner and Heald induction motors, and Robinson electric lifting gear, including monorail hoists, winches, spur gear winches, &c.

Messrs. Henry Wiggin & Co. have a wide variety of resistance wires and metals. Nickel and cobalt anodes are shown as well as a large number of metal salts.

British Electric Vehicles, Ltd., exhibit two examples of their work. The larger of these is an electric locomotive weighing four tons, and capable of hauling a load of from 20 to 30 tons on the level or 8 tons on a 1 in 30 gradient. The motors are double-wound so that series-parallel control is obtained. The battery consists of 40 "Ironclad Exide" cells with a capacity of 258 Ah. The length of the locomotive is 9 ft. 7 in. over-all, and it has a 2 ft. 6 in. wheel base. It is capable of a speed of 5 miles an hour loaded, and will run from 20 to 25 miles on one charging of the battery. The other exhibit is a "Super Giant" industrial electric truck capable of moving a load of 5,000 lb. It has a loading space of 7 ft. 6 in. by 4 ft. The battery of 20 cells has a capacity of 161 Ah. The truck is steered by an up-and-down lever motion transmitted to the wheels by ball and socket joints; spring buffers minimise vibration on the steering lever. The control gear is mounted in a dust-proof case, and the controller unit is easily removable, as it acts through a dog clutch.

The Birmingham Mica Co., Ltd., is displaying a comprehensive range of mica and micanite in various forms. The show includes sheets, washers, and bars, as well as special forms for particular applications.

Messrs. Wm. Whitehouse & Co., Ltd., exhibit one or two lighting fittings, their stand being in the nature of an invitation bureau where facilities for visits to their works are given.

Messrs. Accles & Shelvoke, Ltd., show a number of small motors ranging from 1/10 to ⅓ h.p. Also a patent dynamotor for plating and polishing, and a small dynamo suitable for lighting small cars or motor cycles.

Electric Heating & Hardware, Ltd., exhibit many "Komet" productions, including kettles and irons. A feature of this stand is a cylindrical electric oven. This has an aluminium barrel about 20 in. in diameter and length, with a lid secured by three patent buckles. The back of this barrel is domed, and in the space thus provided two 500-watt spirally-wound heating elements are fixed. A galvanised steel frame fits into the barrel and has a flat bottom upon which the dishes containing the food to be cooked are placed. It is claimed for this oven that the distribution of heat by the interior arrangement makes it far more efficient than the rectangular type.

The Gath Electrical Engineering Co. displays several examples of lighting standards and lanterns which, though plain, are of very effective appearance. The lantern frames are all of cast brass. A great deal of metal work in the form of bell pushes and ceiling and wall plates occupies the front of the stand. A new patent switch plug is shown; this is a double-pole, quick-break, rotary type switch fitted with large plug sockets. The plug has two pins and a key projection, and when the switch is operated, by means of a handle on a spindle passing through the plug, the key turns in a slot in the switch case rendering withdrawal of the plug impossible until the switch is put into the "off" position. This combination is made in several styles for mounting on wood blocks, sunk type with a deep recess at the rear for cables, and a type suitable for installation in exposed positions.

Messrs. Watts, Williams & Co., Ltd., exhibit "Wattalite" electric lighting sets for motor and other bicycles. In the motor cycle set a small dynamo fixed above the tank of the machine is driven by a flexible shaft from the rear wheel. The dynamo is connected to an accumulator which supplies current to a 5-in. head lamp and a small rear lamp fitting through the number plate. The whole of the switches are contained in the dynamo casing. The cycle-lighting set consists of a dynamo and head and tail lamps. The dynamo is driven by a rubber friction wheel in contact with the rim of the front wheel of the cycle.

Messrs. Singleton & Rome have an excellent display of artistic lighting fittings consisting of brackets, pendants, &c., in all kinds of metal finishes, shades, and bowl fittings. "Bipol" accumulators are also shown in various sizes. A travelling light comprising an unspillable accumulator in a strong wooden case, a policeman's or watchman's lamp, for use continuously, or as a flash lamp, charging racks, &c., are exhibited.

Messrs. Drake & Gorham, Ltd., have a "Railodok" electric industrial truck on view. This has a carrying capacity of 1 ton and a loading platform measuring 7 ft. by 3 ft. 4 in. It is driven by a 1¼-h.p., series wound, totally-enclosed motor, which receives its power from a battery of 21 "Ironclad Exide" cells with a capacity of 150 Ah. The vehicle is fitted with a drum type controller, with a patent locking device and cut-out. The cut-out is interlocked with the driver's saddle, the latter being reversible. This renders it impossible for the truck to move unless the saddle is depressed. This firm also exhibits an adjustable girder fitting for electric lighting. This is an extension arm made in one, two, or three parts, and a special spun steel, vitreous-enamelled reflector. The arm may be fitted on the slide rest of a lathe so that the part of the work being operated upon is always illuminated.

Messrs. McKechnie Bros., Ltd., The Metallurgical Co., Ltd., and The James Bridge Copper Works, Ltd., show copper and other non-ferrous metals in various forms as ingots, bars, rods, &c.

The Hoover Suction Cleaner Co., Ltd., effectively displays and demonstrates several of its cleaners.

Messrs. Evered & Co., Ltd., among many examples of highly decorative brass work, exhibit a number of electric lighting standards, brackets, and pendants, as well as bowl fittings and artistic shades and vases.

Messrs. Scholey & Co.'s stand has upon it a number of fractional h.p. motors in a number of applications including "Kutmore" drills, grinders, &c. Special prominence is given to the "Croydon-Premier" electric suction cleaner which can be employed for cleaning carpets, curtains, clothes, cushions, &c., without endangering the fabric.

The Electric Appliances Co., Ltd., specialise in the "Eureka" vacuum cleaner and its accessories, which include a carpet brush, a flat tool for corners, a hose for suction or blowing, tubing, brush, and nozzle.

The Consolidated Pneumatic Tool Co., Ltd., is not giving much prominence to the electrical side of its manufactures, but one or two portable drills and grinders are displayed.

Messrs. Galloway, Ltd., have a number of boiler house appliances upon their stand. These include an accessible wrought steel superheater, steam junction valves, safety valves, and a water softening apparatus, and Milner-Hurd's patent boiler seating blocks which move as a boiler expands or contracts, preventing the breaking of brickwork.

Messrs. Alfred Herbert, Ltd., exhibit a very well-placed selection of their precision work, including a patent universal gauge measuring machine for measuring lengths, diameters, screw pitches, internal and external, &c.

The names of other firms exhibiting articles of an electrical or allied nature were listed in our last issue.

Spain.—A new bank has been founded at Madrid with a capital of five million pesetas under the style of Banco Hispano-Suiza para Empresas Eléctricas.—*Reuter's Trade Service.*

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Single-pole Splitters.

Electric Brass Wares, Ltd., Brakell's Buildings, Rainford Gardens, Button Street, Whitechapel, Liverpool, have drawn our attention to a range of single-pole splitters which they are manufacturing. These are made for any number of ways from 2 to 6—the 2-way type is illustrated in fig. 1. The case of the splitter is of cold rolled pressed steel and is asbestos lined. The bases are made of a special non-hygroscopic material capable of withstanding from 10,000 to 13,000 V per mm. thickness. The advantages claimed for the device are that as there is no cast iron or porcelain in its construction it is practically unbreakable; it is light and easily fixed; it has permanent bushes, and heavy copper contacts, and it is absolutely fireproof.

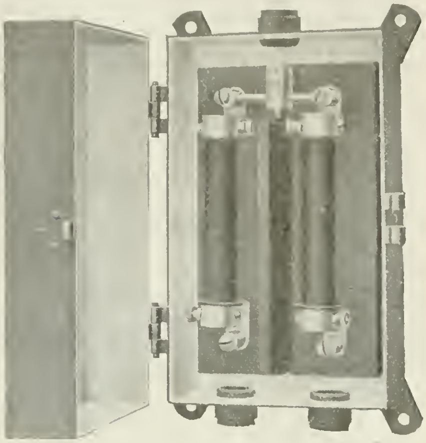


Fig. 1.—Single-pole Splitter.

The "Wild-Barfield" Thermostat.

The increasing demand for a closer automatic temperature control for electric ovens and other apparatus has resulted in the production of a new thermostat which can be set for temperatures up to 400 deg. F. A capsule filled with a volatile fluid is made by its expansion to switch off a part of the heating element as soon as the full temperature is reached. Afterwards the full current is switched on and off intermittently, so that a very steady temperature is maintained in the oven, or other device controlled. The exact temperature to be maintained can be adjusted to a nicety by altering the position of the weight on the lever which projects outside the oven (fig. 2). Contact is made outside the oven, so as to guard against any explosion or ignition should the articles being dried give off an inflammable gas.

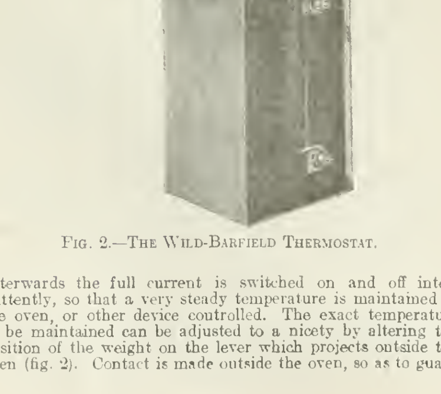


Fig. 2.—The Wild-Barfield Thermostat.

The Wild-Barfield thermostatic temperature control with slight modifications can be adapted to numerous electrically-heated devices, and should open up new channels of business which have hitherto been restricted by the difficulties encountered of easily and safely controlling temperatures within desired limits. For the purpose of illustrating the device, the cover has been removed. The controlling apparatus is manufactured by Messrs. Automatic & Electric Furnaces, Ltd., 281-283, Gray's Inn Road, London, W.C. 1.

An Anti-vibration Fitting.

We have received from the Screwless Grip Fitting Co., Lower George Yard, Halifax, details of a new type of fitting for protecting electric lamps from injury due to vibration. This may consist simply of a spring with a screwless corp grip, as shown in the central diagram in fig. 3. A counter-weight and a flexible metallic tube can be supplied to fit over the lamp "flex" from the spring to the lampholder, as in the left-hand side of the figure. A third variation, shown on the right-hand side of fig. 3, is the fitting of two lengths of flexible metallic tube. In this method the tube takes all the weight of the lamp and shade, leaving the "flex" entirely free.

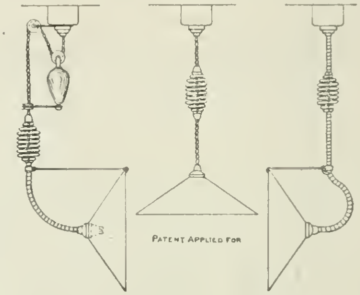


Fig. 3.—An Anti-vibration Fitting.

A New "Outlet" Device.

A newly invented device, which is being developed by the Electric Outlet Co., of New York City, consists of a new style of outlet and a new plug with curved blades, which supports the fixture and makes the proper electrical connection at the same time. The new outlets may be placed in either walls or ceilings wherever a light can possibly be used. Generally more outlets will be put in than ordinary lighting conditions require. The wall outlet is marked by a neat brass plate with a rounded triangular blade centre, fig. 4, and will accommodate the standard parallel blade plugs now commonly used with cord connections. An inconspicuous brass plate marks the ceiling outlet. This installation finishes the

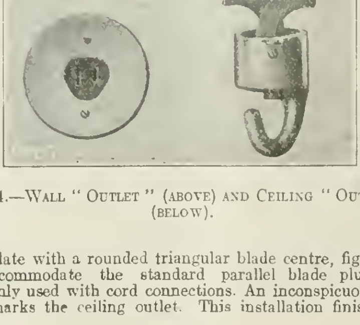


Fig. 4.—Wall "Outlet" (above) and Ceiling "Outlet" (below).

work of the electrical contractor. It will not be necessary to call him in to put up, take down, or shift a light, except in the case of the heavier and more elaborate fixtures.

The plug is attached to the light itself. When it is thrust into the outlet the curved blades point upwards and are capable of holding the heaviest fixture. For the more elaborate wall fixtures the plug is not rigidly attached to the fixtures. In this case the wall fixture is hooked over the plug after it has been inserted in the wall receptacle. In wiring the plug to the wall light, enough slack is left to allow the fixture to be readily hooked and unhooked with the plug in position. The blades of the ceiling plug curve outward like the ends of an anchor, and to shift a fixture, all the user needs to do is to lift the light off the outlet.—*Electrical News.*

A New Trolley Runner.

Mr. A. Harwood has sent us a drawing and particulars of his patent trolley runner (No. 113,091). This is designed to eliminate the trouble experienced in replacing the runner on a wire when the wheel is turned at an angle to the wire. The head has a self-lubricating conical seat, and is stated to be free from all rocking.

THE TEMPERATURE LIMITS OF LARGE ALTERNATORS.

Discussion at Manchester.

Mr. G. A. Juhlin's paper on the above subject, which was abstracted in our issue of February 4th, was discussed before the North-Western Centre of the Institution of Electrical Engineers at Manchester on January 25th.

Prof. Miles Walker was of the opinion that the paper gave exactly the data which were wanted, not only by the designing engineer, but also by the operating engineer. Everyone had known for a long time that mica insulation had very good ability to withstand high temperatures, but they wanted to know exactly what would happen if they constructed a coil according to certain methods known to manufacturers and subjected that coil to, say, a temperature of 150 deg. C. for a long time. Now they had some exact data, and it was an illustration of the enormous value of a well-organised experimental department in a great manufacturing works where a man could be kept on a line of research until he had got satisfactory results. Mr. Juhlin's formula for calculating the temperature rise he admitted was not quite applicable (the speaker referred to fig. 4), because as a matter of fact the heat did travel partly along the copper, but mainly through the slot insulation. The speaker had thought it worth while to tackle the problem of how much heat passed through the insulation, and how much along the bars for various lengths of the machine, and he had plotted a curve from the formula. (Prof. Walker explained a diagram thrown on the screen.) Until he worked out the figures he had no idea that in a stator of 30 in. they could get so much reduction in temperature. The formula was a very simple one, and it was quite easy in any case to fill in the values of the constants and determine the actual temperature. As regarded the measurement of the temperature inside the machine, he had sometimes wondered why the proposition had not been considered of having a thermo-couple halfway or a third of the way in the tubing. There would be no difficulty at all, particularly in the part of the machine where they did not require as much insulation, and with a thermo-couple in there they could get as good a determination with it as if they made a direct reading with an instrument so that a man could see exactly what the temperature of the machine was. With regard to how high a temperature one should work at, he did not quite agree with Mr. Juhlin. So far as the rotor was concerned, there was not the slightest doubt that as long as they were working at a temperature which was proved to be a perfectly good temperature for a rotor to work at, with proper mica thermal insulation, then everything was to be gained by working with copper. But with regard to the stator they had another thing to consider. Suppose the insulation could be made absolutely sound so that even when working at 150 deg. C. nothing could be said against it on that score. Still there arose the question of efficiency. In dealing with that, they must take into account the eddy currents as well as the normal losses. They knew that if they increased the copper in a slot they increased the eddy current, so in some ways the engineer was tempted to say: "Well, we will have as much copper as we can; we will work with abnormal current density and keep down the eddy currents; in that way we are not exceeding our temperatures and we will have a good machine." But there were some things to be considered in days of high-priced coal, and when they knew pretty well how to keep the eddy currents down to a small amount. He did not mean those eddy currents caused by the current in the conductor itself, but those caused by the saturation of the teeth, which were sometimes far more important than the others. Those were things which must be taken into account when they considered increasing the copper, but nevertheless it was possible by sufficient lamination to increase the copper. A 20,000-kW machine of normal design working at fairly high temperatures would take about 2 tons of copper, which could be obtained at a cost for labour and material of about £600. On the other hand, they could reduce the loss by about 40 kW, which, taking £600 at 10 per cent. was £60 a year; on the 40 kW they gained about £350. The annual cost of the power wasted in the copper was five times as much as the interest on the extra cost of the machine. In a stator there was always plenty of room, and they could make the slots they required, but with the rotor they were limited, so he would like to see, first of all, very perfect lamination of the copper, and then the copper arranged so as to produce the most economical machine, not merely from the point of view of the cost of manufacture, but also from that of the cost of manipulation, plus cost of operation. At the present time the buyer did not pay sufficient attention to efficiency, if he did so he could revolutionise the electrical industry. If he was offered two machines, one at £1,000 and the other at £1,050, both by good makers, he would take the former, and would hardly take into account a matter of one-half per cent. more or less efficiency. If the buyer would really consider what efficiency meant, and insist upon manufacturers making highly efficient machines, he would obtain better results, but as it was, the manufacturer knew that if he put a machine on the market at a price 10 per cent. higher than the other man he would not be able to sell it. How many shunt motors had the amount of shunt copper which was actually economical, the amount required from the point of view of really efficient working, not from that of price? One could put three times the amount of shunt copper into an ordinary motor, and it would pay for the copper in the saving effected. Should they not consider the subject from the point of view of complete efficiency and the ultimate cost rather than from the simple manufacturing point of view? He agreed that the temperatures Mr. Juhlin suggested were quite possible, and the paper would reassure operating engineers whose temperatures were fairly high.

Dr. S. F. Barclay was of the opinion that Mr. Juhlin had not made quite clear the relationship that his proposals bore to present-day practice. He proposed to run machines with a higher temperature rise than was at present permitted, and rightly pointed out that actual "hot-spot" temperatures exceeded considerably the rise specified for measurement by thermometer. He referred to a hot-spot temperature rise of 78 deg. C. above the cooling air for a 6,600-volt machine, and of 98 deg. C. for a 10,000-volt machine. He pointed out that although those figures might appear to be high, if the temperatures of existing machines were measured they would probably be found to be in the neighbourhood of those figures, if not higher. Most people would be inclined to agree with Mr. Juhlin's opinion with regard to the actual temperatures of machines built and passed to the conventional specification of 40 deg. C. rise measured by thermometer, but how did Mr. Juhlin reconcile that opinion with his proposal to "increase" the temperature rise to 75 deg. C. (actual temperature)? Clearly, he was recommending the adoption of a specification that would ensure "hot-spot" temperatures being lower than he considered they were at present—a state of affairs that was not consistent with the substance of the paper. In connection with Mr. Juhlin's proposal to measure the temperature of the rotor winding by the resistance method, in consequence of the good cooling of the part of the rotor winding that was embedded in the rotor, and the relatively poor cooling of the part of the winding that was enclosed by the end bells, the "hot-spot" temperature of the rotor must be considerably greater than the average temperature. Clearly, then, so far as the insulation was concerned, and it was from that point only that Mr. Juhlin considered the case, the temperature rise that was suitable for the stator where the "hot-spot" temperature could be ascertained fairly accurately, was excessive for the rotor in which the "hot-spot" temperature was absolutely an unknown quantity. Mr. Juhlin might b disposed to consider that the difference between the average and the maximum temperatures of the rotor should not be very great with a well designed machine, but if his proposal were adopted it would be applicable to badly designed as well as to well designed machines. For that reason the speaker's considered opinion was that an ultimate limit of temperature of 160 deg. C. for the rotor as determined by the resistance method was excessive. The speaker considered that the most important quality of all was reliability of operation; for generating plant reliability should have the first consideration from all concerned, and to impair that first essential for any small gain in first cost or efficiency was an unsound policy. An unduly high percentage of failures of turbo-alternators continued to take place from unknown causes, and it might quite well be that relative movement due to large temperature variations might account for some of those failures. Before higher temperatures were adopted it was important that the matter should be considered from other standpoints than merely that of the suitability of the insulation to withstand high temperature.

Mr. A. B. Field explained that by specifying a low temperature rise measured by resistance the whole direction of design was biased, and the manufacturer no longer had a free hand to do the best he could. Efficiency was a very important feature, and they should distinguish very clearly between temperature limits introduced by considerations of insulation and those due to such considerations as Prof.

Walker had brought forward; they were absolutely distinct. Let the purchaser give the manufacturer sufficient freedom with regard to temperatures and insulation, and call for the very best efficiency he could get, then he would get more efficiency with a smaller amount of copper than by putting a big amount of metal in the centre. At all events, they were two distinct problems, and they should be kept distinct. With regard to the rotor temperatures, the temperature limit dictated by the insulation was one that they were not interested in at all. By leaving the temperature to the manufacturer he would be limited to a lower figure than the temperature that the insulation would stand, and in the revision of the B.E.S.A. rules it would be quite rational to say that as regarded turbo-rotors there was no temperature limit from the point of view of insulation, and therefore, on the insulation tables no temperature limit need be given. If desired, it might be added that from other points of view practice had shown that a temperature rise of 100 deg. C. or so did not introduce serious trouble. He did not think it was realised in this country that the American Institute's Standardisation Rules did not represent the conditions under which a very large proportion of machines in America were sold and bought.

Mr. A. E. Clayton said that when they were told that a 10,000-volt machine had a temperature rise of 98 instead of 40 deg. C., it became obvious that any rating based on temperature measurement by thermometer was quite hopeless. With a thermo-couple they could undoubtedly ascertain the temperature in a particular spot very accurately, but it seemed that the resistance method was rather more robust. In the case of a rotor the author had only allowed 10 deg. difference between the temperature of the hottest part and the temperature measured by increase of resistance. The author's conclusion was that 160 deg. C. was a safe temperature at which to run mica insulation, but should he take 150 deg. measured by the resistance method for the rotor, that would result in a temperature well over 200 deg. being attained in many cases, depending partly upon whether axial or radial ventilation was used.

Mr. G. F. Sills pointed out that the author's coils which had been tested appeared to be composed of four conductors per slot. Presumably those conductors were not in parallel, and if so there was mica between each individual conductor. In a number of instances in the past, although the slot insulation surrounding the conductors had been mica, the insulation between the conductors forming the coil had not always been mica, and in view of the high temperature suggested it would be necessary to have all mica. Water-wheel generator coils, at any rate so far as the rotor was concerned, would be working under more favourable conditions than a turbo rotor. One speaker had calculated that by using extra-high-temperature on a 20,000-kW machine, one could show a net gain of about £250 a year, but when the capital cost of a complete 20,000-kW set and its auxiliaries was taken into consideration a saving of £250 a year would not influence a buyer if it would in any way affect the reliability of the set. With reference to the author's remarks regarding meeting foreign competition, it should be possible to put forward higher temperature machines for export where foreign competitors were doing the same, supplying the lower temperature machines to the home market, until such times as engineers in this country were willing to use higher temperature machines. With the extra-high-temperature machine it might be necessary to have a larger air filter, which would occupy more space, and with present building prices that might offset the reduction in price of the higher-rated turbo-alternator.

Mr. B. G. Churcher, referring to the use of the resistance thermometer, thought it would be found that the argument of robustness would not work out because they could use thick thermo-couples sufficiently strong to stand ordinary shop usage, whereas when using the resistance thermometer in order to get sufficient resistance in the arm of the bridge which formed the resistance element, they had to use very fine wire so as to get it into a small space. In that way the resistance thermometer would probably be no better than an ordinary mercury thermometer. The statement that they could measure surface temperatures accurately by means of a thermometer seemed to be not quite accurate. Thermometers were calibrated by being immersed in a liquid, and they had to correct the emerging column. For commercial testing that might do, but when they were to measure surface temperatures if they placed the thermometer against the surface they would be measuring the temperature of the air just outside the surface, plus a certain amount of radiation from the surface. The use of pads introduced abnormal conditions. The speaker had tried to measure the temperature rise of a commutator by putting a thermo-couple and a thermometer on to the commutator at the same time. In one case the thermometer read 56 and the thermo-couple read 71, which was simply due to the thermometer really reading the temperature of the pad, not that of the commutator, and the temperature of the pad was nothing like the temperature of the commutator. The only real way to get surface temperatures accurately, especially where there was any air blast, was to use thermo-couples and sweat them on to the surface, by which means perfectly satisfactory results could be obtained.

Mr. Baxendale explained that last year they opened up a generator rotor which was manufactured some seven years previously; it was actually as good as the day it was put in, and it seemed to be quite good for another ten years, so he would stick to low temperature. With regard to the junction of the end connections, if the copper expanded at all it would certainly break the joint there and the insulation of the end winding would suffer as well. Ordinary Empire cloth would carbonise in a very short time, and they very often found in drying out a machine that if the temperature became a little high the varnish came out in small bubbles, with the result that the insulation was apt to become very low. With regard to the rotor running at higher temperatures, trouble would be experienced with mica insulation, which was not extended far enough away from the cores, and when the insulation was asbestos, they were apt to part joints there, with the result that they would probably get an earth on the rotor in addition to any moisture coming over the wet filter.

Mr. F. Walker remarked that if they took the charges made by any of the big undertakings they would find that interest and sinking fund absorbed 50 per cent. of the total. If the charge made was 2d. per unit, 1d. would represent the sinking fund and interest; the alternator perhaps represented nearly 5 per cent. of the capital charges. Suppose they added 10 per cent. to the cost of the alternator, the interest and sinking fund would go up by ½ per cent., which represented ¼ per cent. of the charge per unit. On the other hand, a 10 per cent. increase in efficiency would reduce the cost per unit by 2½ per cent. Those round figures made efficiency ten times as important as the capital cost from the point of view of the cost per unit.

Mr. R. Johnson thought that higher temperature limits would force manufacturers to adopt mica insulation more widely, with the result that reliability would automatically depreciate.

Mr. G. A. Juhlin, in reply, asked: "Why should we blink our eyes to the fact that high temperatures are there, always have been, and always will be there?" They could not build machines with an internal temperature of 40 deg. C. Unless operating engineers accepted the fact that there existed very much higher temperatures inside a machine than they could measure by a thermometer, they would not get any further. The high-temperature machine would be more efficient than the low temperature machine, and it depended entirely on the design of the machine what the temperature distribution in the rotor would be. With a well-constructed machine and end windings properly ventilated there was not the enormous discrepancy between the hot-spot temperature and the average obtained by resistance, which some speakers had tried to indicate. Moreover, there were plenty of machines built on a 40 deg. rating, which had been operating for years very much beyond some of the limits which had been suggested. In actual practice he did not think anybody need lose any sleep over the subject of copper expansion. Any piece of insulation when new was absolutely solid, but they had to have certain clearances in getting the bars into the slots; those clearances were absorbed by expansion of the insulation, with the result that they had always got a certain amount of, not clearance exactly, but elasticity in the insulation. The insulation swelled, there was no question about that, but they must also remember that even with mica (and mica there had a very great advantage over any other insulation that could be used because the copper could slide in the mica) although it might be ever so tightly pressed, they had not got the same grip on the copper that they would get with any fibrous material; practical experience would show that there was not much danger from expansion. They had to consider actual operating conditions and specify machines accordingly. Though the standardisation rules had been accepted by American manufacturers they did not work to them. The only reference in the paper to water-wheel generators was the fact that certain coils were taken from these machines. They were not intended as an example of how turbo-generator coils should be taken: they were simply taken because they happened to be there and were useful for experiment. There was nothing but mica from the bar copper to the outside, so that the limits which held good for the insulation to ground would also hold good for the insulation between turns, and it was far more important to have mica insulation on the individual turns because that was the position of hot spots in connection with the copper. Concerning the influence of temperature on paper, at least one manufacturing company in America did not use paper, but varnish, and breakdowns were very few indeed. With regard to the expansion of the core bolt, the core was elastic, and it would expand far more than the bolt; the expansion of the bolt was not very much. There was a temperature gradient from the copper to the core, and a very considerable one; therefore, the core temperature was very much lower than the actual copper temperature. He was quite satisfied that it was correct that an efficient machine with a high temperature required a smaller filter, instead of a larger one; total losses must be less if they could get a higher efficiency out of a given machine. Mr. Sills suggested that they should use a high temperature limit for machines which had to meet foreign competition and keep to low temperature limits on machines for use at home; from a manufacturing point of view this was not practicable. "Where have you built machines similar to this? Where can we see them?" were the first questions British engineers asked, and engineers were not so very different in other parts of the world. When they used mica, why should they stick to temperature limits which were obviously laid down for machines constructed with other material? It was not the same thing at all. If they had the material to withstand the higher temperature he thought it was up to everybody to use it to some extent. There was not the slightest doubt that the further they went the more mica would be used in the construction of electrical machinery. Probably the day would come when they would use nothing but mica, or perhaps by that time they would have found something even better than mica.

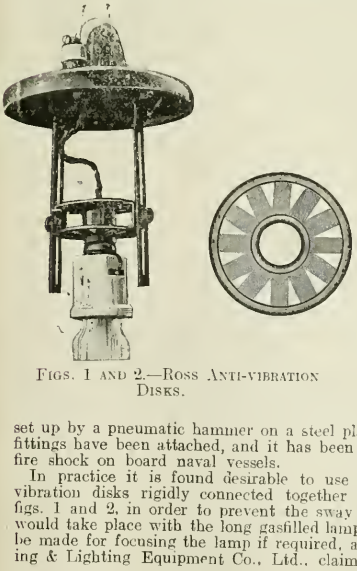
SOME SPECIAL LIGHTING FITTINGS.

The "Anti-break" Lamp Economiser.

There has always been, and more especially so under present conditions with the life of lamps shorter than it might be, a drawback to the universal use of high-efficiency metallic-filament lamps. That is, the fragile nature of the filament results in a reduction of the length of life of the lamps even when they are subjected to the slightest vibration, and when any perceptible vibration, or liability to shock, exists it is often impossible to use them, as the cost of their renewal might outweigh the advantages accruing from their use.

It is for the purpose of overcoming the above-mentioned and similar problems that the "Anti-break" lamp economiser (Ross patents) has been designed. The device, as already illustrated in our pages,* takes the form of a disk composed of two concentric rings connected by a plurality of strips of phosphor bronze gauze cut on the bias with the warp and weft strands disposed obliquely, so that the diagonal of the mesh runs in the direction of the length of the strip. The gauze strands are firmly fixed at their ends to the inner and outer rings of the disk; there is no actual connection between the two rings, the inherent friction of the weft and warp carrying the weight of the lamp and holder. A suspension is thus provided which is inert to the transmission of vibration as there are no wires running direct from the outer fitting to the suspended lamp, through which vibration can pass; in other words, the interrupted mesh of the gauze strips destroys, or damps out, the waves of vibration before they reach the fragile filament. At the same time the lamp is held rigidly in place, and even under the most severe shock the natural resilience of the disk damps the wring, or rebound, owing to the interwoven mesh, and prevents the filament being destroyed.

The device, owing to the corrugated nature of the warp strands interwoven with weft strands, is exceedingly strong, and possesses the further advantage that it is not affected by the heat of the lamp or atmospheric conditions. It has been tested under vibration from running machinery in engine rooms, over propellers on board ship, and under vibration set up by a pneumatic hammer on a steel plate, to which the fittings have been attached, and it has been subjected to gun fire shock on board naval vessels.



Figs. 1 and 2.—Ross Anti-vibration Disks.

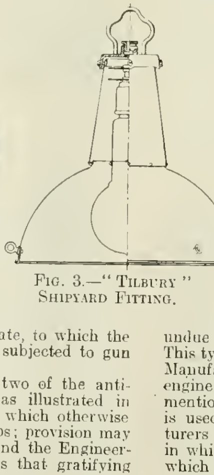


Fig. 3.—"Tilbury" Shipyard Fitting.

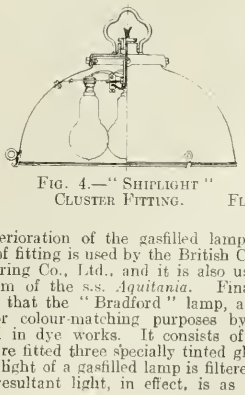


Fig. 4.—"Shiplight" Cluster Fitting.

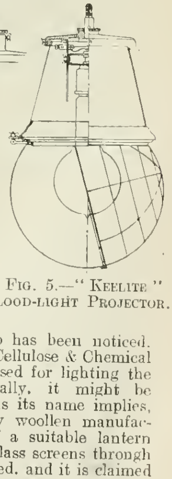


Fig. 5.—"Keelite" Flood-light Projector.

In practice it is found desirable to use two of the anti-vibration disks rigidly connected together as illustrated in figs. 1 and 2, in order to prevent the sway which otherwise would take place with the long gasfilled lamps; provision may be made for focusing the lamp if required, and the Engineering & Lighting Equipment Co., Ltd., claims that gratifying results have attended on the development of the Ross anti-vibration disks for use with gasfilled-lamp fittings. An important city in the north of England has found in actual use that gasfilled lamps suspended from tramway poles have shown 100 per cent. longer hours of burning when fitted with the device. Moreover, numerous fittings are being used on jib and travelling cranes, and in other positions where hitherto it has been impossible to employ gasfilled lamps with any degree of reliability.

For instance, in fig. 3 is shown the "Tilbury" lamp, which it is claimed was the first cargo vessel fitting to use a gasfilled lamp; this is becoming popular in shipyards, and when the rough usage to which such fittings are subjected in shipyards is considered, it will be appreciated that the anti-vibration attachment must be doing its work well. An alternative to the single lamp fitting is the "Shiplight," fig. 4, which is provided with several b.c. lampholders mounted on "anti-break" disks, and is supplied already wired and provided with two brass terminals for connection to the existing supply cables.

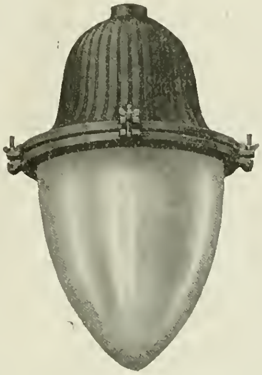


Fig. 6.—"Defiance" Fume-tight Fitting.

A further application is the "Keelite," fig. 5, which has been specially designed for the purpose of projecting a flood light on to the keel of a vessel when in dry dock, where the standard practice is to clamp the fitting on to any convenient stanchion wherever a light may be required, and it will be noticed that the top of this fitting is provided with a ball and socket universal joint so as to allow of the lamp being tilted in any direction that may be required.

The "Defiance" fitting, fig. 6, is appropriately named, since it has been designed for use in cases where it is essential to provide a water or fume-tight lamp, such as in chemical works or in ships' stoke holds where oil fuel is used, and where fumes of a dangerous nature may be encountered. It consists of a solid cast-iron top having radiating fins both inside and out, the opalescent globe being held in a V channel ring, and is thoroughly gas-tight throughout. It has been found on actual test, we are informed, that the above-mentioned fins provide a sufficiency of radiation, and no undue deterioration of the gasfilled lamp has been noticed. This type of fitting is used by the British Cellulose & Chemical Manufacturing Co., Ltd., and it is also used for lighting the engine room of the s.s. *Aquitania*. Finally, it might be mentioned that the "Bradford" lamp, as its name implies, is used for colour-matching purposes by woollen manufacturers and in dye works. It consists of a suitable lantern in which are fitted three specially tinted glass screens through which the light of a gasfilled lamp is filtered, and it is claimed that the resultant light, in effect, is as near as possible to north light.

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* Elec. Rev., Feb. 7th, 1919, p. 148.

ELECTRIC TRACTION.

Sir Philip Dawson's Views.

An extremely instructive lecture on the above subject was delivered by Sir Philip Dawson to the senior students of the Faraday House Electrical Engineering College, on February 23rd. Mr. G. W. Partridge (an old Faradian) occupied the chair, and in introducing Sir Philip explained that the latter had had unique opportunities of studying the subject, as he had inspected practically every electrified railway system in Europe and America. Moreover, as he spoke three or four languages fluently, he was able to discuss technical matters with engineers of various nationalities, and so obtain first-hand data. There was no doubt that the near future would see an enormous development of electric traction in this country; the Brighton railway was to be extended to the coast, and the Great Eastern Co.'s system would also be converted before long. It was gratifying to know that the electrical engineer to the L.B. & S.C. Railway was an old Faradian, and it was not too much to hope that another Faradian would be put in charge of the Great Eastern Co.'s system. A point that should never be forgotten was that it was worse than useless to attempt to consider any railway electrification scheme from the engineering point of view if the commercial standpoint was neglected.

Sir Philip Dawson regarded it as the duty of all experienced engineers to assist the younger generation by every means in their power; it was only by so doing that the young men could hope to compete with their rivals. He had come in contact with engineers of all nationalities during the 30 years he had been connected with electric traction in its various phases, but he was always prepared to back his countrymen. Tramway electrification had reached the end of its development, and would provide comparatively little work for manufacturers in the future, whereas railway electrification had only just begun, and there was an enormous amount of work to be done.

There were two main systems, viz., d.c. at from 600 to 3,000 volts, and a.c. single-phase at any pressure up to 16,000 volts. An a.c. 3-phase system was used on the Continent by the aid of split-phase locomotives, but now regeneration was possible with all three systems, and the latter one had lost its particular usefulness. Standardisation was very useful, but if carried too far it might result in more harm than good being done; in that connection the report of the Advisory Committee to the Ministry of Transport must be considered as reasonable, and the L.B. & S.C. system was wisely to be retained so as to accumulate data and experience, especially as no main line had as yet been electrified in this country. It was very unwise to slam the door in the face of improvement as France had done, and the lecturer read an extract from an eminent American engineer's letter expressing the opinion that France had gone too far in standardising the h.p. d.c. system. Such procedure could only mean one of two things at the present early stage, *i.e.*, either the engineers responsible were not capable of differentiating between the advantages of various systems for the particular railway to be converted, or else manufacturers of certain classes of equipment wished to exclude all competitors. Actually each line to be electrified should be considered on its merits, and a system chosen which would best suit the particular conditions. Nearly every country on the Continent was considering the subject at the moment, but none intended to standardise to the degree that France had done, and in the U.S.A. they were of the opinion that they could not standardise until more experience had been gained; they were accordingly developing various systems at the same time. Of course, in some countries the problem could be easily settled, in Belgium, for example, where the distance between towns was short, the traffic dense, and the lines comparatively short, the d.c. system would probably be the best to adopt. The whole thing resolved itself into terms of capital, working, and maintenance costs; railway electrification was a financial problem entirely, and all the best engineering in the world would not make a scheme a success if it was not sound commercially and financially.

An important point that required settlement was the permissible p.d. in an earth return system, but that subject was now being considered by the Ministry of Transport's Advisory Committee, of which the lecturer was a member. Interference with telegraph and telephone circuits had been made too much of a bogy in the past; on the Brighton line and in Sweden it had been eliminated entirely, but there again it was a question whether the cost could be justified.

The lecturer emphasised the fact that the whole problem was a financial one, pointing out that before the war the cost of electricity consumed equalled 50 per cent. of the total cost of operating an electric railway, and it would, therefore, be appreciated that energy must be supplied as cheaply as possible. A full train starting from Victoria station might require as much as 2,000 amperes, and he was giving away no secret when he stated that the Electricity Commissioners realised that of the total amount of electricity that would be produced in the provisionally-delimited London and Home Counties Electricity District half would be consumed by the railways. The Brighton railway would require between 40,000 and 50,000 kW on the three-hour basis, while the Great Eastern Co.'s system would involve a generating station of about 150,000 kW capacity; railway electrification would, therefore, result in the consumption of large amounts of power which would have to be supplied by stations of large size. For a large railway system the load factor could be taken as 40 per cent., and for London the diversity factor was only a few per cent., but there was really nothing in the latter.

The lecturer next dealt with power-house design, pointing out that steam pressure would be increased to 350 lb. per sq. in., and that there was no advantage in installing individual turbo-generator sets of too large a size, and then passed on to the subject of cables. Sir Philip mentioned that the American G.E.C. hoped shortly to produce a 3-core h.p. cable, but, personally, he preferred to use three single-core cables without any protective devices; such devices were only needed to disconnect the generators, modern cable being able to withstand any surges that might arise. That view had been confirmed on the Continent where three single-core cables had been laid underground in concrete ducts. They had recently tested pieces of the 30,000-volt, 25-cycle, single-core cable that was supplied for the Brighton railway system, and it had withstood a pressure of 200,000 volts at 50 cycles for three hours, after being under water for 24 hours, without showing any signs of breakdown. Moreover, a similar piece of cable after being wound on a drum, having a diameter 12 times that of the cable, six times in one direction and six in the other, had withstood 175,000 volts for 5 minutes.

After discussing the relative costs of transformers, switchgear, and cable for 30,000 and 60,000 volts and higher pressures, Sir Philip explained that experience had shown that very much less trouble was encountered when using h.p. than l.p. lines, which was due to the fact that higher mechanical and electrical safety factors were allowed, and that the lines themselves were relied upon to withstand surges and not the so-called safety devices. For h.p. work the generators would probably be connected solidly to the transformers and the two regarded as a single unit.

In conclusion, the lecturer enumerated some of the advantages that electrification resulted in: 200 per cent. more traffic could be dealt with without any increase in expense for the provision of more lines, &c. The use of multiple unit motor-car trains for suburban work enabled the size of the trains to be varied so as to suit the number of passengers that required transporting, and a more frequent service could be run. Further, traffic was created in the middle of the day because passengers did not have to trouble about time-tables, and they knew they could catch a train at any time. However, the most economical operation would not be secured unless the whole of the line was completely electrified. Some large goods yards in America had been electrified and were operating quite satisfactorily. The L.B. & S.C. Co. had experimented in that direction, and had found that the average shunting speed of a steam locomotive was only 2.5 m.p.h., whereas by using a passenger motor car for the same purpose the speed could be increased to at least 5 m.p.h. An electric locomotive consumed no energy while it was standing idle, neither was there any deterioration of fire bars, &c.; it did not require coal and water to be carried about; the average speed could be increased, and heavier loads could be hauled; a constant torque and better adhesive load could be obtained.

The limit of size of steam locomotives had been reached at about 3,000 i.h.p. on account of boiler considerations, but electric locomotives had been built which developed 8,000 i.h.p. each, and that was by no means the limit. A saving in working expenses resulted from the fact that a smaller number of electric locomotives was required to do the work, and the cost of building a railway track could be reduced because increased gradients could be allowed.

Sir Philip covered the ground comprehensively, and ended his lecture by showing lantern slides which illustrated the various electric railway systems in America and on the Continent.

German Trade Activity in India.—Gradually the antipathy against German goods and German methods of business displayed during the war seems to be disappearing. The figures issued by the Director of Statistics in India regarding the extent of Indian trade with Germany show that that country is beginning to make a bid to secure the hold on the Indian market that she had before the war, and that she is succeeding to a large extent. It is strange, but true, that in the Indian bazaars a German-made article is often preferred to a British article, the reason probably being that German goods have a reputation for cheapness. The present rate of exchange enables the German importer to sell many things, in the making of which the Germans have specialised, at prices which are lower than those of any other country and still yield him a handsome profit. The shopkeeper in the Indian bazaar appears to be under the impression that to say an article is made in Germany is to give it the hall mark of value. In this connection a point worth noting is that German goods are now ousting from the Indian market the produce of Japan which, during the war, supplanted Germany as the principal provider of the many cheap trifles which find such a ready sale in India.—*Indian Textile Journal.*

REVIEWS.

The Real Wealth of Nations, or A New Civilisation and its Economic Foundations. By John S. Hecht, Fellow of the Royal Economic Society. Pp. ix+350. London: George G. Harrap & Co., Ltd. 1920. Price 15s. net.

The science of economics, as Mr. Hecht remarks several times in the course of his book, is sometimes called "the dismal science." The perusal of the work, while giving rise to some doubt in our mind as to the strict applicability of the term "science," in no way invalidates the complete appropriateness of the adjective. There is probably no subject, with the possible exception of religion, which has produced, in the minds of really earnest and capable students, so many conclusions, the variety of which is only equalled by the passionateness of the conviction with which they are held, urged, and maintained.

There can be no two opinions as to the thought and effort that Mr. Hecht has put into the writing of *The Real Wealth of Nations*. As the carefully considered views of one who would seem, by his distinction, to be qualified to write on the subject, the book is well worth reading. Everyone will find in it something with which he can agree, and everyone will also find a great deal of controversial matter. Engineers, who are first and foremost trained brain-workers, will at once accept the statement that, of themselves, neither capital nor labour, nor the two of them together, can produce wealth at all, and that only when they are harnessed to brains and skill can they become productive.

Summed up, the book is an attempt to prove that only by means of an *adequate* system of protection can a country be really wealthy. Protection enables the development of infant industries to be carried out. The "adequate" system amounts to prohibition, nothing less bringing about the object Mr. Hecht desires. Subsidiary questions, which used to be considered of some importance, are dismissed as not mattering at all, and certainly we have by now become so used to the depreciation of the purchasing power of money that to press the process farther by making it impossible for foreign imports to reduce the price paid for goods will only be another straw on the back of the patient beast of burden who has to bear the load. We shall be told that we have not read the book; that it is explained that the real trouble arises out of our having come to think of value in terms of money. We appreciate all that, and we quite see that money is an imperfect standard. But unfortunately, it is the only one available. We are compelled to realise that we have to deal with facts as they are, and not as we would have them be. There is really very little practical advantage to be gained by considering what would happen if Peter grew nothing but potatoes and Arthur grew nothing but artichokes, and they wanted to barter. There is not going to be a new civilisation, and Mr. Hecht may as well make up his mind to it first as last. We shall have to go on with the one we have got, and do our best to improve it.

The effective criticism of such a book as this would involve the writing of another one of equal length; and then no doubt the author would sit down and write a third, so that we might go on, past the point to which Touchstone takes the ethics of controversy, until we reached those sublime heights where dwell Mr. Ernest Newman and Mr. Edwin Evans, whose musical criticisms result in, if they do not aim at, the unending provision of material for the mutual disparagement of each other's intelligence, so that one really wonders at the patience of those who have to provide space for their publication.

It is not correct to suppose the cost of production of any given article as constant, and consisting of the necessaries of life of the producer and his dependents. Standardisation and production of large quantities in properly equipped factories make the cost of production follow a law of the character $y=mx+c$, the constant representing overhead charges, which diminish per article as the number of articles produced increases. While we are mentioning laws, we would point out that it is of no avail to rail against the so-called "law of supply and demand" as if it were of man's deliberate making. When a legislature makes a law, it says, in effect: "We would have things thus and so; and we will pass a law to compel people to act in such a way that things shall be thus and so." A scientific law, however, is a statement founded upon observation of a number of relevant cases, from which it has been observed so frequently that certain results follow certain causes, that it may reasonably be assumed that the same result will always follow when the same things are done. A scientific law is nothing but a theory, and it has been found, not infrequently, that the increase of knowledge makes a theory untenable, as in the case of the phlogiston theory. We fear that it is unlikely that any increase of human wisdom will bring about any result other than that when things are scarce people will charge more for them.

Mr. Hecht opens with a set of what he calls "the real axioms of economics." There are 31 of them. To be an axiom, a truth should be self-evident, neither requiring proof nor capable of it, but serving as a foundation for future reasoning. This is not the case with the majority of Mr. Hecht's axioms, some of which are more than arguable, while hardly any are self-evident. However, Mr. Hecht speaks throughout in an *ex cathedra* manner, and sets forth his definitions with an air of infallibility, while dismissing the dictionary definition of economics as "merely the personal opinion of the dictionary compiler"; whereas the fact is that even the youngest compiler of a dictionary must be guided, to quite a considerable extent, by the precedents established by those who were earlier in the field. Thus we are told, for instance, that wealth is something that exists. Mr. Hecht will have none of the view that coal in the ground, for instance, is worth nothing. Yet wealth can only result when production exceeds purchasing power, which seems to lead to the view that wealth involves movement, the doing of work, which, to our thinking, is much more reasonable.

Mr. Hecht has no good word for those engaged in selling goods. It is neither a skilful nor an honourable occupation. We all suffer, it is true, from the middleman, who too often becomes a simple profiteer, neither producing, transporting, making available, nor even seeing, the goods out of which he takes his toll. But the effective selling of the capacity of a factory is no less important than efficient manufacturing processes. This is, in actual fact, an age of competition. Whether it ought to be so or not is quite another question. So when we hear of some factories being on short time, while others in the same line are not, it may be taken as certain that the selling methods of the short-timers (assuming equally efficient manufacturing methods) are at fault, especially when the demands of the market are still far from being satisfied. And we would observe to Mr. Hecht that, in our view, George Stephenson invented the locomotive because he saw there was a need for it, a demand value for it; in a word, because he knew that if he made it there would be a sale for it. That may not sound romantic, but it is true, and there are few inventions in the scientific or practical world that have been made for any other reason. It is otherwise with works of art. A composer writes music, a poet poetry, a painter makes pictures, because he must, although he hopes to find a market for his product when he has completed it, and often thinks very little of the intelligence of the world if he fails to do so.

The truth is, that whether our object be ostensibly that of remaking the torn and war-exhausted world, making a new civilisation, or merely making the best of things as they are, the only course to adopt is to work as hard as possible, produce as much as possible, and spend as little as possible. Individually and collectively, all must play their part, and there must be no reliance on Government control, or Government regulation of profits, or paternalism of any sort. The world is a hard place, but, on the whole, it is not so hard but that the man who does his best can get something out of it.

We find much that is contradictory in the book, and much that we cannot accept as true. For instance, the sale of luxuries at home is injurious; yet if sold abroad their sale may benefit the producing country. Is not this suspiciously like the "romance of trade" at which Mr. Hecht jibes so bitterly earlier in his work? The statement criticised is to be found on p. 112. Again, on p. 225 we find: "Free trade can now be recognised through all its disguise as false, artificial, selfish, and materialistic. It allows those who are crafty or grasping to exploit the helpless . . . while a Protection based on the value produced per worker is natural, national, and moral . . . Bolshevism, it appears, is not a Russian menace, but the logical outcome of the teachings of the Victorian economists." This sounds perilously like nonsense. Dean Inge finds the genesis of Bolshevism in the ravings of disillusioned sentimentalists, and this view has at least the merit of tallying with the facts as we have all been able to observe them since Bolshevism was first established in Russia.

No, we cannot admit that Mr. Hecht has proved conclusively that Protection amounting to prohibition is the universal panacea for the ills of the troubled world, or even of the nation, and a civilisation is more than a national affair. We cannot do away with nationality—for ourselves, we do not want to do so, and have very little use for internationalism as a policy—but Mr. Hecht says in his subtitle that he is out for a new scheme of things, so he ought not to limit it to individual nations. He will not get any nearer than Omar Khayyam to shattering it to bits, and then remoulding it nearer to the heart's desire, and particularly it may be confidently said that he has not helped us very far along the road by his recommendations.

X.

Aluminium: Its Manufacture, Manipulation, and Marketing. By George Mortimer, M.Inst.Met. Pp. viii+152. London: Sir Isaac Pitman & Sons, Ltd. 1920. Price 2s. 6d. net.

This little volume is one of Pitman's Common Commodities and Industries Series. It fills a distinct gap in technical handbooks, and it fills it decidedly well, because the author utilises the small space at his disposal not in wearisome repetition of facts already published *ad nauseam*, but in giving a great deal of matter known only to the expert, and what he does give us is really interesting and useful. Thus in the laudably brief account of the production of the metal, emphasis is laid on those details of electric furnace construction and operation which make all the difference between success and failure, and not on vague generalities leading nowhere. In this connection we are usefully reminded that the electrolytic recovery of aluminium looks beautifully simple and straightforward on paper, but nevertheless its successful commercial operation calls for the utmost care and vigilance, both as regards choice of suitably pure material and in the regulation of the many delicate operations involved.

The chapter on "Alloys of Aluminium and their Treatment" is a highly-condensed *résumé*, full of useful information and some valuable tables, while the following chapter, "Hints on Working with Aluminium," will be found extremely helpful by the average engineer; the section on "Soldering" is particularly excellent, and for practical purposes it exhausts the subject. This completes Part I of the book, entitled "From Clay to Consumer."

The second half deals with "Applications"; namely, in automobiles and aircraft, in the chemical industry and aluminothermics, and in the electrical industry, and again the author has covered a wide field in an extremely small space. Under the third heading the reminder that nearly 20,000 tons of aluminium (equivalent to double the quantity of copper) are employed on overhead transmission alone, serves to indicate the importance of this use of aluminium. During the war the Germans used aluminium for winding generators and transformers. This use can scarcely become normal, but for bus bars and connections aluminium is frequently becoming a serious competitor of copper. Here rise in temperature is one of the determining factors, and the greater area of radiation afforded by aluminium gives it a manifest advantage.

Another electrical application of aluminium of special interest is its use in winding magnet and other coils. The presence of the oxide film enables a pressure of ½ volt to be safely withstood between turn and turn, and it is therefore possible to use *bare* wire for this purpose, so long as there is insulation between the layers.

These and numerous other examples that might be quoted show how great a field still remains open for aluminium to enter successfully, and we commend this little book to engineers as much for its suggestiveness in this connection as for the direct usefulness of the practical information with which it is crowded.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

4,770. "Annunciators, &c." E. A. Graham. February 10th.

4,772. "Automatic, &c., telephone systems." Relay Automatic Telephone Co., Ltd. February 10th. (Sweden, February 11th, 1920.)

4,777. "Electro-mechanically controlled telephone system." F. Aldendorff and H. Baron (Aldendorff). February 10th.

4,778. "Magneto-electric machines." British Thomson-Houston Co., Ltd. and A. P. Young. February 10th.

4,801. "Electrical apparatus." E. L. W. Byrne. February 11th.

4,810. "Supports for incandescent electric lamps." T. Clark. February 11th.

4,855. "Electric motors for talking machines." J. T. Sibley. February 11th.

4,858. "Manufacture of electrodes." W. G. Michel. February 11th.

4,865. "Measuring unbalance." Western Electric Co. (Western Electric Co., (Inc.). February 11th.

4,889. "Road vehicle electric lamps." A. G. Curnow and Howes and Burley, Ltd. February 11th.

4,896. "Arrangement of insulators of precipitating installations." E. R. Marks (Siemens-Schuckertwerke) and Siemens-Schuckertwerke. February 11th.

4,897. "Arrangement of high-tension insulators of electric precipitating installations." Siemens-Schuckertwerke. February 11th. (Germany, February 11th, 1920.)

4,900/1. "Magnetic chucks." Taft-Pierce Manufacturing Co. February 11th. (United States, November 5th, 1914.)

4,904. "Electron discharge devices." British Thomson-Houston Co., Ltd. (General Electric Co.), and General Electric Co. February 11th.

4,907. "Radio signalling systems, &c." Radio Communication Co., Ltd., and J. Scott-Taggart. February 11th.

4,917. "Telephone transmitters." A. F. Sykes. February 11th.

4,950. "Junction boxes." A. P. Rutherford. February 12th.

4,958. "Connection system for electric transformers." G. Campos. February 12th. (Italy, February 12th, 1920.)

4,959. "Electro-magnetic tractor." C. J. Coleman. February 12th.

4,964. "Automatic fuse indicator." F. G. Dunn. February 12th.

4,990. "Electric motors." H. F. Ponsford. February 12th.

4,995. "Electron discharge devices." A. C. Bartlett and General Electric Co., Ltd. February 12th.

4,997. "Switches." N. Pemberton-Billing. February 12th.

4,998. "Temperature indicators." British Thomson-Houston Co., Ltd. (General Electric Co.), and General Electric Co. February 12th.

5,001. "Coils for electrical transformers." British Electric Transformer Co., Ltd., and J. Roothaan. February 12th.

5,007. "Tubular wall plugs." J. J. Rawlings and Rawlplug Co., Ltd. February 12th.

5,014. "Electric lamp holder." W. M. Strickland. February 12th.

5,015. "Reduction of interference in wireless telegraphy and telephony." H. Morris-Airey, L. G. Preston, and G. Shearing. February 12th.

5,026. "Microphonic sound boxes for telephones, gramophones, &c." F. P. Fry. February 14th.

5,031. "Electric conductors for internal wiring of buildings." D. S. Munro. February 14th.

5,042. "Electric plug and socket couplings." J. A. Crabtree. February 14th.

5,050. "Interchangeable electric holder adaptor." W. M. Strickland. February 14th.

5,059. "Appliance for detecting or measuring electric currents." J. K. Catterson-Smith and C. W. Stopford. February 14th.

5,095. "Measurement of polyphase electric currents." Metropolitan-Vickers Electrical Co., Ltd. February 14th. (United States, February 13th, 1920.)

5,096. "Electrical measuring devices for polyphase circuits." Metropolitan-Vickers Electrical Co., Ltd. February 14th. (United States, February 13th, 1920.)

5,100. "Electric lamp holders." G. F. Ostins. February 14th.

5,102. "Electric live wires or conductors." D. Adamson. February 14th.

5,107. "Transformer rectifier using both halves of the alternating current waves." Thorpe Electric Corporation. February 14th. (France, December 23rd, 1920.)

5,112. "Electro-deposition of metals." British Thomson-Houston Co., Ltd. (General Electric Co.), and General Electric Co. February 14th.

5,124. "Dead cable indicator." H. McCrudden. February 14th.

5,134. "Pre-heater for air in furnace plants, &c." Allgemeine Elektricitats-Ges. and F. Münzinger. February 14th.

5,135. "Heat exchanging apparatus." Allgemeine Elektricitats-Ges and F. Munzinger. February 14th.

5,139. "Electric contact devices." J. W. Walker. February 14th.

5,144. "Terminal pieces for electric conductors." H. B. Cornish. February 15th.

5,145. "Electric switches." H. B. Cornish. February 15th.

5,170. "Anti-vibration devices for supports of electric lamps, &c." E. E. Hopwood and Wardle Engineering Co., Ltd. February 15th.

5,173. "Circuits for magnifying or transforming changes of voltage or current." W. H. Eccles and W. A. Leyshon. February 15th.

5,201. "Magnetos." G. Gibson, H. C. Heckman, and A. E. Smith. February 15th.

5,206. "Alternating current relay." F. B. Dehn (Takamine Commercial Corporation) and Takamine Commercial Corporation. February 15th.

5,210. "Holders for electric incandescent lamps." A. G. Mead and Mead & Jeffery, Ltd. February 15th.

5,211. "Electric incandescent lamps." A. G. Mead and Mead & Jeffery, Ltd. February 15th.

5,216. "Dynamo-electric machines." A. H. Midgley and C. A. Vandervell and Co., Ltd. February 15th.

5,217. "Electric switchboards for motor cars, motor boats, &c." A. H. Midgley and C. A. Vandervell & Co., Ltd. February 15th.

5,223. "Thermo-electric heat accumulating cooking stoves." S. Cristiani and S. Sacerdote. February 15th.

5,231. "Generation of high-frequency alternating electric currents." E. F. W. Alexanderson and British Thomson-Houston Co., Ltd. February 15th.

5,232. "Radio-transmitting systems." E. F. W. Alexanderson and British Thomson-Houston Co., Ltd. February 15th.

5,235. "Electric light pendants." J. E. Barber, H. M. Burr, and W. F. Merry. February 15th.

5,239. "Cut-out for electric circuits." K. Kellendorfer. February 15th.

5,246. "Mercury, &c., vapour electric lamps." F. Reynolds and Silica Syndicate, Ltd. February 15th.

5,248. "Measuring length of electric waves." J. S. E. Townsend. February 15th.

5,259. "Electrical transmission systems." A. M. Taylor. February 16th.

5,286. "Electric globes or tubes for use as advertising signs, &c." F. Oppalfens. February 16th.

5,293. "Wireless, &c., telegraphy and telephony." H. T. Moores and E. E. Stewart. February 16th.

5,340. "Incandescent electric lamps." C. E. Newman. February 16th.

5,341. "Electric switches." C. A. Damey. February 16th.

5,345. "Protective devices for electric distribution systems." British Thomson-Houston Co., Ltd., A. S. Fitzgerald, and H. Pearce. February 16th.

5,347. "Electric switches." Cutler-Hammer Manufacturing Co. and Igranic Electric Co., Ltd .(Cutler-Hammer Manufacturing Co.). February 16th.

5,348. "Electric regulators." Cutler-Hammer Manufacturing Co. and Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). February 16th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1914.

12,156. "Electric gasfilled glow discharge lamps." Lederer. May 19th 1913.

1919.

9,316. "Wireless receiving and transmitting apparatus." J. Erskine-Murray and J. Robinson. April 11th, 1919. (158,005.)

15,937. "Methods of and means for obtaining alternating currents of any periodicity from existing systems of different periodicity." A. M. Taylor. June 25th, 1919. (Addition to 151,294, cognate applications 17,384, 1919 21,399, 1919, and 23,724, 1919.) (158,008.)

18,634. "Thermionic valves." L. A. McDougald. July 28th, 1919. (158,011.)

19,167. "Magnetic cores for dynamo-electric machine, transformers, electromagnets, and the like." W. A. A. Burgess. August 2rd, 1919. (158,013.)

24,640. "Cooling of transformers and other electrical apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). October 8th, 1919. (158,027.)

25,435. "Renewal of the filaments in metal filament electric lamps." S. Coxon and W. A. Williams. October 17th, 1919. (158,034.)

25,815. "Controllers for electric motors." British Thomson-Houston Co., Ltd. (General Electric Co.). October 21st, 1919. (158,045.)

25,817. "Electric ignition systems for internal-combustion engines." M. A. Codd. October 21st, 1919. (158,046.)

25,999. "Means for supporting electrical conduits and cables, pipes, rods, and the like." L. R. Lee. October 23rd, 1919. (158,059.)

26,016. "Electrically operated horns for motor vehicles." G. Frecheville. October 23rd, 1919. (Addition to 153,038.) (158,060.)

26,165. "Controllers for electric motors." British Thomson-Houston Co., Ltd. (General Electric Co.) October 24th, 1919. (158,067.)

26,199. "Electric torches." A. A. King. October 25th, 1919. October 25th, 1919. (158,070.)

26,223. "Electrically heated cooking utensils." N. C. Joseph. October 25th, 1919. (158,073.)

26,279. "Form of thermo-electric measuring instrument." C. M. R. Balbi. October 27th, 1919. (158,076.)

26,313. "Ventilation and cooling of electrical or other machines." K. Baumann and Metropolitan-Vickers Electrical Co., Ltd. October 27th, 1919. (158,081.)

26,314. "Ventilation and cooling of electrical or other machines." J. E. Jolly and Metropolitan-Vickers Electrical Co., Ltd. October 27th, 1919. (158,082.)

26,332. "Production of aluminium nitride by electrically-generated heat." Armour Fertiliser Works. July 10th, 1919. (146,919.)

26,347. "Means for controlling the transmission of electrical impulses." Sykes Interlocking Signal Co., Ltd., and W. R. & R. W. Tarrant. October 27th, 1919. (Cognate application, 8,897, 1920.) (158,085.)

26,488. "High frequency alternators." E. F. W. Alexanderson. November 4th, 1918. (134,830.)

27,804. "Electromagnets for magnetising permanent magnets." A. Luzy February 1st, 1918. (135,188.)

29,813. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., and G. W. Flynn. November 29th, 1919. (158,141.)

30,396. "Magneto-electric machines." C. E. P. Julien and ,B. Wolkoff. August 27th, 1919. (150,296.)

32,790. "Electrolytic gas generators." I. H. Levin. December 31st, 1919 (158,148.)

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502. "Limit switches for controlling electric motors." E. T. Caparn. January 7th, 1920. (158,150.)

4,950. "Control mechanism for electric cars provided with pneumatic brakes." Westinghouse Electric & Manufacturing Co. February 18th, 1919. (139,191.)

5,846. "Circuit breakers with automatic variation of the ignition for internal-combustion engines." J. E. Tuscher. February 26th, 1920. (158,157.)

16,064. "Production of high unidirectional voltages from an alternating voltage." Siemens-Schuckertwerke Ges. May 15th, 1918. (Addition to 142,465.) (145,029.)

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THE ELECTRICITY DISTRICT INQUIRIES.

AT a recent company meeting, Mr. George Balfour, M.P., gave a staggering figure for the cost of the inquiry which took place at Liverpool in January; he said he had ascertained that this amounted to not less than £40,000. Up to the present the inquiries have been very unpromising, and it seems that the matter demands very serious consideration, in view of the large number of inquiries that are pending. In the House of Commons the question is being pressed whether the holding of further inquiries, and the consequently large expenditures, should not be postponed. This follows on a previous question asking why the Electricity Commissioners are holding local inquiries to consider schemes for the formation of Joint Electricity Authorities, seeing that there is no power to finance such authorities at present. This question of finance depends, we are told, on the Electricity (Supply) (No. 2) Bill being passed. The introduction of the Bill has been postponed, and there are rumours that this is a preliminary to quietly shelving it. In any case, every month that passes is likely to make the passage of a finance Bill of this kind more difficult. At this time, when the need of economy in all directions is so apparent, it seems difficult to justify the holding of inquiries costing £40,000, when their outcome is contingent upon the passage of a somewhat controversial Bill which the Government has apparently shelved at least for a time.

Whilst our leaderette last week was being printed, Mr. Ll. B. Atkinson, at the annual dinner of the Institution, was likewise deploring the unsatisfactory outlook consequent upon the inquiries which have been held, and which reveal so little evidence of that spirit of willing co-operation on the part of corporations, companies, and consumers, which is essential to the success of the national scheme for the development of electricity supply. He, also, pointed out that the schemes put forward would not carry conviction to the minds of the financial experts upon whose collaboration the whole structure must eventually be based. If we err, then, we err in excellent company when we take a somewhat gloomy view of the future of the system of Joint Electricity Authorities as generally understood. We pointed out, over a year ago, that the opportunity had been afforded to the existing authorities to demonstrate their good faith and to carry the proposals of the Act to a successful issue by hearty co-operation for the national welfare—failing that, compulsory powers would inevitably be conferred upon the Electricity Commissioners; Sir John Snell, in December last, repeated that warning, as we reported in our issue of December 24th, 1920, and this fact was also very seriously emphasised by Mr. Atkinson last week.

Obviously, to continue holding inquiries at a cost of £40,000 a week (and be it noted that the Liverpool inquiry was adjourned, and was reopened on Tuesday last, to cost, perhaps, another £40,000) would be the height of folly unless very valuable results were obtained; so far there has been no such return for the extravagant outlay, unless the writing on the wall be an adequate return—the ominous warning that the scheme has been numbered, weighed, and found wanting, and that the kingdom is to be divided *compul-*

sorily! No; if the object cannot be attained in this way, the sooner we cut our losses and find another way, the better. One inquiry has been completed—and the Commissioners will have a difficult task to formulate a rational decision on the evidence that has been laid before them. One is still in progress, and another has been begun and promptly deferred *sine die*. And time is flying.

In December, 1919, the epoch-making Act was passed, and we surmised that the promised amending Bill would not be brought forward until the Commissioners had had time to explore the situation; we were partly right and partly wrong, for it was introduced and dropped; introduced again, shorn of its most contentious clauses, and shelved—anyhow, no legislative progress has been made since 1919, and even if the Joint Electricity Authorities are brought into existence, they will be powerless until the Act is amended and supplemented by further legislation. After a lapse of 14 months, the first inquiry was opened. In the meantime, with a few notable exceptions, the hands of supply authorities have been tied, would-be consumers are clamouring for service, unemployment is increasing, and the electrical millennium seems as far away as ever. The electrification even of suburban railways has been similarly held up by the uncertainty as to the future of our railway system due to Government control, and more recently fresh disturbances have been created by the sudden resolve of the Government to abandon control. All these factors tend to depress the electrical industry and, still more, the industries which it serves. It seems inevitable that whatever the Government lays its hand on is paralysed from that moment.

We have consistently objected to the nationalisation of our industries and public services; with the object lesson of the telegraphs before us, we issued many warnings as to the consequences of nationalising the telephone service, and we have similarly opposed the nationalisation of electricity supply. The alternative that we have advocated to the latter is development by companies under public control, a system which has worked most admirably in the United States and elsewhere, and which can be made absolutely safe if undue exploitation is feared. Incidentally, we have seen no evidence that the public interests have suffered from the operations of the North-East Coast companies, the one example of almost unfettered development that this country can show—successful, in spite of their being deprived of the right to supply in many parts of their area; and there no public control has been in force. But we fully approve of the provision of such control in some suitable form.

Now that the Joint Electricity Authority inquiries are failing to "produce the goods," we turn again to this system as the most hopeful way of escape from the threatened *impasse*.

We have before us a most illuminating case to illustrate our argument—the report of the Committee appointed by the Conference of Local Authorities of the West Riding Electricity District, a Committee of eight electrical engineers to local authorities which are statutory undertakers, appointed to prepare a draft scheme for submission to the Electricity Commissioners. We give an abstract of the report elsewhere in this issue. (In passing, we note that of the 17 authorities concerned, only ten voted in favour of the resolution advocating that the Authority should consist of elected public representatives—*i.e.*, excluding companies—and that the local authorities should accept the financial responsibility entailed.)

This committee agreed that the formation of a Joint Electricity Authority was essential, and that it must possess full owning and operative powers. Immediately the committee came up against the fact that the only alternative to this policy was to appoint the Yorkshire Electric Power Co. to be the Authority. With the candour of the engineer, unbiased by political considerations, the committee says: "From an engineering point of view this should prove a most satisfactory arrangement"—and it goes on to say that the company already possesses the necessary powers for almost the whole of the district, and a considerable network of mains in existence. If the Electricity (Supply) (No. 2) Bill became law, as we pointed out some months ago, a Joint Electricity Authority could delegate its powers to the company, and would then become an advisory body, while the company would be the operative body. This is the arrangement preferred by the Committee; moreover, the possibility of representation of the local authorities on the directorate of the company in consideration of financial support is regarded with favour by the committee, which concludes that such proposals would be "sound from an engineering standpoint." Thus it satisfies its collective engineering conscience—and we heartily endorse the scheme outlined, every item in which has been advocated in our columns.

But "right here" the politician butts in; the committee recognises that "the principle of the control of public utility undertakings by local authorities has obtained firm root in Yorkshire," and proceeds to demolish the scheme which it has characterised as "sound from an engineering standpoint." It points out that the existence of the Power Co. is an insuperable obstacle to the operations of a Joint Electricity Authority, owing to the rights which Parliament has conferred upon it in perpetuity, the duplication of mains that would be necessary, &c., and concludes that if a Joint Electricity Authority is established, it must have the whole of the main transmission system in its hands. After studying the possibility of representation of the Power Co. on the Authority, and finding that such an arrangement might confer upon the company a still stronger hold on the district, the committee concludes that the only possible solution is the purchase of the company's whole undertaking and rights, necessarily by negotiation. An inquiry as to its views elicited from the company the natural reply that as there was no body in existence to treat with, it could not discuss the sale of the portion of its undertaking concerned, and the committee was left to draw the optimistic inference that if such a body were constituted the company would be willing to consider the proposition—a view for which we find no basis in the company's reply.

That is where the matter stands at present. We have dealt with it fully because it is typical of the circumstances in numerous other cases, and the point which we wish to emphasise is this: That this committee of electrical engineers managing supply undertakings (including those of Bradford, Huddersfield, and Leeds) deliberately states that the best engineering solution of the problem is to entrust the whole business to the hands of the existing Power Co., which already possesses the necessary powers, and to appoint a Joint Electricity Authority without operative powers, to act in an advisory and supervisory capacity. A very similar proposition was put forward at Llandudno by the North Wales Power Co. It is a solution which we fully approve; it would make for efficiency and economy, and would ensure the safeguarding of the public interests together with the quickest possible progress. It would obviate the necessity for holding inquiries at fabulous expense, and would enable the engineers to go ahead at once (the Yorkshire Power Co., for instance, has important developments in hand, which are held up purely by the operation of the 1919 Act, just as were those of the County of London Co.). Financial difficulties would at once disappear—the inquiries have shown how nebulous are the ideas of the promoters of Joint Electricity Authorities on this most important subject, whereas the companies can find the money without delay.

The position of such municipal undertakings as those of Manchester and Glasgow, which, like many others of importance, have proved highly successful, would call for special treatment. We see no reason why they should not continue to develop on the present lines, becoming in effect the power companies for the immediately adjoining areas.

As we go to press we learn from our special correspondent at Liverpool that, directly the Mersey and West Lancashire District Inquiry was reopened on Tuesday, the representatives of two important municipalities announced the withdrawal of their support from the main scheme, and deprecated the formation of a Joint Electricity Authority. This announcement confirms and strengthens the views that we have set forth above.

State-aided Industrial Research.

The criticism which has for some time past been levelled at the Department of Scientific and Industrial Research, that its grants to industrial research associations result in commercial firms being subsidised by the State, was revived by the report of the Development Commission, which was published recently. The Development Commission has now been in existence for some ten years, and when constituted by Mr. Lloyd George, then Chancellor of the Exchequer, was granted nearly £3,000,000, to be employed in stimulating the economic development of the United Kingdom, with special reference to certain industries, such as agriculture, forestry, and fisheries. The important point, however, to which we wish to draw attention is that the Act of Parliament constituting the Development Fund stipulated against giving advances to an association of persons or a company trading for profit, and we are told that the Commissioners have interpreted the stipulation in the strictest sense. Having regard to the fact that the work of the Development Commissioners deals largely with research, it is impossible not to contrast the terms of its constitution with the policy adopted by the Department of Scientific and Industrial Research, of definitely fostering the establishment of industrial research associations, the funds of which are provided partly by the State and partly by the particular industry.

This matter can be looked at from several points of view. In the first place, the underlying principle of the formation of research associations under the Department of Scientific and Industrial Research was that every firm engaged in a particular trade should join the association, and by its contribution towards the funds, benefit by the industrial research work which it carried out, with State assistance. Literally, of course, this would imply that the State was providing money to enable commercial firms so to improve their processes that they could make greater profits, although, alternatively, the argument can be used that the result of this State-assisted research work ought to mean improved working processes, and necessarily a reduction in the price of the particular commodity as supplied to the public. Whether the one or the other of these hypotheses has been given practical effect by the policy of the Department of Scientific and Industrial Research with regard to industrial research associations it may, perhaps, fairly be argued that it is too early to form a judgment. On the other hand, there is the point of view of the firm which, for reasons satisfactory, at any rate, to itself, does not see fit to join the Industrial Research Association. One of the terms of the formation of industrial research associations is that the results of any research work are to be the property of the contributing firms, although other firms in the industry not associated can obtain the results by paying for them.

The original idea of the Industrial Research Associations was, in the first place, to co-ordinate research, and at the same time to make available to all members of a particular industry results which could only otherwise be obtained by much overlapping and unnecessary repetition, leaving it to individual firms, even though members of the Association, to make special investigations of particular interest to themselves in their own way. The terms of the grants made by the Department to industrial research associations are that they shall continue for five years on a £1 for £1 basis, *i.e.*, that for every £1 provided by the industry the Department shall provide a similar amount, although in at least one case the Department has provided £3 for £1, that being the glass industry. What the position will be at the end of this five years it it not possible to say, but the critics of State aid of this character cannot be sure of having things all their own way, because we notice that the Development Commissioners have asked for a modification of the Act of Parliament under which they work which will enable them to proceed on more or less similar lines to the Department of Scientific and Industrial Research. It seems to us that the real test of the matter is a public one, because all members of a particular industry can obtain the results of the work of their research association, whether they belong to the association or not. On that point there can be no cause for complaint, and the real justification for the continuance of State-aided industrial research is the production of higher quality articles at lower prices to the public.

The Poulsen Patent.

The application for the prolongation of the Poulsen patent, of which the hearing and judgment are recorded elsewhere in this issue, awakens mental echoes of the turbulent days through which the art of wireless telegraphy was made to pass before the war. Then the owners of the patent were moving heaven and earth to secure a share in the projected Imperial wireless chain, and the system was prominent in the Parliamentary question list, and in the proceedings of the Select Committee of Inquiry into the Post Office contract with the Marconi Co. But the Poulsen interests failed to attain their goal. The war broke out, commercial wireless development abruptly ceased, and all efforts were concentrated on meeting the requirements of the Naval and Military authorities; both the Marconi and the Poulsen systems were used, some remarkable long-distance "circuits" being carried out with the latter, and other methods of generating continuous waves were also employed. The Poulsen patent expired in 1917, and since then the British Post Office has adopted the system for some of its long-distance stations; it is also being used on some of the big ocean liners, and has, in fact, acquired a new lease of life since the death of the patent.

The patent rights passed through an extraordinary series of adventures during their existence; we need not follow their vicissitudes—suffice it to say that they finally came into the possession of the Marconi Co., which undertook a liability of £150,000 in respect of them, and thus acquired for a brief interval a virtual monopoly of long-distance wireless telegraphy in this country. Naturally the owners sought to revive that monopoly, and lodged an application for the extension of the patent. Mr. Justice Sargant, however, had no difficulty in making up his mind on the matter; he pointed out that the war had not prevented the owners of the patent from securing capital (per the Marconi Co.), and that it had brought them much business from Government departments—hence he did not even call upon the opponents to state their case. He remarked rather caustically that it was strange that an application should be made for compensation for loss due to the war on behalf of a company which only came into existence during the war, and that even if the life of the patent were prolonged to the utmost, it would extend only to July, 1922, so that it would harass those who had made use of the system since the death of the patent, without much prospect of benefiting anyone.

We cannot but approve of his decision, which appears to accord with common sense. The way is now clear for salutary competition between the various existing systems to come into play. There is plenty of scope for them all, and progress will be accelerated by the spur of necessity.

THE INFLUENCE OF TRANSFORMER CONNECTIONS ON THIRD HARMONIC VOLTAGES & CURRENTS.

By S. AUSTEN STIGANT, A.M.I.E.E., M.Am.I.E.E.

It is the purpose of this article first to enunciate briefly the fundamental principles of third harmonic voltages and currents in symmetrical three-phase systems; secondly, to indicate their origin purely in respect of transformers; thirdly, to marshal the facts and present them in tabular form, and finally to indicate their objectionable features.

It is not claimed that any new theories are introduced in the article, but simply that facts, often understood in a more or less vague sort of way, are here crystallised and presented in a clear manner.

Principles of Third Harmonics in Symmetrical Three-phase Systems.

There are two general forms of connections of three-phase systems to be treated of:—

(*a*) Star connection.

(*b*) Delta connection.

(*a*) *Star.*—In any star-connected system of conductors it is a basic law that the instantaneous sum of the currents flowing to and from the common junction or star point is zero.

In a symmetrical three-phase, three-wire star-connected system the currents and voltages of each phase at fundamental frequency are spaced 120 deg. apart, and at any instant the current in the heavier loaded (instantaneously) phase is equal and opposite in direction to the sum of the currents in the other two phases, and at fundamental frequency this balance is maintained throughout the cycle. At third harmonic frequency, however, currents flowing in each phase would be 3 × 120 = 360 deg. apart, or, in other words, in phase with one another and flowing in the same relative direction in the phases at the same instant. The sum of the currents in the star connection would, therefore, not be zero, and consequently in a symmetrical three-phase, three-wire star-connected system, third harmonic currents cannot exist.

If, however, a connection is taken from the neutral point in such a manner that it completes the circuit of each phase independently (though through a common connection), a current at three times the fundamental frequency can circulate through each phase winding and through the line wires and the fourth wire from the neutral point. The fourth wire acting as a drain for third harmonic currents preserves the current balance of the system; it has, of course, no effect on the currents at fundamental frequency as these are already balanced.

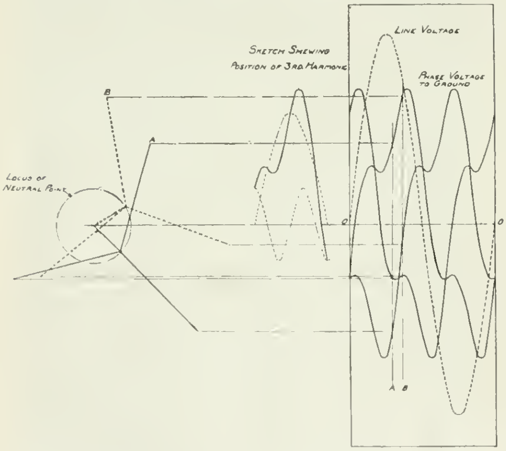


Fig. 1.—Phenomenon of "Oscillating Neutral" in a Symmetrical Three-phase, Three-wire, Star-connected System, with unearthed neutral.

Third harmonic voltages, on the other hand, can exist in each phase of a symmetrical three-phase, three-wire star-connected system, that is, from each line wire to ground,* but they cannot appear in the voltages between lines. The third harmonic voltages in each phase are in phase with one another so that there is one third harmonic vector only, and the neutral point of the star is located at the end of this vector. The potential of the neutral point is consequently not zero, but oscillates round the zero point at triple frequency and third harmonic voltage. Fig. 1 † illustrates this phenomenon and also shows how the third harmonic voltages to ground cancel out, so far as the voltages between lines are concerned, leaving the line terminal voltages free from their influence.

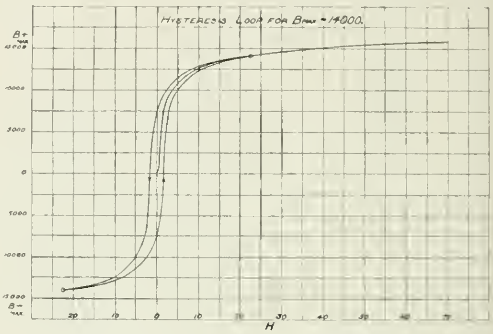


Fig. 2.—Typical B.H. Curve and Hysteresis Loop for Transformer Sheet Steel Core Plates.

When a connection is taken from the neutral point in such a manner as to allow third harmonic currents to flow, the third harmonic voltages to neutral are expended in forcing the currents round the circuits. It will be seen subsequently that according to the characteristics of the circuit in which these currents flow, the third harmonic voltages may be totally or only partially suppressed.

(*b*) *Delta.*—In any delta-connected system of conductors it is a basic law that the resultant fundamental voltage round a mesh is zero. That is, the addition of the voltage vectors at fundamental frequency which are spaced 360 ÷ *m* (where *m* = number of phases) degrees apart forms a regular closed polygon.

In a symmetrical three-phase delta-connected system third harmonic voltages tending to occur in each phase would be spaced 360 deg. apart, and so would be in phase with each other and act in the closed delta circuit as a single-phase voltage of third harmonic frequency. Such a voltage could not actually exist in a closed delta system so that third harmonic currents circulate round the delta without appearing in the line wires, and the third harmonic voltages are suppressed.

In discussing the third harmonic aspect of various combinations of star and delta connections for three-phase transformer operation we therefore have the following bases to work upon:—

1. With a three-wire star connection third harmonic voltages may exist between lines and neutral or ground, but not between lines.

2. With a three-wire star connection third harmonic currents cannot exist.

---

* With unearthed neutral, or from each line wire to neutral with earthed neutral. See appendix.

† Taken from a paper by J. F. Peters, "Harmonics in Transformer Magnetising Currents." *Procs.* A.I.E.E., 1915, p. 2,157.

3. With a four-wire star connection third harmonic voltages from lines to neutral or ground are partially or completely suppressed, according to the impedance of the third harmonic circuit.

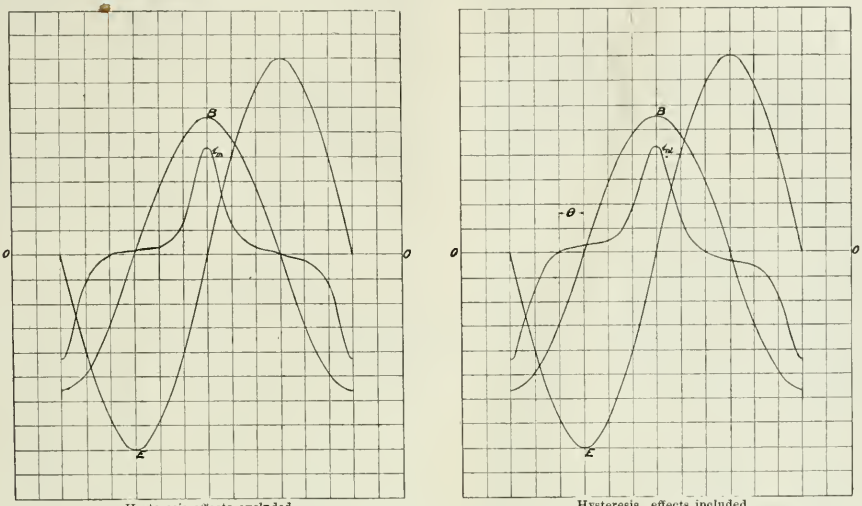
4. With a four-wire star connection third harmonic currents may flow through the phases and through the line wires and fourth wire from the neutral.

5. With a three-wire delta connection third harmonic voltages in the phases and hence between the lines are suppressed.

6. With a three-wire delta connection a third harmonic current may flow round the closed delta, but not in the lines.

Origin of Third Harmonic Voltages and Currents in Transformers.

It should be understood that this discussion is quite distinct and apart from higher harmonic functions of the source of supply, and it is limited to those which are inherent in the magnetic and electric circuits of the transformer. The two circuits being closely interlinked, it is a natural sequel that the higher harmonic phenomena occurring in both should be interdependent.



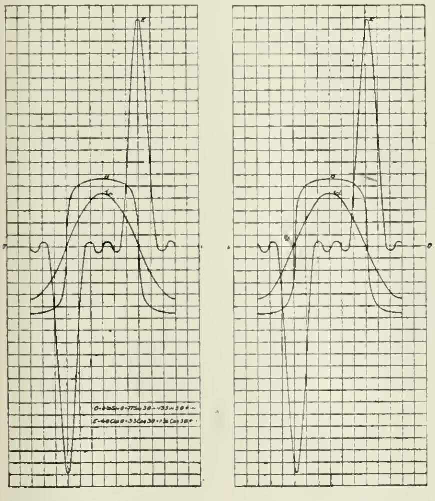
Hysteresis effects excluded. Hysteresis effects included.

Figs. 3 and 4.—No load Current, Induction, and Induced Voltage Waves, with a Sine Wave of Impressed Voltage.

It is well known that there are two characteristics in the behaviour of sheet steel transformer plates when under the influence of an alternating electro-magnetic field, which produce an appreciable distortion in the wave form (from the standard sine wave) of certain alternating functions. These functions are magnetising (or more truly no load) current, flux, and induced voltages, the distortion of which severally, or together, is due to the varying permeability of the sheet steel plates and to cyclic magnetic hysteresis. For the purpose of this article the range of the phenomena involved is more briefly and cogently explained by means of diagrams with short explanations than by lengthy dissertation and tedious mathematical equations; figs. 2 to 7 inclusive, together with the following remarks, aim at attaining this end.

Fig. 2 shows an average B.H. curve with hysteresis loop for modern silicon steel transformer plates; the hysteresis loop shown corresponds to a maximum induction of 14,000 lines per square centimetre. This figure is intentionally taken high in order to magnify the harmonic phenomena.

Fig. 3 shows the wave form relation between the no-



Hysteresis effects excluded. Hysteresis effects included.

Figs. 5 & 6.—No-load Current, Induction, and Induced-Voltage Waves with a Sine Wave of No-Load Current.

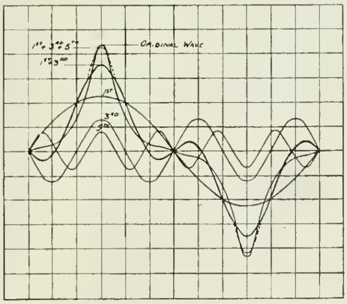


Fig. 7a.—Harmonic analysis of Peaked No-Load Current Wave of Fig. 3.

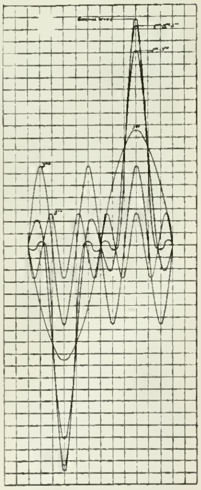
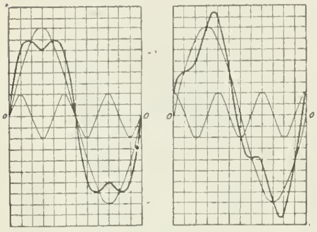


Fig. 7b.—Harmonic Analysis of Peaked Induced-Voltage Wave of Fig. 5.

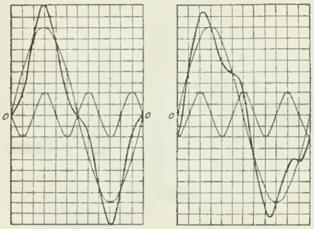
load current, flux, and induced e.m.f. when the e.m.f. is a sine wave and when hysteresis is absent. From a study of these curves it will be seen that the current is a true magnetising current, being in phase with the flux, its peaked form showing the presence of a prominent third harmonic. It will also be noted that this wave is symmetrical about the horizontal axis, and each half wave about a vertical axis. The flux must, of course, be sinusoidal on account of the assumption of a sine wave induced e.m.f.

Fig. 4 is similar to fig. 3, with the exception that hysteresis is taken into account. In this case the current is not a true magnetising current on account of the hysteresis component which is introduced, which makes the no-load current lead the flux by a certain angle θ, the hysteretic angle of advance. This figure also shows that for the same maximum induction the maximum values of the true magnetising and no-load currents are the same, but that when taking hysteresis into account the no-load current becomes unsymmetrical about a vertical axis passing through its peak. It will, however, be seen by comparing figs. 3 and 4 that the third harmonic component is contained almost entirely in the true magnetising current, and very little, if any, in the current component due to hysteresis, thus indicating that third harmonic currents are produced as a result of the varying permeability of the sheet steel plates, and only in a very minor degree by magnetic hysteresis.



Harmonic in Phase

Harmonic 90° Lead.



Harmonic in Opposition.

Harmonic 90° Lag.

Fig. 8.

Combination of Fundamental and Third Harmonic Waves.

Fig. 5 shows the wave form relation between the no-load current, flux, and induced e.m.f. when the current is a sine wave and when hysteresis is absent. As in the case of fig. 3 the current is a true magnetising current and in phase with the flux. The flux wave is flat topped which indicates the presence of a third harmonic in phase with the fundamental, the harmonic having a negative maximum coincident with the positive maximum of the fundamental, and so producing a flat-topped resultant wave. It will be noticed that the flux wave is symmetrical about the horizontal axis and each half wave about a vertical axis. The induced e.m.f. is, of course, affected by the departure of the shape of the flux wave from the sine, a flat-topped flux wave producing a highly peaked wave of induced e.m.f. (as shown in the figure) in which also appears a prominent third harmonic. In the case of the voltage wave the third harmonic is in opposition to the fundamental, the positive maximum of fundamental and harmonic waves occurring at the same instant, so that the resultant voltage wave becomes peaked.

Fig 6 is similar to fig. 5, with the exception that hysteresis is taken into account. In this case the no-load current leads the flux, thereby producing the hysteretic angle of advance θ as in the case of fig. 4. The flux wave is somewhat more flat topped, and while still symmetrical about the horizontal axis, each half wave is unsymmetrical about a vertical axis passing through its peak.

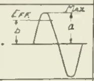
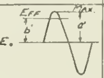
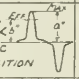
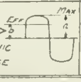
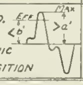
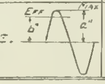
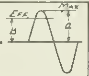
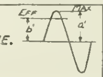
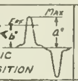
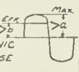
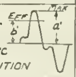
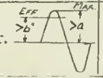
Hysteresis does not alter the maximum value of the flux wave, though it increases its dis-symmetry; the wider the hysteresis loop the greater the dis-symmetry of the flux wave.

Fig. 7 shows the analysis up to the fifth harmonic of (*a*) the magnetising current wave $_{m}$, fig. 3, and (*b*) the induced voltage wave E, fig. 5; in each case waves are given showing the sum of the fundamental and third harmonic, and indicating the degree of the error involved in ignoring harmonics beyond the third.

In order to obtain some idea at a glance as to the approximate phase of the third harmonic relative to the fundamental in a composite wave, fig. 8 is given showing the shape of the resultant waves obtained when combining the fundamental and third harmonic alone with different positions of the harmonic.

TABLE I.

Constant B_{Max}

Flux.			Induced Voltage		No Load Current.	
Wave Shape	Form Factor Compared To Sine Wave.	Iron Loss Compared To that with Sine Wave Flux	Wave Shape	Form Factor Compared To Sine Wave	Wave Shape	Form Factor Compared To Sine Wave
Sine. 	Same	Same	Sine. 	Same	Peaked. Third Harmonic in Opposition 	>
Flat. Third Harmonic in Phase 	<	Same	Peaked. Third Harmonic in Opposition 	>	Sine. 	Same
Constant $E_{Eff.}$						
Sine. 	Same	Same	Sine. 	Same	Peaked. Third Harmonic in Opposition 	>
Flat. Third Harmonic in Phase 	<	>	Peaked. Third Harmonic in Opposition 	>	Sine. 	Same

Wave-shape relationship between flux, induced voltages and no-load current.

From the foregoing discussion on the origin of third harmonics the following conclusions are to be drawn:—

1. With a sine wave of flux, and consequently induced voltages, the no-load current contains a prominent third harmonic which produces a peakiness in the wave. The third harmonic is introduced mainly into the true magnetising current component through the variation in the permeability of the sheet steel and only in a very small degree into the hysteresis component of the current by the cyclic hysteresis.

2. With a sine wave of no-load current the flux and consequently the induced voltages contain prominent third harmonics which produce a flat-topped flux wave and peaked induced voltage waves.

Table I summarises the above conclusions (*a*) for constant B maximum; (*b*) for constant E eff.

(*To be continued.*)

An Electrically-Welding Motor Repair Boat.—There was recently completed at Gothenburg a small motor tug and repair boat named *Esab IV* constructed by the Svetsnings Aktiebolaget, for the firm's own use. She is 52 ft. 6 in. in length, with a beam of 13 ft. 1½ in., and is fitted with a semi-Diesel engine for propulsion, in addition to semi-Diesel-engine-driven welding generating sets. The boat is used both as a tug and as a repair boat, the object being for it to proceed to vessels lying at anchor requiring welding work to be carried out on them. All the necessary equipment for the purpose is carried on *Esab IV*.—*Motor Ship.*

THE PRICE OF COAL IN RELATION TO ITS HEAT VALUE.

By J. S. EVENDEN.

The de-control of the mining industry, and the resultant de-control of prices, are matters of such importance to the coal consumer that they should command the closest possible attention, particularly in view of the many anomalies which have been permitted to exist for some time past. It will be generally admitted that the purchase of coal upon the basis of its heat value should be the aim of all large consumers, and concerted action on their part would tend towards the realisation of this ideal, but this action must not be confined to mere destructive criticism, its object should be the enlightenment of the colliery owners as to the real requirements of the consumers and the many disadvantages which are inseparably associated with the existing practice of charging for fuel by gross weight alone. This system, it is needless to say, will continue so long as it is passively accepted as inevitable by the consumer.

Those who have studied the publications of the United States Government relating to the preparation, purchase, storage, and utilisation of coal and allied subjects, and at the same time have had experience as large consumers in the United Kingdom, will have no doubt as to the urgent need for reform or the possibility of effecting a marked improvement upon our present methods.

At the time of writing (January, 1921) a comparison between the prices charged for several typical grades of coal shows some extraordinary vagaries, the following examples being sufficient to illustrate how the consumer is affected. These examples were not specially selected, but were taken at random and based upon a list of current prices f.o.r. London, and they are sufficient to show that there is at present no fixed relation between the price and the quality of coal.

	Calorific value (as received). B.th.u.	Cost per pound of ash-free dry coal. Penny.
Monmouthshire nuts	14,250	.313
Yorkshire washed doubles ...	12,800	.287
Nottinghamshire D.S. nuts ...	11,390	.293
Nottinghamshire nutty slack	10,500	.303
Derbyshire D.S. nuts	11,880	.317
Derbyshire nutty slack ...	10,400	.328
Derbyshire fine slack	9,300	.328
Leicestershire nutty slack ...	9,800	.315

It is surprising to observe from these figures that Yorkshire washed doubles and Monmouthshire nuts of high calorific value show an appreciably lower cost per pound of combustible than Derbyshire fine slack or Leicestershire nutty slack of very poor quality. Now it will be generally conceded that, in most power plants, a high average efficiency will be most easily maintained with good coal, while the most careful and continuous supervision is essential if good results are to be obtained with low-grade slacks. Therefore, it follows that, under prevailing conditions, the user of the latter class of fuel is subjected to a dual penalty, inasmuch as he has, in many instances, to pay more for his combustible (ash-free, dry coal), and has to spend more money in order to secure efficient combustion, and to pay for the handling and removal of an excessive quantity of incombustible residue. This is, of course, contrary to what would naturally be expected as a reduced cost per pound of combustible is necessary to compensate for the disadvantages which attend the use of low-grade fuel, and make its acceptance a commercially attractive proposition.

An important step towards the standardisation and equitable assessment of coal values would be made if washing and grading could be extended. With the exception of extremely poor coal, it would appear desirable that the whole output should be graded throughout down to peas so that only fine slack or slurry would remain as residue. The pre-war standard of care in mining, and the hand-picking of shale, &c., might well be restored, and every effort made to reduce the incombustible content as nearly as possible to the intrinsic ash contained in, and impossible to remove from, the coal.

It should be appreciated by the suppliers that consistency in quality and physical characteristics is of paramount importance to the consumer as, particularly in the case of coal used for steam boiler furnaces, such consistency tends to stabilise furnace conditions, and thus forms a valuable basis for efficient combustion.

It is, of course, appreciated that the war period imposed grave and far-reaching restrictions upon the mining industry and that, subsequently, industrial and other difficulties have rendered developments and improvements almost impossible, but the time is now approaching when the consumer will look for better service and, to no small extent, he has the power to secure it.

The recently legalised method of charging for gas by the therm (100,000 B.th.u.) would appear to afford a very suitable basis for the valuation and sale of coal. A standard pit-head charge per therm could be set up which might form the basis of a compensating scale to meet the variable factors attributable to the presence of excessive moisture and/or ash in certain grades. In other words, a premium would have to be added to the price per therm for good coal or a reduction made in the case of low-grade fuels.

The fixing of these charges could be made the business of a carefully selected committee representing the coal owners, the Government, and the consumers, and, when once established, it would do away with the anomalies already referred to in this and a previous article. Such a charge would, of course, be subject to the variations which changing industrial or market conditions might render advisable, just as the price per ton is now varied, from time to time, for similar reasons.

At the same time, it would be necessary to organise and make compulsory the continuous sampling and testing, at the pits, of each and every grade produced. This testing and sampling would need to be carried out in strict accordance with standard methods laid down by a small committee of experts appointed for the purpose, otherwise there would most certainly be an unfortunate lack of uniformity and, what is almost equally certain, the supreme importance of the utmost care in sampling, upon which the reliability and value of coal testing depends, would be overlooked.

When once this organisation had been established, it would become customary, if not compulsory, for the seller to supply the consumer with test results and definite guarantees relating to all coal supplied, the following being a rough suggestion as to the form which such an ideal guarantee might assume:—

Guarantee as to Class and Quality of Coal Invoiced.

The coal invoiced hereon was mined from the............ seam of the..................pit at..................Colliery in the County of.................. It consists exclusively of freshly mined coal in the form of..................nuts made through a screen of..............and passed over a screen of....................

The average of our daily tests on this identical class and grade of coal for the week ended........................ gave the following results.

Calorific value (dry)...................B.th.u.
Ash (as received)..................per cent.
Volatile matter (as received)..................per cent.
Moisture..................per cent.

and we hereby guarantee that the coal now supplied is equal in average value to the above.

Certain modifications would, of course, be necessary in order to adapt this form to the many classes of coal which are marketed for various purposes, but it is safe to say that some such guarantee would induce, if not compel, the seller to take a far greater interest in the quality of coal sent out, and would be extremely beneficial to the consumer. It will doubtless be said that the work of testing and furnishing results and guarantees would be a somewhat costly matter, but although this may be so, the expense would be very small in relation to the cost of production; moreover, it may surely be claimed that it is, and always has been, the obvious responsibility of the seller to take some really practical interest in the value of his output and be prepared to furnish to the purchaser a reliable guarantee as to quality and class of coal supplied, and the source from whence it was derived.

From the consumers' point of view there can be nothing but advantage in buying coal upon a thermal basis under strict guarantees, assuming, of course, that the methods of testing adopted by the collieries are of a proper character, the tests regularly conducted by experienced men, and liable to inspection at any time by Government inspectors. Moreover, the large consumers would naturally continue to carry out their own tests, and these would constitute a very valuable inducement to the colliery owners to see that their own testing was done in a proper manner and reliable figures furnished to their customers.

To the small consumer who cannot very well undertake his own testing the information provided by the suppliers would be most valuable, enabling him to ascertain the efficiency of his plant and generally increasing his interest in the all-important question of coal economy, which, even if it makes no appeal to the colliery owner, is of very great national interest.

Further, the very fact of selling coal by the therm instead of by weight, would have a beneficial effect upon the all-round quality of coal sent out, as it would no longer be desirable to permit an undue proportion of incombustible matter to leave the collieries, whereas, at the present time, it is obviously to the advantage of the seller to work in as much rubbish as the consumer will tolerate. In fact it seems as unreasonable to permit the sale of coal, free from all legal restrictions and requirements as to quality, as it would be to permit the supply of gas without any stipulation as to calorific value, illuminating power or pressure.

In this rapid survey of a big problem, the many difficulties to be surmounted and the conflicting interests involved have not been overlooked, and are fully appreciated, but it is confidently believed that, given the assistance of men possessing the necessary knowledge and experience, and having as their single objective the establishment of a more equitable and sensible method of preparing, distributing, and selling coal, the difficulties to be faced, although formidable, could most certainly be overcome. That this is a consummation much desired by the consumer does not seem open to question, but action upon his part appears to be necessary if it is to be brought about.

MOTOR-HOUSE LIGHTING FROM A CAR.

By "VOLTMAN."

The importance of having a good working illumination in a private motor-house requires no emphasising. If an ordinary lighting supply is already available there is, of course, no difficulty, one simply has a number of lamps placed in the required positions. To connect up specially a supply from the house and have special wiring and fittings put in is, however, nowadays so costly a matter that the ordinary motorist, with his greatly increased expenditure, has to look round for something suiting his diminished resources. The use of oil lamps is obviously attended with serious risks in view of the presence of inflammable material, and had better not be entertained. Yet it is quite a simple, and withal, inexpensive, matter to adapt the car installation to light the motor house very effectively to meet ordinary requirements, for which a general illumination suffices.

A car owner with an ordinary 12-volt equipment carried out his lighting on the following inexpensive lines:—He strung tightly two bare copper wires, No. 14 gauge, a few inches apart under the roof of the motor house which was originally a stable with the fittings removed. The wires he supported at the middle by a light wooden cross-bar or batten.

To the ends of the line nearest the door a length of lamp flexible was soldered, an ordinary pin socket contact being attached to the other end so that it could at any time be pushed into the connection provided on the switchboard of the car. Then three miniature b.c. lamp fittings with flexible, &c., were dropped at selected positions from the bare wires and the joints soldered. The usual miniature shades were not efficient, and larger and better ones were made from cardboard. In these fittings bulbs of 8 c.p., 10 volts, were inserted, thus allowing for a slight voltage drop, and the result was a very practical working light. A switch is quite unnecessary, as the socket serves the same purpose. A useful supplement to the installation is an inspection hand-lamp, having a few feet of flexible permanently connected through a switch to the line where it is brought down near the door. Usually the pin contact socket is reserved for this purpose.

In thus using current out of his battery for what is strictly an unintended purpose, it is important for the motorist to get his battery on charge as soon as he takes the car out again, otherwise he may find his lamps rather "low" at an inopportune time, particularly if the starter has to be used; this operation, of course, tends to "drain" the battery fairly rapidly. Car batteries, moreover, nowadays are of smaller capacity than formerly.

THE USES OF WOOD IN LEAD ACCUMULATORS.

By T. E. GREEN.

Wood, its treatment, and the study of its behaviour, play a much more important part in the manufacture and efficient working of lead accumulators than appears at first sight. It is used in large quantities for such important parts as the containers, stands, separators, &c., and for each part the suitability and special treatment of the wood has to be studied. That most commonly used is pitchpine, whilst a considerable quantity of teak is also used for certain special conditions. Pitchpine is a heavy resinous wood which shrinks greatly, and is rather liable to split. It is, however, cheap and plentiful. Teak is a more expensive wood, and is only used in special cases, such as for the containers of cells for use in tropical countries. It has immense durability. A comparative table of breaking weights for standard beams 1 ft. long by 1 in. sq. has been deduced by Sir John Anderson, from a close study of many experiments; the strength of teak is given as 814 lb., whilst that of pitchpine is in the region of 550 lb.

For stands for accumulators, pitchpine is usually used. It must be carefully selected, well seasoned, and free from knots, shakes, and other defects. The cells may be supported on wooden trays, which, if the cells are of the glass container type, may be filled with sawdust to take up any inequalities in the containers. The stands must be of ample dimensions for the work they have to do, and carefully made and erected, so that the weight of the battery is evenly distributed over the floor. They should receive at least three coats of acid proof paint, and should be without any metal fittings of any kind.

Wood is also often used for the containers of cells, mainly for the larger sizes, but also for portable cells and train-lighting batteries. As mentioned above, in cells intended for use in tropical countries, the wood used is usually teak, on account of its freedom from warping, even under the most extreme variation of climate. Pitchpine is the wood generally used for the containers of large stationary cells. The wood must be carefully selected and free from any defects. The sides must be of ample dimensions to stand any stresses which may be set up from the working of the cells. The sides are usually fastened by dovetailed joints, and pinned at the corners with dowels, the latter sometimes being made of hard wood. Before the lead lining is inserted in the containers, they must be either pitched or waxed or treated with some other equally good acid proof compound. In the case of portable cells and train lighting sets, teak is used, waxed and polished with paraffin wax.

The separators are a very important part of an accumulator, and before wood can be used for this purpose it has to be chemically treated, to get rid of all the wood acids, and thus render it inert when in the cell. It is obviously necessary for the wood to be highly porous when ready for use. After treatment, the separators are kept in water, and are dispatched wet; for if they were allowed to dry, they would warp and split. The treatment by which the wood is rendered inert also makes it very weak mechanically, and it is necessary to handle the separators very carefully. This should be especially remembered if at any time it is necessary to remove them from the cell for cleaning or similar purposes. The wood separators may be either in the form of dowels or sheets. Dowels are sometimes used in stationary cells. A grid is laid on the bottom of the container, and the dowels fit into this; they are further held in position by horizontal supports along the top of the battery and at right angles to the plane of the plates. Separators in the form of sheets are often used, especially for vehicle and other portable work. They are better than the dowel type, and are practically standard practice to-day. These sheets should be fastened so as to be flush with the top of the plates, and should project ¼ in. to ½ in. on each side and ½ in. to 1 in. or more at the bottom. They are held in position by means of wood dowels. They are usually placed exactly midway between the positive and negative plates; in the case of grid-type negatives, they may be placed against the negative plate, but care must be taken that they are never placed against the positives. This is sometimes done by inexperienced erectors, and the result is that the free diffusion of the electrolyte is considerably interfered with, and corrosion takes place. In the case of portable cells, train-lighting sets, &c., the sections are often rested on blocks of wood placed at the bottom of the containers, the wood being first treated with paraffin wax. In large stationary cells, waxed wood is often used for packing pieces between the edges of the plates and sides of the container.

LEGAL.

Philips v. Ajax, Ltd.

An Electric Belt Claim.

In the King's Bench Division of the High Court of Ireland, Dublin, before the Master of the Rolls, in an intended action by Mr. Edward McPhilips, of Bundoran, Co. Donegal, against Ajax, Ltd., manufacturers of electric apparatus and appliances, 25, Holborn Viaduct, London, an application by the intended plaintiff to serve a writ of summons out of the jurisdiction was refused, but liberty was given to apply to the full Court.

Counsel for the plaintiff (Mr. Maguire) said the action was being brought for alleged breach of contract with respect to an electric belt or appliance supplied by the defendants to the plaintiff, who sent them a cheque for £21 in payment for it.

In an affidavit Mr. McPhilips stated that in the month of January, 1920, he saw in a Dublin newspaper an advertisement inviting the public to send to the British Electric Institute (Ajax, Ltd.), at the address mentioned, for a copy of their book on electric treatment, which, it was stated, contained a price list for electric batteries. The advertisement set out the curative properties of the electric batteries manufactured by Ajax, Ltd., and represented that they were a remedy for nervous trouble and many other disorders and ailments. He wrote for, and obtained, a copy of the book advertised, entitled "Electricity, the Road to Health," with a covering letter enclosed, explaining that Ajax, Ltd., had spent many years studying the science of electric therapeutics. Eventually Mr. McPhilips sent them a cheque for £21 for the appliance, which Mr. Maguire now stated turned out to be quite worthless. The intended plaintiff further stated in his affidavit that the action could be more conveniently tried in Ireland than in London, as all the witnesses he intended to call resided in Ireland. One of them would be an expert.

The Master of the Rolls remarked that it might cost the defendants £500 to bring their experts over to Dublin.

Mr. Maguire described the plaintiff as a man of substance, and said it would be a negation of justice if he were not allowed to issue and serve the writ out of the jurisdiction.

The Poulsen Arc Patent.

Prolongation of Patent Refused.

In the Chancery Division, on Thursday, Mr. Justice Sargant heard an application for the prolongation of letters patent No. 15,599 of 1903, granted to Valdemar Poulsen, for improvements relating to the production of alternating electric currents. The applicants were Mr. Christopher Hage, of Copenhagen; the British & Overseas Engineering Syndicate, Ltd., 4, Old Burlington Street; and the Poulsen Wireless Telegraph Co., Ltd., Marconi House, Strand. The Board of Trade, Mr. C. F. Elwell, and the Radio Communication Co., Ltd., opposed the application.

Mr. J. Hunter Gray, K.C., and Mr. Trevor Watson appeared for the applicants; the Attorney-General and Mr. Jas. Whitehead for the Board of Trade; and Mr. Courtney Terrell for Mr. Elwell and the Radio Communication Co.

Mr. Gray said the application was made under the 1919 Act. The subject of the patent was usually spoken of as the Poulsen arc. With the arc they got a continuous oscillation of equal amplitude as long as the arc was burning. Mr. Poulsen suggested and obtained the use of hydrogen or coal gas as an atmosphere in which the arc was to burn. The result was that the oscillations were of greater amplitude, and consequently they were in a position to send these disturbances over much greater distances than was possible with the arc of Mr. Duddell. Mr. Poulsen also used a strong magnetic field which broke the arc at each oscillation, and it was the combination of these two devices with the Duddell invention which was claimed in Poulsen's specification.

The Attorney-General: We do not propose to make any attack upon the validity of the patent.

His Lordship: Does that apply to the opponents also?

Mr. Terrell: Yes.

The Attorney-General: We shall have to submit to your Lordship that this is not a case within the Act of 1919, inasmuch as there has been no loss or damage suffered in consequence of the state of affairs brought about by hostilities, and it is not really a case for originating summons.

Mr. Gray said the Poulsen arc as worked to-day was a most valuable commercial and industrial invention. Unless they had the continuous wave system of transmission they could not send telephonic messages as contrasted with mere Morse signals or telegrams. He had a long affidavit by Mr. Corby, the secretary of the Poulsen Wireless Telegraph Co., and he would call Mr. Gambil, who could deal with this from his own knowledge. Mr. Hage was only the legal owner of the patent, and the British Overseas Engineering Syndicate, Ltd., were at the date of this summons the beneficial owners; the Poulsen Wireless Telegraph Co. were now under an assignment really the beneficial owners. For some years from the beginning of the life of the patent the owners apparently had not got the money or did not take the proper steps to get it pushed at that time; many approaches were made to Government bodies and other people from time to time, first of all to take up the installation of this system, and also to other people to finance it, but there seemed to be, quite properly, a great reluctance on the part of those authorities and people to venture money on a thing which at the moment had not been proved in a commercial way, especially as the Marconi system was then realised as being a commercial matter, and was in fact used exclusively on board ships. At the time that war broke out there were altogether six stations which had been built and were worked on behalf of the Poulsen Co. under licence from the Post Office. The applicants said that if the war had not taken place they would have done a large business with the Admiralty, the War Office, the Post Office, and the India Office. They were equipped in August, 1914, to do big business, and if it had not been for the war they would have done it.

Evidence was then given by Mr. J. St. V. Pletts, who was for 20 years with the Marconi Wireless Telegraph Co., and was now an independent consulting engineer; Prof. E. W. Marchant, David Jardine Professor of Engineering of the University of Liverpool; Mr. Gambil, of the Poulsen Wireless Telegraph Co., and Mr. F. A. Walrond.

His Lordship, giving judgment, said the summons was certainly brought under very exceptional circumstances. The patent expired as long ago as July, 1917, and the originating summons was only taken out on July 5th, 1920, three years after the expiration of the patent and only two years from the utmost time to which under the provisions of the Act he could possibly extend the patent. If he granted an extension for the full term asked the only practical result would be that the patentees or applicants would get an extension from to-day till July 14th next year, and in the meantime the result would obviously be that any persons who had been working under the system in connection with the patent would find their operations hindered and jeopardised for that period of 15 months. He was deciding this on the submission by Mr. Whitehead that the evidence on behalf of the applicants was not sufficient to raise a prima facie case for extension. At the outbreak of war Mr. Hage was the sole owner of the patent. After the outbreak of war rather a complicated transaction was entered into under which the two petitioning companies came for the first time into the story: the British and Overseas Engineering Syndicate, Ltd., and the main applicants here, the Poulsen Wireless Telegraph Co., Ltd. Under the agreements that were made then, the English patents and some foreign patents were sold to the syndicate for the purpose of the syndicate reselling them to the Poulsen Co., and the syndicate, which had comparatively small capital, undertook some extraordinarily onerous obligations towards the Poulsen Co. By a deed of covenant entered into between the Marconi Co. and the Poulsen Co. the Marconi Co. undertook to fulfil the obligations of the syndicate as regards the provision of capital and so on, the result of which was that the Poulsen Co. became in a position to enforce from the Marconi Co. the provision of no less than £150,000 cash for the purpose of developing this patent. The first cause of loss that had been put forward on behalf of the applicants was that the Treasury restrictions which existed at the date when these agreements were entered into prevented the Poulsen Co. providing the capital which was necessary for the adequate exploitation of the patent. It seemed to him that it was quite plain that by reason of the practical cession of its rights to its rival, the Marconi Co., the Poulsen Co. did become in a position to command the whole of the capital necessary for the adequate development of its patents, and that therefore any loss that might otherwise have been said to be due to the Treasury restrictions was in fact not so caused. That source of loss being negatived, he had yet to deal with the loss which was alleged by reason of the company not getting such a large user of its patent as would have been the case but for the state of war. It seemed to him a curious state of circumstances that a company, not in existence before the war, should claim loss or damage by reason of the war when it only was constituted, as in this case, after the outbreak of war. He did not think that any substantial prima facie case had been made by the applicants for saying that they had had a smaller user of their patents than they would have had if the war had not broken out.

His Lordship then dealt with the user of the patent by the Government departments. As far as the Admiralty and the War Office were concerned, the evidence led him to think that there was in consequence of the war a much larger use on the part of both those Government departments than if the war had not occurred. He did not see any real reason to think that the result of the war was, as regarded general commercial uses, to interfere with any reasonable prospects of business that were enjoyed by the applicants at the date of the outbreak of the war. In his judgment, and having regard to the very strong case which had to be made by any patentee coming so long after the expiration of the patent, this was not a case in which the applicants had made a sufficient prima facie case for it to be necessary for him to call on the Crown and on the opponents of the applicants. He therefore dismissed the application with costs as towards the opponents, and of course no order as to costs in regard to the Crown.

A Cape Town Electrician Fined.

An electrician named Frank Scullard was recently charged at the Magistrates Court at Cape Town on two counts with contravention of the City Electric Lighting Regulations. The proceedings arose owing to a native having been killed by an electric shock, which was alleged to be due to defective wiring by Scullard, who had installed a light in a yard by running a flexible wire along a galvanised iron fence. The result was that the fence became alive, and the native received the shock on getting through the fence, a sheet of iron having been removed.

A fine of £5 on each charge, or three months' hard labour, was imposed.

Workmen's Compensation Claim.

(Telephone Linesman's Death.)

In the Mayor's and City of London Court, on March 7th, Mrs. Edith Farmer, 11, Redgrave Road, Putney, demanded £300 compensation under the Workmen's Compensation Act against the Postmaster-General for the death of her husband, who was a telephone linesman in the telephone department, and who met his death as the result of injuries received on February 17th of last year when he grazed his thumb, septicæmia supervening, death following on March 2nd.

Dr. Murray Leslie, the Home Office Medical Referee, sat with Judge Atherley-Jones, K.C.

Plaintiff stated that her husband complained to her that while at work on telephone subscribers' wires he scratched his thumb with a piece of copper wire. He did not pay much attention to it, but it got worse. She called in a doctor, who treated her husband for rheumatism and subsequently rheumatic fever. What he was really suffering from was septicæmia, and he was admitted to St. George's Hospital, where he died 14 days after the injury.

Mr. Gallaher, for the Postmaster-General, urged that there was no evidence to show that the deceased scratched his thumb while at his work, and there was nothing to connect his death with the accident, if there was one.

Ashby Cardrey, sectional engineer to the Post Office, who had charge of the deceased, said he worked on jointing lead covers for cables and joining subscribers' circuits, but he never complained of hurting his thumb.

Col. Prynne, D.S.O., C.B.E., F.R.C.S., chief medical officer to the Post Office, thought it improbable that the injury to the deceased's thumb caused his death.

Judge Atherley-Jones, K.C., deplored the fact that the plaintiff had had to conduct her case in person, instead of which the Postmen's Union should have looked after her. He found for the applicant for £300.

SWISS ELECTRICAL PROBLEMS.

The trend of affairs in Switzerland is of no little interest to the electrical world just now from two points of view. First, that country's progress towards normal conditions is being watched because upon it depends Switzerland's power for competition in the world's markets for electrical apparatus. Linked with that factor is the prospect of early and rapid development of the Swiss railway electrification programme, and of the capacity of that country's own engineering industry to cope with the consequent orders for plant. Two documents bearing on these points have just come into our hands, viz., a review of economic conditions by the Swiss Bank Corporation, and a note on Switzerland's water power in *The Anglo-Swiss Review*.

Rise in Wages.—Already Swiss industrialists have adopted the policy of establishing branch works in countries where that appeared to be the best method of tackling a market. This course has been pursued in the case of the machinery trades as well as in others perhaps better known, *e.g.*, condensed milk and chocolate. Hitherto the necessary capital has been provided by the parent concerns or closely allied financial groups; now funds are being sought in the countries where such branches are set up.

It must be said, however, that although Swiss industrialists complain of the reduced output of their workpeople, it is doubtful whether they will find much improvement in this respect in other countries, save perhaps in those where it would be useless to seek funds for the establishment of branch works.

The Association of Machinery and Metal Manufacturers has published the following table showing the effective wages of their workmen during recent years:—

	Average weekly wage of adult workmen. (Francs.)	Index of wages increase (adults).	Index of cost of living.
June, 1912	35.34 ...	100 ...	100
June, 1914	37.50 ...	105 ...	95
June, 1918	61.30 ...	174 ...	180
June, 1919	74.20 ...	210 ...	205-210
December, 1919 ...	77.85 ...	220 ...	205-210

When the figures for 1920 are complete it is expected that a further tendency in the same direction will be shown. It is estimated that as a result of increases in wages granted since the commencement of the war, the workers' conditions have been improved not merely sufficiently to compensate for the general rise in the cost of living, but by an additional 15 per cent. to 20 per cent. for all classes. Swiss manufacturers find themselves in consequence paying higher rates of wages than their international competitors. They ascribe much of their difficulty to the enforced adoption of the eight-hour day.

At the beginning of last year, new factory legislation came into force, and manufacturers have been chafing under its stringency. It enacts a maximum of 48 hours per week save under special authorisation, and places a strict limitation on overtime. Even if employers and employés agree together, the 48 hours may not be exceeded. In spite of concessions and increased wages (these have been doubled since 1914), there appears to have been a falling-off all round in quality and quantity of work.

Whilst a satisfactory state of activity prevails in the machinery works, it is felt that something like a crisis is approaching in the electrochemical industry, the majority of producers having shut down owing to the absence of export orders.

Use of Water Power.—The demand for cheaper electricity in Switzerland has given rise to a series of very interesting investigations. The Association of Swiss Electricians suggests the following two remedies: The erection of bigger power stations and the creation of more extensive artificial lakes for the storage of water, and the sale of energy by night at a cheaper rate than by day.

The creation of artificial lakes or accumulator lakes for the storage and control of the water supply of power stations has such undeniable advantages over the old method of procedure, that accumulator lakes are now being constructed wherever it is possible to do so. By damming a valley at a suitable spot a huge water reservoir can be created with a comparatively small expenditure of labour. The supply of water for the turbines is no longer entirely dependent on the water level of the river, and can be regulated at will by releasing more or less water from the reservoir.

The utilisation of hydro-electric power in Switzerland is of comparatively recent date, extending back for hardly more than 20 years. Since then the development has been extremely rapid. The war put a temporary stop to constructional work, but in 1916 it began again with renewed vigour. In no other branch of economics in Switzerland has such progress been made since then. To-day the capital invested in the various hydro-electrical undertakings in the country can hardly amount to less than one milliard francs.

At the beginning of the year 1914 the number of works in existence was 6,860, the average net output of which totalled 526,000 h.p. During the war these were found insufficient to meet the new demand, and they were enlarged by various temporary devices wherever it was possible. The level of most of the Swiss lakes was raised—among them the lakes of Geneva, of Neuchatel, of Lucerne, &c.—and a considerable increase in the power output was obtained during the winter of 1917-18.

In addition to these temporary measures, the erection of a number of new power stations was begun. Following is a list of the most important power stations that have been erected since that date. Some of them have not yet been completed: Laufenbourg, 25,000 h.p.; Bramois, 16,400 h.p.; Fully, 12,000 h.p.; Olten-Goesgen, 80,000 h.p.; Biaschina, 15,000 h.p.; Eglisau, 32,200 h.p.; Amsteg, 80,000 h.p.; Ritom, 72,000 h.p.; Muehleberg, 64,000 h.p.; Broc, 24,000 h.p.; Loentsch, 15,000 h.p.

Export of Energy.—The power stations of Ritom and Amsteg with their combined power of 152,000 h.p. are destined to supply the necessary current for the electrification of the St. Gothard line.

The exportation of energy to the surrounding countries has caused no little interest in Switzerland, and has frequently been a subject of comment in the Swiss Press. The exportation of energy has had to be authorised in every case by the Federal Government, and a maximum amount to be exported has been laid down. The maximum amount authorised up till the end of 1919 was approximately 100,000 kW, and was distributed in Germany, Italy, and France. It is very probable that in years to come Switzerland will be able to supply the surrounding countries during the summer months with a considerable amount of electrical energy which will be returned during the winter by power stations worked on the big coalfields in Germany and France. The saving in coal which would thus be effected would, when viewed in the light of the rapidly dwindling European coal resources, be a substantial step towards the solution of the present difficulties besides considerably stabilising Switzerland's economical position.

CORRESPONDENCE.

Letters received by us after* 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Lead-covered Wiring.

In my town a large amount of lead-covered cable is used for installation purposes by contractors, and I shall be glad if you will give me an indication as to how far any rules issued by the I.E.E. are legally binding in respect of any system of wiring. I have understood that the above-mentioned system is condemned.

If, for the sake of securing a contract, a firm can put in any rubbish, with the consequent liability to fire, what is the remedy?

There are, doubtless, many people who pay the price of a screwed or grip conduit system, and in return receive something which is not only a positive danger to themselves, but a bad advertisement for the supply authority. It is possible that chief engineers do not realise the dangers of cheap wiring owing to the fact that contract work is outside their domain.

If any recognised rules are binding, it appears to me that the sooner many chief engineers assert their authority the less we shall hear about "fires caused by an electric fuse."

Bourgeois.

March 2nd, 1921.

[The only wiring rules that are legally binding are those issued by the Board of Trade (now by the Ministry of Transport) for pressures exceeding 250 volts, and the Home Office Regulations for Factories and Workshops. The I.E.E. Wiring Rules have no legal force; they do not forbid the use of lead-covered cable, but Rule 68x prescribes the methods of installing and protecting it.

There is no legal remedy for damage resulting from bad wiring, other than that provided by the civil law.

Electricity supply engineers, with a few exceptions (where special powers have been obtained) have no power to "assert authority" over wiring. They can refuse to connect an installation unless they are reasonably satisfied that the wiring, fittings, and apparatus are in good order, and not calculated to affect injuriously the use of energy by themselves or other persons; unless they can substantiate their objection, they are liable to a penalty not exceeding 40s. a day during the default. Apparently the only recognised criterion of the condition of an installation is a leakage test prescribed by the Board of Trade.

The best remedy for shoddy wiring is the registration of contractors, which the Electrical Contractors' Association is endeavouring to secure.—Eds. Elec. Rev.]

Standard Costing Systems.

May I say how much I enjoyed your leading article of February 25th?

It would seem that the idea of costing as a necessity to every manufacturing concern has been rather too readily accepted. What is not so readily accepted is the certain standard of efficiency for which you plead. It is for the works accountant to keep this standard always before the management—and himself. He must, in short, be an idealist, for one hears of costing systems which were only perfected after years of investigation and hard work.

Your suggestion that standard systems might be applied to the various branches of the engineering trade, as the "Federation system" is applied to the printing trades, is admirable. One may hope that this question will soon be actively taken up.

It would surely be a simple matter to form committees of works accountants and practical engineers representing the various branches of the trade? This, I submit, is a first step which should carry us far.

W. Pope.

Wakefield.
March 4th, 1921.

Income Tax.

With regard to the Chancellor's announcement that a Bill will shortly be introduced abolishing the three years' average system, it may be well to consider the position produced by the alternative proposal to substitute (as recommended by the Royal Commission) the profits of the preceding year, having regard to the serious slump which has taken place in so many businesses.

Hitherto the three years' average has been based upon the profits for the three years ending on the date, preceding the year of assessment, to which the accounts have usually been made up, and most probably a similar system will be adopted with regard to the new basis of assessment.

Thus if a firm makes up its accounts to June 30th, the assessment for 1922/23 would be based on the profits for the year ending June 30th, 1921, and would thus include a large portion of the period prior to the slump. It is therefore an important question whether, in many businesses, it might not be advantageous to change the financial year so as to end on March 31st, in which case the assessment for 1922/23 would be based, as it should be, on the twelve months to March 31st, 1922. The Revenue officials could scarcely raise objection to this method being adopted, as it is merely carrying out the system advocated as nearly as possible.

May I suggest, therefore, that traders and manufacturers to whom this might be an advantage should take stock on the 31st of the present month so that later on in the year, when they will be able to judge whether it is advantageous to adhere to their old financial year or not, they will be in a position to adopt either system.

Chas. H. Tolley.

London.
March 7th, 1921.

The Severn Barrage Scheme.

In your account of the discussion on the above at the joint meeting in Birmingham, which appeared in your issue of February 25th, you report some remarks which I made. There are one or two errors in the figures which you quote, which I should be obliged if you will correct. The horse power available should be 7,000 b.h.p. instead of 700; the units developed per annum 15,000,000 and the units utilised 12,000,000, instead of 150,000,000 and 120,000,000 respectively.

F. J. Moffett.

Birmingham.
March 7th, 1921.

[The errors occurred in the official report, and appeared also in our contemporaries.—Eds. Elec. Rev.]

Payment According to Ability.

As a regular reader of the Review, I note certain ideas of contributors on the cause of low production. I am only a workman cable jointer; my idea is that none of your contributors have stated the right cause. It all lies in the system of wages. The grading, as it is called, would be better done away with. There should certainly be a decent starting wage in every trade, and for skilled and unskilled labour, and every man should have to undergo a work test to prove his capabilities before he was put on the books.

Take any class of work you like—for a start we will take a large fitters' and turners' shop where they employ 250 hands;

one-third of those will be good skilled mechanics and proper workmen; one-third will be fairly good men; the last lot will be men who are not worth their keep; yet they all get a standard rate. The consequence is that the skilled men will only do the same amount of work as the poor lot.

Then again, take a man who has served his time learning his trade, and has worked, say, 15 years at it besides; if he is any sort of a man his experience should make him worth all he gets by that time. Then take a young man who has just served his time, and is starting as a mechanic; he will receive the same wage as the man who has had the 15 years' experience.

It is the same in all trades nowadays. Trade will get worse instead of better if the wages system is not altered. Take my own case as a sample. I am an all-round man at cable work—making, laying, jointing, &c., but a non-plumber where I work now. I have done as much jointing in one day, by myself, as any two men that have ever been here. Yet we have men here who have not had a quarter of my experience; and I could make two joints to their one, and they are getting the same wage as me, and some of these men I have learnt them their work. I say let's have a fair starting wage for all, then let wages rise according to abilities and not by favour or chin wagging; let every man know that if he is worth more he will get it. You will soon find the good workmen then, and also the won't or can't workers.

A Regular Reader.

February 26th, 1921.

BUSINESS NOTES.

Easter Holidays.—The advertisement department of the Electrical Review draws the attention of advertisers to the arrangements for our issue of Friday, March 25th. As this will be published on the morning of Thursday, March 24th, it is necessary for new copy and alterations to existing displayed advertisements to reach 4, Ludgate Hill, by the morning of Thursday, March 17th (next week). Official notices and small prepaid advertisements can be received up to 5 p m. on Tuesday, March 22nd.

It will, of course, be necessary for editorial matters to reach us earlier than usual.

Bankruptcy Proceedings.—*Re* Malcolm Thomas Birch Gordon, 2, Beverley Road, Chiswick, and 165, King Street, Hammersmith, lately carrying on business at 20, Western Broadway, King Street, Hammersmith, under the style of Thomas Gordon, electrical and general merchant.—At the London Bankruptcy Court, on Monday, before Mr. F. T. Garton, Official Receiver, the first meeting of creditors was held under this failure. After dealing with the proofs of debt lodged, the Official Receiver stated that the debtor was at present employed as a traveller, but until March last he carried on business in his own name as a dealer in electrical accessories. He left school at the age of 17, and went to India where he was trained as an electrical engineer. In May, 1915, he commenced business on his own account, dealing in electric pocket lamps. He had no capital of his own, but he was joined in partnership by two other persons, who provided £25 each, and they traded as the Felux Co. The business was successful until November, 1915, when the supplies were stopped, and the business practically came to a standstill. His partners then left the firm, and he continued it under the name of Thomas Gordon at the same address. One of his creditors subsequently took back goods valued at £600, and another creditor goods to the value of £100. In February, 1920, the business again came to a standstill, but it was afterwards purchased by another firm who had since employed the debtor as traveller. He was sued by one of his creditors, and decided to file his petition. He executed a deed of gift to his wife, prior to his marriage in 1918, which covered the whole of the household furniture. He alleged his failure to have been caused through heavy interest on borrowed money, bad debts, and falling off in trade. The debtor had been adjudicated bankrupt, and a summary order obtained for the realisation of the estate. The statement of affairs showed liabilities amounting to £807, and assets £17, thus leaving a deficiency of £790. The estate was left in the hands of the Official Receiver for summary administration in the usual manner.

Henry John Monson, described as a radiographer, of 26, Manchester Street, W.—At a sitting of the London Bankruptcy Court, held on March 4th, before Mr. Registrar Francke, an application was made for an order of discharge on behalf of bankrupt. The Official Receiver reported that in October, 1911, the bankrupt commenced the electrical treatment of rheumatic, &c., patients, and in May, 1919, he transferred the business to a private company registered as Henry J. Monson, Ltd., which went into voluntary liquidation in the following December. The business was subsequently assigned to him by the liquidator for £1,156, which was set off against his interest in the company, and he continued the business until execution was levied on his effects by a creditor in August, 1920. He was made bankrupt in November, 1920, with liabilities £2,662 ; the assets had realised £237, and a dividend of between 1s. and 1s. 3d. in the £ would shortly be paid. The bankrupt attributed his failure to mismanagement by others of the company's business, and consequent loss of his shares in the company ; to loss by the forced sale of his effects, and to interest on loans. The discharge was granted subject to a judgment for £5 to be satisfied by an immediate cash payment.

W. H. Mellon (H. B. Wallis & Co.), electrical engineer, 37, Elliott Road, Chiswick. Trustee (Mr. T. Gourlay, 14, Bedford Row, W.C.) released February 25th.

A. E. Goodings, motor and electrical engineer, The Grove, Watlington Street, Reading.—Receiving order made March 4th, on debtor's own petition.

J. V. Bell, electrical engineer, 21, North Bar Within, Beverley, York.—Trustee (Mr. E. P. Dutton, Bowlalley Lane, Hull) appointed March 3rd.

J. Skinner (Foster, Skinner & Co.), electric fittings dealer, 6, South Castle Street, Liverpool.—Last day for proofs for dividend, March 23rd. Trustee, Mr. E. D. Symond, Official Receiver, 11, Dale Street, Liverpool.

Company Liquidations.—Steel Wing Co., Ltd., 48a, Gillingham Street, S.W.—Under a compulsory winding-up order, the report of Mr. W. J. Warley, Official Receiver, has been issued to the creditors and shareholders The company was formed in May, 1903, by the late Mr. George Pauling as the Krieger Electric Carriage Syndicate, Ltd., its primary objects being to acquire certain patents relating to electric vehicles, and to let out and vend such vehicles. The nominal capital was increased from £30,000 to £100,000, but was reduced to £72,250 by resolution, confirmed by the Court, in March, 1909. The business was carried on at a loss for some years, but in 1915 it was extended to include the construction of aeroplane wings and accessories. Contracts were obtained from the Air Ministry, and a mortgage for the sums payable thereon was given to the company's bankers to secure an overdraft. The accounts filed under the liquidation showed liabilities £27,064 against assets valued at £11,505, and a deficiency of £43,319 with regard to contributories. The failure of the company is attributed to an action launched in connection with the company's indebtedness to the promoter.

The statutory first meetings of the creditors and shareholders were held on March 3rd at the Carey Street Offices of the Board of Trade, Lincoln's Inn, W.C., before Mr. W. J. Warley, Official Receiver. No resolution was passed at either meeting, and the liquidation was left in the hands of the Official Receiver.

Electrical Industries, Ltd., 9 and 10, Pancras Lane, Queen Street, E.C.—A compulsory winding-up order was made against this company on January 18th, upon the petition of a creditor, and Mr. W. J. Warley, Official Receiver, has now issued his report to the creditors and shareholders. The accounts filed under the liquidation show unsecured creditors £1,611 ; preferential claims, £65 ; loans on debenture bonds, £1,050 ; assets valued at £1,045 ; and a deficiency of £2,033 as regards contributories. The company was registered as a private company in May, 1920, with a nominal capital of £2,000, its objects being to carry on business as manufacturers of, and dealers in, electric fires, lamps, &c. Mr. Edmund Woodroffe was the promoter of the company, and acted as sole director until October 4th, 1920. The company agreed to take over the business of Mr. E. G. K. Calder, a dealer in electrical appliances, and to manufacture and sell electric fires under a licence granted to the company by Mr. A. E. Woodhouse. In December, 1920, a debenture for £1,050 was granted to the Industrial Debenture Corporation, Ltd., to secure previous loans and a further advance of £50, and during the same month Mr. Edmund Woodroffe was appointed receiver on behalf of the debenture-holders. The Official Receiver observes that having regard to the date on which the debenture was issued, its validity was contested, and, as a result, it has been agreed to admit the debenture-holders as secured creditors for £50, and as unsecured creditors for the balance of £1,000. The Official Receiver has taken possession of the company's assets. The failure of the company is attributed to heavy overhead charges, fall in market price of goods purchased, and to the failure of a customer to take delivery of goods which had been purchased for £375.

Harman Electric Co., Ltd.—Meeting of creditors, March 16th, at 9, Walbrook, E.C. Liquidator, Mr. F. M. Jehoult.

F. Hudson & Co, Ltd.—Meeting of creditors was held on Wednesday, 9th inst., at 89, Chancery Lane, W.C. 2.

Dissolution of Partnership.—Johnson & Co., electrical engineers, 23, Piccadilly, Bradford.—Mr. A. Johnson, H. Hirst, and L. Harding have dissolved partnership. Debts will be attended to by Messrs. Johnson & Hirst, who will continue the business.

Trade Announcements.—Mr. W. T. Bower has resigned his appointment as managing director of Electrical Components, Ltd., and, pending the appointment of his successor, Mr. H. S. Seccombe (a director and London representative), will act as manager.

Mr. A. G. Perring, of Unity Buildings, 14, Temple Street, Birmingham (telephone, Birmingham Central 2159), has been appointed to represent Messrs. H. W. Smith & Co. (1920), Ltd., in the Birmingham District.

Messrs. C. Lorenz Aktiengesellschaft, Berlin, have purchased the Wild-Barfield patent rights for Germany, Poland, and the former Austria-Hungary. Messrs. Lorenz have already placed a first order with Automatic and Electric Furnaces, Ltd., for various parts to complete nearly 100 furnaces.

The Hamworthy Engineering Co., Ltd., has opened a branch office at 22, Dean Street, Newcastle-on-Tyne, with Mr. P. E. Brittain as Northern sales manager.

Messrs. J. M. Juniper & Son, electrical contractors, have opened new premises at 115, Chorley Road, Swinton, Lancashire.

The telephone number of Automatic and Electric Furnaces, Ltd., is now "Museum 4187."

Messrs. H. Pratt, Ltd., of High Street, Aston, Birmingham, have opened an electrical department in connection with the installation of electric lighting and power plants and the sale of electrical plant and accessories. They desire to receive catalogues and prices from manufacturers.

The London Electric Stores, of 39, Furnival Street, High Holborn, London, have been appointed sole London agents for the following firms:—Messrs. Ironclad Switchgear Co., Ltd., Eccles, manufacturers of ironclad switchgear; Messrs. Baker & Hyman, Ltd., Leeds, manufacturers of starters, resistances, &c.; Messrs. S. E. Giles, Kobe, Japan, importers of electrical accessories.

Catalogues and Lists.—Messrs. Pettigrew and Merriman, Ltd., 7, Henrietta Street, Covent Garden, W.C. 2.—An illustrated and detailed booklet (14 pp.), dealing with the "Select-o-Phone" for interior communication.

Henry Wells Oil Co., 11, Haymarket, S.W. 1.—A booklet entitled "The 'Germ Process' in a Nutshell," giving many details of this process of lubrication applied to various types of machinery.

Lanston Monotype Corporation, Ltd., 43 and 43a, Fetter Lane, E.C. 4.—An illustrated booklet giving particulars of "Radbore" heads for boring square holes.

Simplex Conduits, Ltd., Garrison Lane, Birmingham. "Installation News," February, 1921.—This booklet describes rectangular multiple switch boxes, lighting fixtures &c.

Messrs. Campbell & Isherwood, Ltd., Raleigh Street, Bootle, Lancs. General catalogue (103 pp.).—This is a well-produced and profusely illustrated list of electrical machinery and accessories. The catalogue includes steam-driven generating sets of 3½ kW and above, electrically-driven winches, motors, hoists, switch and fuse gear, gearing, ship's lights, measuring instruments, &c. Many useful tables are embodied in the publication, including the fusing current for wires of various materials and sizes, mechanical and electrical units and equivalents, thermometer scales, metric conversion tables, &c.

Engineering and Lighting Equipment Co., Ltd., Sphere Works, St. Albans, Herts.—An illustrated and priced booklet of fittings for "half-watt" and metal-filament lamps, including lanterns, reflectors and bowl fittings of many types.

Messrs. Kenrick & Jefferson, Ltd., 22, St. Andrew Street, E.C. 4. "K. and J. News," No. 1.—A booklet dealing with office furniture of various types, including desks, chairs, filing systems, &c.

The Ever-Ready Co. (Great Britain), Ltd., Hercules Place, Holloway, N. 7.—An illustrated price list of "Ever-Ready" dry batteries for wireless sets, ranging from 15 to 100 volts.

The Cable Accessories Co., Ltd., Britannia Works, Tividale, Tipton, Staffs.—Three leaflets, illustrated and priced, dealing with "Revo" house service switches and fuse boxes and electric light fittings (lanterns, bowls and watertight switches).

Messrs. L. G. Hawkins & Co., 116, Charing Cross Road, W.C. 2.—"The Link," Vol. I, No. 2, containing notes on shop window displays, and "Universal" appliances, with current prices.

The Hamworthy Engineering Co., Ltd., 76, Victoria Street, S.W., 1.—An illustrated leaflet giving price and details of the "Powerlight" 2½ b.h.p. lighting set.

The Midland Electric Manufacturing Co., Ltd., Barford Street, Birmingham.—Two illustrated advance lists of "Glasgow," "Kantark," and "Paragon" switchgear, giving revised prices.

The Edison Swan Electric Co., Ltd., Ponders End, Middlesex.—Abridged catalogue No. BB 143, giving illustrations and prices of electric bells, buzzers, indicators, pushes and accessories.

The Wallwin Co., Saltisford Ironworks, Warwick.—A folder advertising soft grey iron castings, and giving views of the company's works.

Messrs. J. F. Irvine & Co., Ltd., City Hall (Dock Street), Dundee.—Priced leaflet of "Plexsim Royal" electric suction cleaners.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Catalogue P (3) Section, dealing with d.c. motors; full details and illustrations are given. Catalogue P (4) Section; "Witton" a.c. motors; illustrated and dimensioned.

Mr. O. N. Beck, 11, Queen Victoria Street, E.C. 4.—A booklet dealing with "Roto" boiler tube cleaners, and a leaflet illustrating the "Torpedo" soot remover.

Twiss Electric Transmission, Ltd., 62 & 63, Queen Street, E.C. 4.—List TL 2a, illustrating and describing surge-proof pin insulators, spindles and clamps, with details of tests carried out upon insulators.

Lead.—Messrs. James Forster & Co., reporting under date March 5th, stated that the week had seen a very natural reaction from the low level of values touched on the last market day of the preceding week. "Highest prices paid were on Thursday, when £19 7s. 6d. was done for June, and £11 15s. March. The turnover was on a small scale, sales aggregating about 3,000 tons. . . . In the face of expectation of further supplies of the metal arriving from the Continent in the near future and the very spasmodic trade demand, it is doubtful whether present prices can be maintained. On the other hand, it must not be forgotten that lead is selling below production cost, and, in the long run, on a return to normal conditions, prices must advance to a permanently higher level."

An Effective Fire Showcard.—A novel design of showcard is being issued by The English Electric and Siemens Supplies, Ltd., Brook House, 191-192, Tottenham Court Road, W. 1; it is printed in attractive colours, and carries a model of the 1-kW Britannia fire. This model is illuminated by means of a 30-watt lamp carried in a box attachment fitted direct on to the back of the card, and a realistic reproduction of the glowing fire is thus obtained. Transparencies let into the card complete the advertising value by vividly displaying the name "Britannia Electric Fires," and the slogan "Cheerful and economical." A thermo-electric "flasher" can be connected to the lamp circuit should the exhibitor desire to obtain an intermittent illumination effect. The whole device folds flat, and is enclosed in a cardboard box to facilitate dispatch. These showcards are offered to all electrical dealers interested in the sale of Britannia fires, and afford an opportunity of effectively demonstrating a 1-kW fire with a consumption of 30 watts.

British Industries Fair.—Following upon a visit by a Swiss Commission to the Birmingham Section, a number of nationalities were represented in a large party which inspected the exhibition on March 2nd. The delegates were principally officials of the various Departments of Trade, but a number of business men also attended. The countries whose delegates attended were the United States, Belgium, Bulgaria, Canada, Czecho-Slovakia, Denmark, Holland, Finland, France, Italy, Norway, Poland, Portugal, Rumania, Jugo-Slavia, Sweden, and Switzerland. The visitors expressed their appreciation of the Fair and the hospitality extended them. A dinner, presided over by the Lord Mayor, was given to the delegates by the organising council.

Errata.—We regret that in our description of the Birmingham section of the Fair, last week (p. 289), we inadvertently styled the Midland Supply Co. as the Midland *Electric* Supply Co. The G.E.C. "Klersite" dynamo was also referred to as a magneto in one or two places. This is a series-wound machine.

Milan Sample Fair.—Under the patronage of the Italian Minister of Commerce, the International Sample Fair of Milan will be held from April 12th to 27th next in buildings specially constructed for the purpose. The object of the Fair is to place buyers in direct contact with producers. The trades and goods that will be represented include:—Agriculture, textiles, clothing, jewellery, silverware, sanitary appliances, chemistry, timber, minerals, glass and chinaware, paper, printing, furniture, automobiles, aviation, cycles, electricity, building construction, hydraulics, metallurgy, &c. The business transactions at the Fair last year amounted to upwards of 1,000 000,000 lire. A stand with an area of about 12 sq. metres, costs about £16. Special terms are arranged for several firms occupying the same stand. An interesting booklet in English has been issued by the Organising Committee, copies (gratis) of which can be had at the London offices of the Italian State Railways, Waterloo Place, Regent Street, S.W. 1, where arrangements incidental to the journey to Italy (reservations on trains, through tickets, &c.), can be made. There is every indication that both British buyers and British industries will be well represented at this Fair.

Low German Tender for Sheffield Plant.—According to the *Sheffield Daily Telegraph*, Mr. S. E. Fedden, general manager of the Sheffield Electric Supply Department, speaking at the second annual dinner of the Sheffield Section of the Junior Institution of Engineers, on 4th inst., said that during the last few days he had received a German offer of a large plant which complied in every way with the requirements of the city's supply department. It was offered at £40 000, and the lowest tender by English manufacturers for the same thing was £100,000. How could we possibly compete with that sort of thing? By working long hours at low wages the Germans were making a bold bid to be in the position of victors instead of vanquished. Dealing with the industrial situation at home, Mr. Fedden said that it presented a most difficult problem at present and, personally, he felt that there were still greater difficulties to be faced before industry really settled down to its normal level. Such a position could be restored only by everybody putting his back into work.

"Wages in all branches of industry will have to come down" he continued, "and they will have to come down heavily. The sooner we face it the better, but politicians will not face the fact. Wages have got to come down, and the sooner the working men realise it the better. Otherwise half the population will have to emigrate." Along with less wages must come less profits if the situation was to be saved.

The price of coal must be brought down to half or even lower, and therefore there must be a big cut in miners' wages. This would be followed by lower railway rates, and so on.

Czecho-Slovakia.—*Trua*, the new organ for the electrical trade in the Czecho-Slovak Republic and East Bohemia, which has seen its eleventh issue, is mainly a workman's organ, but the highest branches are catered for, its editor being Engineer Gustav Meyer. It is interesting to observe that, while advocating the Socialist standpoint, it is emphatic regarding the Bolshevic version of it. "Russia," it says, "which, after the collapse, took the first step to realise the beautiful Socialist idea, can offer us generally no good example." Its Socialism, apparently, is of the respectable, rational order, which seeks to raise the working class by self-education, both technical and economic. This education, it says, will save them from the "unreason of striking workmen," whose action in the past has ruined rich industries, or rendered them useless for indefinite periods for the welfare of whole kingdoms. "In this connection Russia offers us a sad and warning lesson."

Book Notices.—The "Practical Engineer" Electrical Pocket-Book and Diary, 1921. (610 pp.). London: The Technical Publishing Co., Ltd. Price, 2s. cloth, 2s. 6d. best binding, net.—The twenty-second issue of this pocket-book has been revised carefully, and additions have been made in many directions. The section on "Wireless Telephony" has been amplified to include thermionic valve reception, &c. New information is given on power-factor indicators, and the use of condensers for improving power-factor. The section on "Patents" has also received attention.

"The Electrical Power Engineer." Vol. II, No. 8. February, 1921. Price 4d.—In this issue the editor complains of lack of contributors, but admirably fills the gap himself. Reports of negotiations in the matter of the National Joint Board award, notes on the Ilford dispute, &c., occupy a large part of the journal.

The *Journal* of the Röntgen Society. Vol. XVII, No. 66. January, 1921. (48 pp.). London: Percy Lund, Humphries & Co., Ltd. Price 5s. net quarterly (to non-members).—The Presidential Address of Dr. Robert Knox is given in full, and many important subjects are dealt with. "X-Ray Work at Schenectady," by Dr. W. D. Coolidge (with discussion), and "Electrons" (Twelfth Kelvin Lecture), by Sir William Bragg, K.B.E., F.R.S., also appear, as well as abstracts of current literature upon radiology, &c.

"Electric Bells, Alarms and Signalling Systems." By H. G. White. Pp. 114, 75 diagrams. London: S. Rentell & Co., Ltd. Price 3s. 6d. net.

"High-Tension Switchgear." By H. E. Poole. Pp. viii + 118; 26 figs. London: Sir I. Pitman & Sons. Price 2s. 6d. net.

New Indian Company.—Among the new companies connected with the supply and distribution of electricity in India is the Maymyo Electric Power Station, Ltd., Maymyo, Burmah, capital 500,000 rupees.

The Revival of German Industries.—Ex-President Poincaré, in the political article in the *Revue des Deux Mondes* (February 1st), dealing with Germany's reparations, argues that her ability to pay lies, not in the amount of her actual capital, but in her annual productive capacity, and adduces as evidence of the increase of that capacity the following illuminating information on the rapid recovery of German industry, furnished in a public lecture by M. Georges Blondel, Professor at the Collège de France, who has paid several visits to Germany since the peace, and corroborated by all the leading German papers. At Essen, Bochum, and Dortmund, the ironworks are in full activity. The great firms of Krupp, Thyssen, Stinnes, and Mannesmann distribute dividends of 10, 15, 20, 40, and even 50 per cent. The Allgemeine Elektricitäts Gesellschaft has just distributed 14 per cent., and Krupp reports net profits of Mk. 69 mill. The textile industry is equally flourishing. The *Kolnische Zeitung* (January 7th) states that the mills have resumed full activity, and are distributing dividends of 10, 15, and 18 per cent. In the chemical industry, the firm of Bayer, of Leverkasen, has recently paid a dividend of 18 per cent. On all sides are to be seen the same signs of recovery. The wood industry has been reorganised the more rapidly, in that Germany possesses immense forests, 39 per cent. of which, in the form of domain and Crown forests, are owned by the State. The paper industry has no longer anything to complain of, and the Reishotz works have also paid a dividend of 18 per cent. While the majority of French banks dare not lock up any of their funds, and in many cases are living from hand to mouth, the German banks realise large profits and distribute dividends varying from 10 to 25 per cent. The cartel system, which was so widespread before the war, has been re-established in all its force, as the *Kolnische Zeitung* and *Germania* exultantly proclaim. To-morrow we shall see German industry rejuvenated, and, led by a select number of bold captains of industry, ready once more to capture the world's markets. All the better for Germany. This marvellous revival does credit to her spirit of initiative, her will, and her patriotism. We are not so ungenerous as to fail to do justice to these remarkable efforts. But at least let her cease from shouting ruin. Do not let her continue to pose as the insolvent debtor, and let her lay aside the disguise of starvation and poverty.—*Economic Review.*

Registration of Contractors.—The *Electrical Contractor* says that one of the most important matters immediately before the Electrical Contractors' Association is the question of Registration. Every effort is being made to press this claim before the Government Departments which have power to initiate the necessary legislation.

Prices Reduced.—The Bastian Electric Co., Ltd., announces that, owing to the lower cost of raw material, it is reducing the list prices of Bastian tanks and accessories by 10 per cent. We understand that upwards of 200 of these tanks have now been installed, with satisfactory results.

Scandinavian Electricians' Union.—*Berlingske Tidende* learns from Christiania that a meeting has been held there between representatives of the Danish, Norwegian, and Swedish Electricians' Unions. Important decisions were reached, the chief one being an agreement by which, in case of a serious dispute in one of the Unions, the other Unions would be bound to contribute pecuniary support amounting to at least Kr. 90,000 during a period of 12 weeks. In less important disputes assistance is to be afforded according to a fixed scale. These and other agreements will have the effect of combining the three Unions into what, for practical purposes, will be one body.—*Reuter's Trade Service* (Copenhagen).

Trade-Mark Applications.—Appended is a summary of the recent applications for British trade-marks in connection with the electrical industries and trades:—

Wagner Quality (lettering and design). No. 401,788. Class 6. Electrical machinery. Wagner Electrical Manufacturing Co., 6,400, Plymouth Avenue, St. Louis, U.S.A. March 12th, 1920.

Singalvo. No. 409,749. Class 11. Electric appliances for curative purposes. Paul Bischofberger 21, Central Strasse, Lucerne, Switzerland. November 15th, 1920.

W (letter in form of design). No. 407,511. Class 13. Electrical goods. Mitchell & Co., Ltd., Endwell Works, Endwell Road, Brockley, S.E. August 28th, 1920.

G.H.B (lettering and design). No. 410,071. Class 13. Sparking plugs. G. H. Barraclough, John Street, Thornton, Bradford, Yorks. November 26th, 1920.

Leefur. No. 408,431. Class 18. Electric furnaces, electric rivet heaters, and electric hardening and tempering plant. Leeds Electric Construction Co., Ltd., Charmouth Street, Leeds. October 6th, 1920.

Dagea. No. 409,771. Class 18. Electric heating and cooking apparatus. Auerlicht Gesellschaft, 11-14, Ehrenberg Strasse, Berlin. November 13th, 1920.

Westinghouse (lettering and design). No. 410,655. Class 13. Connectors for secondary batteries. Westinghouse Union Battery Co., Swiss Vale, Penn., U.S.A. December 15th, 1920.

Commercial Experts to Visit Italy.—At the suggestion of the former British Ambassador, Sir Rennell Rodd, the Lord Mayor of Glasgow is arranging that between two and three hundred important persons from political, industrial, and commercial centres in Glasgow, Manchester, Liverpool, and London will shortly make a trip to various Italian cities, including Milan, Venice, Florence, Genoa, and Rome. The party is expected to arrive shortly. Commercial circles here welcome the visit, as it will enable English business experts to ascertain the situation in Italy for themselves, and thus initiate the strengthening of business relations between their country and Italy.—*Reuter's Trade Service* (Rome).

Catalogues for Venezuela.—A commercial museum is to be established in connection with the Department of Commerce in the Ministry for Foreign Affairs of Venezuela. The museum is intended to be a permanent exhibition of samples of both home and foreign products, of catalogues of foreign firms, commercial reviews, &c., and a free information service with regard to these matters will be maintained. The Director of the Department of Commerce has informed H.M. Vice-Consul that United Kingdom samples, catalogues, in fact, anything that will help to promote trade between the two countries, will be gladly received, and should be addressed as follows:—Senor Director, Direccion de Politica Commercial, Ministerio de Relaciones Exteriores, Caracas, Venezuela.

Underground Efficiency.—In pursuance of the sixth series of Staff Efficiency Meetings organised by the Underground Companies, the fifth meeting was held at the L.G.O.C. Training School at Chelsea. It was attended by upwards of 300 members of the Administrative and Control Staff. A paper on "Lifts and Escalators" was read by Mr. W. S. Graff Baker, electrical assistant to the mechanical engineer of the Underground Railways, and was followed by a general discussion. The importance of the subject is emphasised by the fact that nearly 1,000,000 passengers are carried by the Underground lifts and escalators every week-day.—*Islington Gazette.*

Social Events.—The members of the Victoria Works Athletic Club (Messrs. Johnson & Phillips, Ltd., Charlton, S.E.) held their annual dinner on Saturday, 5th inst., in the club-rooms attached to the works. The chair was occupied by the president, Mr. H. J. Sheppard, general manager of the firm, supported by the vice-presidents (departmental managers). After dinner the usual toasts were given, with a concert following, the artistes all being members of the club and firm.

German Electric Companies in Sweden.—The Siemens-Schuckert Co. and the Allgemeine Elektricitäts Gesellschaft have formed a new company at Stockholm for the purpose of manufacturing and selling incandescent lamps and electric apparatus. The minimum share capital is fixed at Kr. 250,000.—*Reuter's Trade Service* (Stockholm).

For Sale.—By direction of the Disposal Board, Mr. H. D. Phillips will sell by auction on March 22nd, 23rd, and 24th, at the Royal Hotel, Bristol, shipyard plant, cranes, machine tools, electric generators, motors, cable, &c., lying at Beachley, Portishead and Portbury, and Frampton gravel pits. Mr. G. Tinsley will sell by auction on April 13th and 14th, at the South Careton Aerodrome, Lincs., huts, hangars, and machinery, including the contents of the power station, also surplus materials, fixtures, &c.

Messrs. A. T. & E. A. Crow will offer by auction on April 7th, at Lemington, near Newcastle-on-Tyne, a quantity of electrical plant, motors, machine tools, &c., lying at depôts in the Newcastle district.

Peterborough Corporation Electricity Department invites offers for one 240-kW d.c. generating set, one 120-kW ditto with one spare armature, various pipes, valves, &c.

Accrington Corporation Electricity Department has for disposal a surface condensing plant, by Ashton, Frost & Co., complete with pumps, oil separator, &c.

Winchester Corporation invites offers for two 200-kW generating sets. For full particulars, see our advertisement pages to-day.

Art in Illumination.—There is increasing evidence that the enormous possibilities of lighting as a means of beautifying a building, as well as serving its primary object, are being realised more and more. People are not satisfied nowadays with a plain lamp and reflector which clash with their surroundings, but seek to find a means of illumination which, while efficient, falls in with the general scheme of things. In these circumstances a collection of such means becomes of more than ordinary interest. Messrs. Albert Lee & Co., Ltd., 8 and 9, New Zealand Avenue, E.C. 1, have recently instituted a display of this nature. Behind a rather unpretentious exterior they have amassed an exhibition of all kinds of lighting fittings showing excellent taste and variety. The show-room is of ample size, and is not over-crowded in spite of the multitudinous nature of the display. From the ceiling are suspended many types of bowl fittings in alabaster, carved "rottenstone" and glass of all kinds, including some examples of pressed glass, which is a wonderful imitation of alabaster with a "moonstone" effect. There are lanterns of all periods, and the old brass and ironwork is very true to type. The cut-glass bowls, of which there are numerous examples, are of very fine workmanship, and the same may be said of the painted coloured bowls. Wall fittings have their place in the showroom, and are tastefully arranged with a view to correct display. A "secret" light shown consists of an elliptical alabaster bowl with an oxidised silver rim, and gives a beautifully soft light. This is suitable for installing in the nooks usually found in houses of the Tudor or Elizabethan periods. Many kinds of glass shades for wall brackets are shown, including flambeaux, candelabra, and tinted and painted glassware. Some excellent examples of Japanese silk shades for lamp standards are exhibited, as well as standards in various woods and metal finishes. Floor standards, Tudor, Jacobean, Sheraton, &c., appear, and "outlets" are provided at intervals in the floor for plugging into to demonstrate these. There are "outlets" all over the place, making demonstration a very simple matter. The lights are wired in small groups, and the switching arrangements provide for the switching off of a group from the next switch plate in progress round the room, so that it is unnecessary to run back and switch off each time a new group is reached. The furniture is in harmony with the spirit of the display, the smaller exhibits being mounted on antique dark oak or mahogany tables. The display is, without doubt, worthy of a visit from those interested in the art of illumination.

Scottish Electricians' Strikes.—In many parts of Scotland electricians have come out on strike over a wages dispute, the National Conference in Edinburgh, on March 4th, having failed to reach a settlement. The employers are reducing the wages by 3d. an hour, making the wages 2s. an hour. In Aberdeen the position is complicated by the Union's action in bringing apprentices out, and it is stated the employers are to raise the question of the legality of this action. Public lighting is not affected, nor are shipyards or engineering works.

E.T.U. Conference.—The Electrical Trades Union will hold its annual conference in Blackpool during Whit-week.

Electrical Exhibitions.—Under the auspices of the municipal authorities, an electrical exhibition is to be held in the Town Hall, Aylesbury, from March 21st to 24th. Practical demonstrations of electrical cooking, heating, washing and cleaning will be carried out, and electric-lighting sets, electric vehicles and small farm plants will be shown in operation. Lectures upon electricity in the home and applied to agriculture are being arranged.

The municipality of Hereford is also contemplating the arrangement of a display of electrical apparatus, with an electrical *café*, &c.

The Lyons Fair.—At the Lyons Fair, which opened on March 1st, Great Britain heads the foreign representation with 115 stands. More than 60 firms are grouped by the Federation of British Industries. The Federation is giving a daily kinema show in which many British products are seen in process of manufacture.—*Daily Mail.*

The Fall in Metals and Australian Production.—Owing to the fall in the price of metals, the Queensland Government is closing down the Chillagoe silver, lead, and copper smelting works. Fifteen hundred employés are affected.—*The Times.*

New Italian Companies.—There has been formed at Borgosesia the Società Idroelletrica dell'Artogna with a capital of 3,000,000 lire, for the development of the hydro-electric industry.

The Società Impianto Elettrico has been embodied at Cagliari, with a capital of 300,000 lire, and offices at Sanluri.

The Stabilimento Italiano Lavorazione Elettrica Serramenti M. Bassi Janovitz has been established at Gorizia with a capital of 200,000 lire.

There has been constituted at Milan (Via Monte Napoleoni 39) the Società Italiana per l'Accumulazione Termoelettrica T.E.A. for the manufacture of economical electric cooking apparatus. Capital, 5,000,000 lire.

The Imprese Forniture Elettriche Ing. Beretta has been launched at Milan (Via Meravigli 7) for the manufacture of electrical machinery, with a capital of 300,000 lire.

The Società Elettrotecnica Ing. F.G. Pistorelli e Ca has been embodied at Padua for the construction and equipment of central stations. Capital, 400 000 lire.

At Varese has been formed, as a company, the Industria, Commercio, Applicazioni Termiche Elettriche, with a capital of 5,000,000 lire, for the equipment and carrying out of electrothermic installations.

LIGHTING AND POWER NOTES.

Aldenham.—House Lighting.—The Watford Rural District Council has arranged to extend the lighting mains to supply electricity to houses at Aldenham, and to connect at the rate of £4 per house.

Australia.—Sydney (N.S.W.).—A keen controversy is taking place in Sydney as to whether a new turbo-alternator, required in connection with an extension of the city's electricity service, should be manufactured locally or imported from the United States. It has been shown that the Cockatoo works can manufacture the boilers and the turbine, and that they may possibly be able to make the greater part of the generator. The boilers made there for H.M.A.S. *Brisbane*, and other warships, are said to be of a similar type to those required by the City Council. The turbines made and installed in the ships were also much the same as the Council requires. Meanwhile the contract is in abeyance.—*Reuter's Trade Service* (Melbourne).

The Municipal Council has decided that it is inadvisable for the electrical engineer to join a conference of representatives of Government authorities and other suppliers of electricity to consider what form legislation should take to provide for the control of wholesale bulk power development and transmission within the State.

Bentley (Yorks.).—House Lighting.—The Doncaster Electricity Committee, after considering correspondence with the Bentley-with-Arksey Urban Council, has recommended (1):—That the Corporation undertake to supply electricity to the proposed houses at Arksey Lane at (*a*) a fixed rental of 1s. 3d. per week per house, plus 2d. for each unit metered; (*b*) that the charges in respect of the Victoria Road site be revised to correspond with the above-mentioned terms; and (2) that in the event of acceptance, application be made for sanction to borrow £6,205 for the provision of high- and low-pressure mains and transformer equipment for these purposes.

Bexhill.—Second-Hand Plant.—The Council has ascertained from the Electricity Commissioners that the shortage of electricity cannot be met for several years by the Government scheme or the Hastings scheme for bulk supply. It being, therefore, incumbent on the Council to provide the required generating plant, it was resolved to purchase a second-hand 500-kW Belliss-Dick, Kerr generating set from the Accrington Corporation for the sum of £3,800. The Council is advised that the plant should be good for at least 10 years.

Bideford (Devon).—Electricity Supply.—The Town Council has signed an agreement with Mr. S. L. Knill, of Barnstaple, for a supply of electricity for the town.

Birmingham.—Profit on Undertaking.—In the period April 1st to December 31st, 1920, the Birmingham electric supply department made a profit of £39,500. Of that surplus, £32,500 was realised during the December quarter, when local trade was fairly active; the six spring and summer months, with the comparatively small and broken load, realised but £7,000 profit. It was reported that since the New Year there had been a great falling-off in the consumption of electricity, due, of course, to trade depression, and, in view of present conditions, the Committee decided that it would be unwise to make any contribution to the relief of the rates, and the credit would be carried forward.—*Birmingham Post.*

Blackburn.—Proposed Sub-Station.—A Committee of the Town Council is inquiring into the question of erecting an electricity sub-station at Brownhill in connection with the generating station at Whitebirk, now approaching completion.

Disposal of Old Plant.—The Electricity Committee has authorised the electrical engineer to dispose of the older plant at Jubilee Street station, when no longer required.

Blackpool.—Smoke Nuisance.—At a meeting of the Town Council, complaints were made that soot from the electricity works was driving visitors away from the town. An undertaking was given that the nuisance would be abated.

Bolton.—Visit of Inspection.—The Electricity Committee has authorised the chairman and the electrical engineer to visit the works of the Escher, Wyss Co. for the purpose of witnessing the testing of the 12,000-kW turbine that is being manufactured for the Corporation.

Bradford.—Electricity Works Alterations.—Expenditure approved by the Corporation Advisory and Co-ordination Sub-Committee, covering a total for all Committees of £54,922, as a charge on capital account and revenue expenditure of £8.227, includes £19,557 for steel-work for alterations at the Bolton Road electricity works.

Braintree.—Electricity Supply.—The Urban District Council has signed an agreement with the East Anglian Electricity Co. for a public supply of electricity on the overhead system, at 11d. per unit for lighting and 4d for heating, less 1d. for cash.

Burton-on-Trent.—Extension Scheme.—The Gas and Electricity Committee recommends the Corporation to approve a scheme for the extension of the electricity works, with a view to supplying the South Derbyshire district, subject to the consent of the Electricity Commissioners and the ability of the Finance Committee to raise the necessary funds.

Canada.—Central Stations.—Some interesting facts are contained in the part of the Census of Industry, 1918, dealing with central stations in Canada. The enormous preponderance of water power stations is clearly shown. The hydro-electric stations in the Dominion represent 91·4 per cent. of the total, and develop 1,682,191 h.p. Steam stations constitute 7·9 per cent., and gas and oil stations ·7 per cent., the total development being 1,811,114 h.p., or ·209 h.p. per head of population. The number of separate undertakings is 795, of which 418 are municipally owned; 515 of the undertakings are generating, and the remainder distributing. The total amount of capital sunk in the industry is given as $101,942,402. The number of persons engaged in central station and allied work is 9,696, representing an annual wage bill of $10,354,242. The revenue from the sale of power reaches a total of $53,549,133. The majority of the stations have capacities of less than 200 kVA—the actual number being 281. The rest of the stations are classified as follows:—200-500 kVA, 80; 500-1,000 kVA, 47; 1,000-2,000 kVA, 26; 2,000-5,000 kVA, 41; 5,000 kVA and over, 37.

Chile. — Hydro - Electric Developments. — Vast natural water-power resources in the central provinces of Chile are to be used for generating electricity for Santiago, Valparaiso, and neighbouring cities and towns. A company, capitalised at $3,250,000, has been formed for the purpose and work has already been started on a hydro-electric plant on the Colorado River, near Santiago, where it is expected 18,000 h.p. can be developed. The project is backed largely by Chilean capital. The motive for the promotion of the company was the need of more power by both the Valparaiso and Santiago tramways and by mining and industrial enterprises. Until recently no water-power concessions in Chile were granted by the President of the Republic for more than 35 years, but the latest concessions are said to be perpetual.—*Reuter's Trade Service* (Santiago).

Continental. — Holland. — In a recent issue the *Nieuwe Rotterdamsche Courant* states that, in accordance with the conditions of the contract for the supply of electricity to Stolwijk, Bergambacht, and Ammerstol by the municipality of Gouda, the latter has been requested to replace by underground cables the aerial network which is used at present. The costs have been estimated at 83,000 gulden, to which 7,000 gulden is to be added for a telephone cable of 14 km.

Italy.—The ambitious scheme of the Provincial Administration of Udine to extract the waters of the River Tagliamento and divert them into the Lake of Cavasso, in connection with a large hydro-electric station to be built there, has already passed the official scrutiny, and leave to begin the works is likely to be issued shortly. Equally favourable reception has also been accorded to the request for a concession of the waters of the Rivers Lumieci and Degano.

A concession has been granted to the Società per le Forze Idrauliche della Silal to construct and utilise three reservoirs to be built on the upper courses of the Rivers Neto, Arvo, and Appollino, in the province of Cosenza, for the generation of electricity and for irrigation purposes. The power to be yielded by these plants is estimated at over 160,000 h.p., and the Government reserves the right to acquire energy at cost price for public purposes, and stipulates that within a year after the starting of the first central station, power to the extent of one-third of its output, and not less than 5,000 kW, is to be supplied to work the Calabro-Lucana railway. The construction and equipment of the reservoir with the necessary piping, &c., will represent a large engineering undertaking. The contents of the Arvo and Appollino reservoirs alone are estimated at 210,000,000 cb. metres. The equipment of the Appollino station will comprise seven generators of 12,500 h.p. each, reserve included, with exciters coupled, the machine hall having floor dimensions of 54 × 21 metres. The equipment of the Neto station will consist of eight generators of 14,700 h.p. each, including the reserve, and three 500-h.p. exciters, the machine hall having floor dimensions of 64 × 17 metres. The electric energy which these large undertakings will supply, when completed, is expected to benefit not only the province of Calabria, but the whole of southern Italy.

Luxembourg.—A general strike has been declared. All the factories in the mining district are at a standstill, and have been occupied by the military. The town of Luxembourg is without light. It is feared that the strike may extend to the railways.—*Reuter's Trade Service* (Luxembourg, March 3rd).

Finland.—A Committee appointed by the Government has reported in favour of a vote of credit of 10·5 millions of marks for the purpose of harnessing State waterfalls and the purchase of new falls. According to the present proposals, work is to begin at Imatra and Linnankoski, which are to be joined, and power generated from one station. During the present year certain expropriations are to be made for Linnankoski, and a temporary power station erected at Imatra.—*Times Trade Supplement*.

Belgium.—Owing to the increasing demand for electricity for lighting and power purposes, the Société d'Electricité de l'Escaut, of Antwerp, is enlarging the capacity of its generating station at Merxem to 33,000 kW. The company has recently secured the concession for the supply of electricity to 13 more communes, including the town of Lierre, and is in negotiation with reference to a number of others.

Bosnia.—The Jugoslav Government has granted a concession for the establishment of a big electric central station in Bosnia. The station will be worked by the water of the Kovalschevo Polje, which will be led by a 10-km. channel to Tricana, where a fall of 245 metres will be arranged. It is estimated that 30,000 h.p. will be obtained.

Darwen.—Loan.—The Town Council has applied to the Electricity Commissioners for sanction to borrow £1,524 to extend electricity mains. The Council has approved the agreement for the supply by Blackburn Corporation of electricity in bulk to Darwen. The laying of mains has already been undertaken.

Dewsbury.—Bulk Supply.—Having entered into an agreement to buy electricity in bulk from the Yorkshire Electric Power Co., at a cost of £3,000 per year, the electricity department has installed new rotary converter plant to deal with this supply. The payment to the company is guaranteed for three years, irrespective of whether a supply is taken or not. The new plant, which has cost £7,000, comprises a sub-station, two transformers, two alternating-current rotary starting panels, two rotaries, and a direct-current switchboard. The plant will reduce the voltage of the supply from 10,000 to 450.

Dover.—Mains Extensions.—The Town Council has received sanction to a loan of £6,165 for mains. The mains are to be extended to St. Margaret's, at a cost of £4,000, to supply the village and the South Foreland lighthouse, and the authorities are asked to pay 10½d. per unit for the lighthouse supply of 1,500 units per annum.

Dublin.—Water-power Investigations.—A report of the Electricity Supply Committee to the Corporation states that recent investigations have definitely established that the River Liffey, if properly utilised, is probably capable of supplying all the present power requirements of Dublin and district and that the power passing to waste in the river averages 10,000 h.p. if spread uniformly over the 8,700 hours of the year. The Committee expresses the opinion that an eminent water-power engineer should be secured, at a fee not exceeding £1,000, to report fully on the possibilities.

Extended "Curfew" Order.—Military regulations extending the curfew to 9 (instead of 10) p.m., have not interfered with the public electric lighting, but early closing of shops—such as licensed premises—theatres, kinemas, and of the chief post-offices where counter-work is done, and the early retirement of private consumers, must necessarily have a serious effect on the consumption. Some important industries using electricity have abandoned nightwork altogether.

Dundee.—The Grampian Scheme.—Asked if it was not possible that the Town Council might get some share in the management of the company in the event of the Town Council taking power in bulk, Sir Henry Babington Smith (chairman of the Hydro-Electric Development Co.) said the company would welcome representation from Dundee if Dundee would contribute a share of the capital and take a share of the profits. They might participate in the provision of or provide the transmission line for carrying the power to Dundee.

Report on Loch Ericht Scheme.—The Corporation has received a report from Prof. Gibson, Manchester, and Major Richardson, the Corporation engineer, on methods for adding to the city's electricity supply, particularly by water power. Attention is called to the increasing demands upon the existing steam station, and the two practical ways in which hydro-electricity may be obtained, by developing the Ericht-Tummel scheme, or a part of it, or by purchase from the suggested Grampian Electricity Supply Co. If purchase from the company were decided upon, a definite contract would have to be entered into for supply at a lower price than that at which the city could produce it, and an adequate supply must be guaranteed. Failing this, the Corporation should consider developing the Ericht portion of the scheme alone, and this could be done for an approximate capital expenditure of £1,100,000. If this were worked in conjunction with the present steam station and the extensions proposed, the total supply would be at least 110 million units per annum, or fully four times the present output. The average cost would then be approximately 0·61d. per unit.

East Ham. — Estimated Deficit. — The borough treasurer has submitted a report to the Lighting Committee, upon the approximate position of the electricity undertaking for the nine months ended December 31st, 1920, showing an estimated net deficiency for the period of £11,780, which is accounted for by increases of war bonus, cost of coal, &c.

Electricity Districts.—West Riding (Aire and Calder) District Inquiry.—In pursuance of the provisional determination by the Electricity Commissioners of the above-named district, they give notice that they will hold a local inquiry in the Civil Court, Town Hall, Leeds, on Tuesday, April 12th, 1921, at 10.30 a.m. and following days with reference to the area to be included in the proposed district, and the objections and representations which have been made, and to consider schemes which have been submitted by (*a*) the Corporation of Leeds; (*b*) a conference of West Riding local authorities; and (*c*) certain proposals by the Yorkshire Electric Power Co., for effecting an improvement of the existing organisation for the supply of electricity in the said district.

Copies of the respective schemes and proposals may be obtained from (*a*) Sir Robert Fox, Town Clerk, 11, Park Square, Leeds, at a cost of 5s. each; (*b*) Mr. N. J. Fleming, solicitor to the Conference of West Riding Authorities, Town Clerk's Office, Bradford, at a cost of 5s. each; and (*c*) the Secretary, the Yorkshire Electric Power Co., Wellington Road, Dewsbury, at a cost of 2s. 6d. each.

Copies of technical particulars in support of the said schemes and proposals can also be obtained at a reasonable charge on application at the addresses stated prior to the date of the inquiry.

Proposed Generating Station at Ferrybridge.—The Commissioners give further notice that they will at the same time inquire into an application made by the Yorkshire Electric Power Co. for the consent of the Commissioners under Sec. 11 of the Electricity (Supply) Act, 1919, to the establishment by the company of a new generating station at Ferrybridge.

London and Home Counties.—At a special meeting held on Tuesday, the Conference of local authorities owning electricity undertakings in Greater London, had before it a draft administrative scheme and also a proposed technical scheme. The Electricity Commissioners have fixed March 31st for the deposit of, and June 7th (provisionally) for the inquiry into, schemes for this area.

The engineering proposals have been drawn up for the conference by Mr. C. H. Wordingham, in conjunction with Mr. J. H. Rider, representing the London County Council, and Sir A. B. W. Kennedy and Mr. G. W. Partridge, representing nine of the principal supply companies within the area. Sir Philip Dawson also co-operated with regard to railway electrification and power demands. In preference to shutting down all existing local stations and taking the supply from new capital power stations erected on suitable sites, the committee recommends the retention and development of certain existing stations, the remainder being gradually shut down and new capital stations being established as required. It points out the improbability of any capital station being erected and made fully ready for work before the winter of 1925, and it proposes a scheme in two stages.

In the first stage 34 existing stations would be progressively shut down and supplied in bulk by means of interconnecting cables from the remainder. In the meantime the erection of four new capital stations would be started, three on the north side of the Thames, and one on the south side, on sites (three to the east of Blackwall Tunnel and one up-river).

As these stations became ready for work, the second stage would be reached, and 26 of the remaining stations would be progressively closed. Of the remaining 17 stations in the area two would be reconstructed and considerably enlarged to act as capital stations, seven would be permanently retained to act as auxiliary generating stations in conjunction with the new capital stations, and the remaining eight, near the outskirts of the area, would have to be kept at work for a considerable period to serve the local demands, until it became commercially practicable to extend the transmission mains to their neighbourhood.

The installed capacities of the capital stations would vary, in the first instance, between 70,000 and 200,000 kW, mostly in sets of 25,000 kW. Several of the sites would permit of much larger stations if required. The estimated capital expenditure by the Joint Electricity Authority for the first stage ending 1925-6 is £13,050,000, including the first portions of the capital stations with an installed capacity of 200,000 kW, and for the second stage ending 1930-31 at £30,750,000, including an installed capacity of 875,000 kW in the capital stations. These figures do not include the cost of acquiring existing generating stations or existing interconnecting mains.—*The Times.*

Ellesmere Port.—Electric Lighting Order.—The Council has been informed by the Electricity Commissioners, in connection with the Ellesmere Port and Whitby Electric Lighting Order, 1913, that in the event of an order being made authorising the Mersey Power Co. to supply electricity to the Wolverhampton Corrugated Iron Co., the order would contain the usual clause empowering the Council to take over the supply when it was able to give a supply to those premises; and with regard to the question of further time being required for carrying out the works under the Council's order, it was open to the Council to apply to the Ministry of Transport to postpone further consideration of the question of revoking the order beyond March 31st next.

Glasgow. — Inspection of London Lighting. — According to *The Times*, the Corporation is sending a deputation to London to investigate the newest systems of street lighting.

Glossop.— Public Lighting Contract.—The Town Council has accepted the tender of the Urban Electric Supply Co. for public lighting for a year.

Grampian Electricity Scheme.—Committee's Investigations.—The Perthshire Highland District Committee is asking the Highland Railway Co. to authorise the latter's engineer, Mr. Newlands, to go into the engineering proposals for the Grampian electricity scheme, particularly as to the sufficiency of the proposed dams at Loch Ericht. The Duke of Atholl says that certain stipulations as to the price at which electricity would be supplied to the district from Blair Atholl to Perth had been considered, but the distribution would require to be done by a private company or other combination as the promoters would only supply in bulk. The County Council is continuing negotiations with the promoters.

Guiseley and Yeadon (Yorks.).—Electricity Supply.—The Electrical Distribution of Yorkshire, Ltd., has received a special draft order from the Electricity Commissioners, under which it is intended to lay mains for the general supply of electricity within the urban districts of Guiseley and Yeadon within a period of two years after the commencement of operation of the order.

Hereford.—Extension of Supply.—The Town Council has entered into negotiations with a view to supplying electricity to coal-owners of the Forest of Dean, and numerous parishes *en route* will be supplied. A loan of £34,000 for the erection of a line to Ross and Lydbrook is to be applied for.

India.— Electricity in the Punjab.— A scheme, involving an estimated expenditure of about one crore of rupees, has been initiated by the Punjab Hydro-Electric and Industries Association of Delhi. The Association proposes to develop electrical power on four canal falls, and to connect them electrically so that power will always be available when any canal is closed.—*Reuter's Trade Service* (Bombay).

Kirkburton (Yorks.).—Electricity Supply.—When a letter was submitted to the District Council last week, from the Electrical Distribution of Yorkshire, Ltd., intimating its intention to apply for an order empowering the company to supply electricity within the district, and asking for approval, it was stated that the Council, at a previous meeting, had already agreed to support the application of the Huddersfield Corporation to supply the district.

Liverpool. — Extensions. — The Tramway, Electric Power, and Lighting Committee has approved of the extension of the l.p. mains from the static sub-station in Charles Street to the Liverpool Head Post Office, at an estimated cost of £2,083, and switchgear in connection therewith, at a cost of £150.

London.—Bethnal Green.—The Electricity Committee reports that the purchase of the "Oval Chapel" is about to be completed, and it has accordingly considered plans prepared by the borough engineer for the conversion of the building into an electricity sub-station. The borough engineer estimates the total cost of the works, including the cost of a travelling crane, to be £3,400.

Islington.—The Lighting Committee has presented a report which the borough treasurer has prepared upon the financial position of the electricity undertaking. This shows the capital expenditure to December 31st, 1920 (£627,966), the amount of loans paid off (£209,196), the amount of loans outstanding (£497,718), the amount of interest paid (£287,897), and the total commitments, including the above-mentioned capital expenditure (£836,048). The borough treasurer has dealt with the alleged over-capitalisation of the undertaking, and the Committee agrees with the conclusions at which he has arrived, viz., that the basis of capital cost per kilowatt shows that the undertaking is not over-capitalised, and that a comparison of the prices charged by Islington with those charged elsewhere supports this view. In the circumstances, the Committee does not consider there is any necessity for the Council to appoint a Special Committee, as was proposed.

Macclesfield. — Proposed Price Increase. — The Electricity Co. has signified its intention of applying for permission to increase its charges from 8d. to 1s. per unit. The Town Council is opposing the application, and calling upon the Ministry of Transport to hold a local inqiry into all the circumstances.

Middleton.—Loan.—The Town Council has decided to apply to the Electricity Commissioners for sanction to borrow £46,000 to defray the cost of laying a cable and effecting sub-station alterations to enable an increased bulk supply of electricity to be given by the Manchester Corporation.

Newark.—Proposed Electricity Scheme.—Following upon a report by Mr. C. H. Wordingham, C.B.E., and a canvass of the inhabitants, it has been decided that the probable demand justifies the application for a provisional order. At a meeting of the Council the Mayor was asked if the possession of an order committed the Council to a scheme. The Mayor replied that during the past 20 years the Council had had two orders which they had not acted upon.

New Zealand.—Lake Coleridge.—It is hoped that the third pipe line will be completed by June next. By that time it is expected that the fifth generator, with a capacity of 3,000 kW, will have been installed, ready for use. When this generator is installed the capacity of the Lake Coleridge power house will be brought up to 9,000 k.W. The sixth generator, which will provide an additional 3,000 kW has been ordered. Specifications are ready for the fourth pipe line, but a contract has not yet been let. With the installation of the sixth generator and the fourth pipe line the total capacity will be brought up to 12,000 kW, the total aimed at when the scheme was originally formulated. It is noteworthy, as indicating how keen the demand is for electrical energy, that if the Lake Coleridge power house was at present capable of generating 12,000 kW, it would just about meet the total demands for North Canterbury. The works connected with the diversion of the Harper River into Lake Coleridge are progressing satisfactorily, and by May the waters of the Harper should be flowing into the lake in time to assist in keeping up the winter load.—*Auckland Weekly News.*

Horahora-Auckland Transmission Line.—The construction of a high-pressure line, at a cost of £150,000, from Horahora to Auckland, has been approved by the Cabinet. Asked when it was proposed that this work should be proceeded with, the Minister for Public Works, the Hon. J. G. Coates, said he hoped that arrangements would be made for a start at the earliest possible moment. The whole question was contingent upon the Department being able satisfactorily to dispose of approximately 2,000 h.p. of electricity. When that had been arranged, he had authority to sanction the construction of the transmission line to Auckland.—*Reuter's Trade Service* (Melbourne).

Newcastle (N.S.W.).—Newcastle (N.S.W.) has been advanced the sum of £50,000 by the Commonwealth Bank of Australia for the purpose of installing an electrical plant. It is stated that exclusive of the demand for bulk power, there are 2,500 householders who would avail themselves of the opportunity of using electric light.—*Reuter's Trade Service* (Melbourne).

Tasmania.—Launceston.—The report of the city electrical engineer upon the electricity undertaking for the year ended June 30th last, records a total income of £40,847, and working expenses, &c., amounting to £26,963, leaving a gross profit of £13,884. This was distributed as follows:—Interest on loans, £9,204; sinking fund, £1,922; general account, £2,000; reserve fund, £758. The last two items represent the net profit, and compare with £2,010 in the previous year. During the year the connected load was increased by about 600 kW to 6,845 kW, while the maximum load reached 1,790 kW; the total plant capacity is 1,537 kW, including reserve.

Torquay.—New Station.—The question of a new electricity generating station was further discussed by Torquay Town Council on March 1st. Some of the members of the responsible Committee, becoming alarmed at the financial position of the authority, and the impossibility of securing a loan under 6½ or 6¾ per cent., carried a proposition that the matter should be delayed. The Council decided to secure expert opinion on the question of installing a new boiler.

Tynemouth.—Year's Working.—The annual report of the borough electrical engineer (Mr. C. Turnbull) for the past year, just issued, states that the units sold were 5,811,884, and the receipts £34,851, compared with 5,027,069 units, and £27,248, in 1919. The apparent loss upon the year was £293, compared with a profit of £224 for the preceding year; but the department spent out of revenue on mains, £605, and on meters, £576, so that the profit on the year's working was actually £888. The costs per unit sold (excluding three-phase, not sold through Corporation mains) were:—Generation, including bulk supply and wages, 0·743d.; distribution, 0·125d.; management and establishment expenses, 0·300d.; rates and taxes, 0·144d.; interest on loans, 0·216d.; sinking fund and redemption, 0·418d.; capital expenditure out of revenue, 0·113d.; total, 2·059d. The question of increasing the charges had been considered, but the Committee felt that it was desirable to keep them as low as possible, so that consumers would get the benefit. Even with the increased rates the charges were still far below those ruling in the majority of towns. The engineer notes that the output equals a yearly sale of 90·5 units per inhabitant.

United States.—Development of Niagara Falls.—The development of Niagara Falls water power as a national asset on a gigantic plan that would assign all water-power privileges to one individual or corporation, thus eliminating grants to various smaller interests, is urged in various recommendations now before the Federal Power Commission. Although agreeing generally that a comprehensive system of development should be adopted, the recommendations vary greatly as to the nature of the development. In approving any grants, the members of the present Commission, Messrs. Baker, Payne, and Meredith, are inclined to anticipate development of methods in the near future that will permit the economical transport of power to points 500 miles or more from the Falls. Experts have told the Commission that the "single assignment" plan should include assignment of water-power privileges below the Falls as well as those above. Plans to combine the several hundred thousand horse-power taken from the Gorge with the millions taken from above the Falls into one project were presented. The plans range from tunnelling under Goat Island, which hangs on the precipice between the American and Canadian Falls, to digging a power and ship canal from Lake Erie to Lake Ontario. Proponents of some of the schemes claim that the Government could tax such development to the extent of half a million dollars a year, and still give much cheaper power than at present, and leave a profit for the corporation on the investment. Mr. Baker, chairman of the Commission, has announced that no privileges anticipating future amendments to the existing water diversion treaty with Canada will be considered by the present Commission. Experts inform the Commission that 13,000 cb. ft. additional to the 20,000 now diverted on the American side could be taken from the Niagara River without marring the scenic beauty of the Falls.—*Reuter's Trade Service* (Washington).

Wallasey.—Price Increase.—The Wallasey Electricity Committee recommends the Council to increase the charges for electrical energy by ½d. per unit for lighting, and by ¼d. per unit for power and heating.

Walton-on-Thames.—Price Increase Approved.—On condition that the rent of meters is not raised, and that the maximum charge for electricity is reduced to 1s. per unit, the Urban District Council has agreed not to oppose the application of the Urban Electric Supply Co. for leave to increase the present charge. The company's original application was for 1s. 2d. per unit.

Worksop.—Supply to Colliery.—The Urban District Council has made an agreement with the Wigan Coal and Iron Co., Ltd., for an additional supply of electricity to the company's Marton pit.

TRAMWAY AND RAILWAY NOTES.

Australia.—Perth.—Following on the award raising the tramway men's wages to the extent of £13,000 a year, the Government announces a revision of tramway fares. The first 1d. section fares from Perth Town Hall have been abolished, the rate being increased to 2d. For Sunday and holiday travelling an extra 1d. will be charged.—*Sydney Morning Herald.*

Toowoomba.—There is much comment in Toowoomba on the proposed tramway scheme. In his detailed report to the Toowoomba City Council, the consulting engineer estimates the cost of the tramway at £147,184. The cost of a transmission line, sub-stations, and apparatus, is £73,827, making a total estimated cost of £221,011.—*Brisbane Courier.*

Belfast.—Track Renewals.—The City Corporation has had under consideration a recommendation of the Tramway Committee to relay or repair 58 miles of permanent way at an estimated cost of £121,500, the work to be spread over a period of five years. Certain members of the Council were in favour of the work being carried out by direct labour. The general manager's recommendation was that the work be contracted for. Ultimately the matter was referred back to the Committee for reconsideration.

Bolton.—Track Renewals.—The Tramway Committee has decided to relay the track in Blackburn Road, from Halliwell Road junction to Dunscar Bridge, in Great Moor Street between Bradshawgate and Mawdsley Street, and also in Station Street.

Bradford.—Inspection of New Car.—The new double-deck railless car introduced by the Tramway Department is exciting interest in many parts of the country. The latest deputation to inspect the car was from Wigan, and intimations of a desire to pay visits have been received from the Tramway Committees of Glasgow, Oldham, and Southend.

Track Renewals.—The Corporation Advisory and Co-ordination Sub-Committee has approved, amongst other prospective expenditure, the recommendation of the Tramway Committee for track construction and renewals at Great Horton (two sections), Horton Park Avenue, and Wakefield Road, at a total cost of £31,184.

Chester.—Tramcars *v.* 'Buses.—It was stated at a recent meeting of the Council that the cost of bringing the track into proper order would be in the neighbourhood of £70,000. The only alternatives to this were the institution of a railless system or motor-'buses. Reports upon the whole condition of the tramways are to be prepared, dealing with both the working and financial sides of the question.

Continental.—Holland.—In the course of his memorandum in reply to the Preliminary Report of the Second Chamber on the Bill for the supply of electricity in Holland, the Minister of Public Works states that the result of an inquiry has convinced him of the desirability of combining the electrification of the whole railway system with the generation of electricity for other purposes, and that the general high-pressure system offers the greatest advantages. From every point of view, including cost of management, working expenses, and constant service, it was necessary that the industry should be controlled by the State. For this purpose it is proposed to establish the Nederlandsch Electriciteitsbedijf Limited Liability Co. at The Hague, with power to take over all existing power stations and organise a proper supply for the whole country. The capital of the company, which is given a 99 years' lease of life, will be Fl. 15,000,000 in 100 shares of Fl. 150,000, 51 of which will be held by the State. The board of management will consist of three members of Dutch nationality, appointed for five years at a general meeting of shareholders, whose decisions will be subject to the approval of the Minister of Public Works.—*Economic Review.*

Germany.—The electrification of the suburban lines from Berlin to Bernau and Hermsdorf has been commenced. A total length of 20¼ miles is involved. For this purpose single-phase current at 15,000 volts and 16⅔ cycles has been selected; but at present current is to be generated as three-phase, the power being taken from an existing power house. Overhead catenary suspension with a span of 100 metres has been adopted. At Bernau, carriage sheds and workshops are being erected, and it is hoped to complete these within two years.—*Technical Review.*

Halifax.—Tramway Finance.—At a recent Town Council meeting, the Tramway Committee asked the Finance Committee to make provision in the next year's estimates for an amount equal to a 1s. rate, to cover any deficiency which the Tramway Department might have to face during the year, but the minute was deleted, as neither of the Committees had yet framed its estimates. The Tramway Committee also recommended application to the Ministry of Transport for power to borrow £243,222 for track renewals during the next three years, but the minute was referred back, on the ground that action should not be taken until after the appointment of the new tramway manager.

India.—Electric Headlights.—The principal railway companies of India are reported to be negotiating for the installation of the Pyle-National electric headlight, which throws a beam of light 3,000 ft. along the track.—*Reuter's Trade Service* (Bombay).

Liverpool.—Year's Working.—The report of the general manager of the Corporation tramways states that the total revenue for the year 1920 was £1,457,549, as against £1,207,229 in the previous period. Operating costs amounted to £1,386,522, compared with £1,022,414, leaving a gross profit of £71,027 (£177,785). Capital charges absorbed £104,103 (£102,300), leaving a net deficit of £33,077, which compares very unfavourably with a profit of £75,485 in 1919. The reason given for the unsatisfactory result is the enormous increase of working costs which increased fares have failed to cover.

London.—Success of Fare-concession Scheme.—The London County Council Highways Committee, reporting upon the results obtained by allowing passengers to travel long distances for a fare of 2d. during the middle of the day, says that, while it is possible that receipts would have risen on account of the increased fares put into force last September, it is satisfied that the innovation has been of substantial financial benefit. There is no evidence to show that the increase of receipts during the slack hours has adversely affected receipts at other times, and it is reasonable to assume that some of those who are induced to travel by tramcar by reason of the introduction of the cheap mid-day fare return at times when the full fares are charged. As regards rush-hour traffic, there is still insufficient accommodation for passengers desiring to use the tramways; but although there has been a considerable increase in the number of passengers travelling at the cheap fares, there is still ample accommodation for more passengers in the mid-day cars.

A Tramcar "Queue".—Owing to a car fouling the points in Kennington Road, last week, cars were held up for a considerable period. A string of cars extended two miles from the scene of the accident along the Clapham Road; there was also another queue in the opposite direction.

Lincoln.—No Sunday Working.—A proposal to run tramcars and omnibuses on Sundays for three months, as an experiment, was not carried at a meeting of the City Council.

Tasmania.—Launceston.—The total income of the city tramways for the year ended June 30th last was £30,822, compared with £27,717 in the previous year. Working expenses amounted to £27,684, as against £22,380, leaving a gross profit of £3,138 (£5,337), plus £156 from maintenance account, making a total of £3,294. Capital charges absorbed £6,480, leaving a net deficit of £3,186, a considerable improvement on last year's debit balance of £617.

Stourbridge.—Proposed Conference on Fares.—The Town Council has decided to communicate with the Brierley Hill Urban District Council, stating that it is desirable that a conference of local authorities should be held to consider the question of tramway fares. This action has been taken as a result of the attitude of the Dudley-Stourbridge Electric Traction Co. in enforcing a minimum fare of 2d. on most of the sections.

West Ham.—Tramway Reconstruction.—The Tramways Committee recommends the expenditure of a total of £100,065 on the reconstruction of the tramway system, track renewals and cars. The proposals have been approved.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—Wireless Telegraphy.—The Australian Government is sending a party of experts to the Willis Islands, with a view to reporting on the possibilities of establishing there a wireless telegraph station. This remote group of islands is 250 miles off the coast of Queensland, and it is thought that a station there would be of great assistance to the Government meteorologist in the preparation of his forecasts.

Germany.—Telephone Service.—A few months ago the German Postal Authorities introduced a condition that, apart from the annual rentals, each subscriber to the State telephone service must lodge a deposit of 1,000 marks. This compulsory loan, as it is now termed, has so far yielded 1,000,000,000 marks to the State, and is being utilised for extensions of the telephone system.

Poland.—Wireless Telegraphy.—The Polish Legation announces the signature of a million-dollar contract with the Radio Corporation of America involving the construction by the company of a large wireless station at Warsaw. The station and its 12,400 ft. steel towers will be capable of handling 200 words a minute. At the request of the Polish Government it has been arranged that the Corporation will operate the station for a term of years.—*Reuter's Trade Service* (Washington).

Telephone Message Recorder.—G.P.O. Tests.—Tests are about to be carried out at the G.P.O. of an invention by means of which, it is claimed, a permanent record of the conversation of the calling subscriber at the receiving end. On the 7th inst., the instrument was in process of being installed in the office of one of the chief officials of the telephone department, says the *Evening News*, who explained that matters were in a purely experimental stage. "Supposing the called subscriber is out of the room when the telephone bell rings, the message will be recorded on a cylinder. When the subscriber returns he places the receiver to his ear, turns a switch, allows a needle to run over the record, and the caller's conversation is repeated."

Telephone Service.—It is understood that Mr. Evelyn Cecil, M.P. for Aston, Birmingham, has accepted the chairmanship of the new Select Committee, which is to be appointed to inquire into the telephone service.

The Federation of British Industries has appointed a Committee to consider the question of giving evidence regarding the working of the telephone system before the Select Committee of the House of Commons.

The printing and paper costs of the first issue of the complete London and provincial telephone directories, produced at the Government printing works at Harrow, was £71,762, states Mr. Baldwin in Parliamentary papers. For subsequent issues, the cost will be approximately £18,900, says the *Birmingham Post*.

Mr. Pike Pease, Assistant P.M.G., in a recent speech at Merrow, admitted there had been inefficiency in the telephone service, and added that a large number of subscribers would be obliged to give up the telephone. It was impossible, he said, to hand over the telephones to a private company unless the telegraph service and post-offices went as well. The majority of exchanges were in post-offices, and it would be impossible to provide new exchanges in the rural districts from a financial point of view.

Sir Andrew Ogilvie, late Second Secretary of the Post Office, who was a member of the Departmental Committee on Telephone Rates and was closely connected during his official career with the telephone department. has been invited by the London Chamber of Commerce to join the Telephone Advisory Committee, on which, besides the Chamber, the Corporation, the London County Council, the Port of London Authority, the National Union of Manufacturers, &c., are represented, says the *Daily Telegraph*.

Mr. Illingworth, Postmaster-General, replying to a question in the House of Commons, said:—"The approximate number of telephone calls effected in the year ended March 31st, 1920, was about 850,000,000. Of these about 40 per cent. were made by existing flat-rate subscribers. About 50,000 of the present flat-rate users (including the £8 residence flat-rate) did not originate 2,000 calls per annum. It is estimated that, as regards 25 per cent. of the existing trunk calls, the new charge will be lower than the old. The number of calls in 1921-22 is roughly estimated at between 800,000,000 and 850,000,000. The additional staff required for registering calls and collecting charges under the new tariff is estimated to be 150, at an annual cost in salaries of £23,000."

Telephone Finance.—From the accounts of the telephone service for the year ending March 31st last, issued on February 15th, it appears that the total capital raised up that date amounted to £37,669,609, the annual charge in respect of which was £2,326,556. Capital expenditure in the 12 months totalled £2,634,242, bringing the aggregate up to £37,701,561.

The revenue account shows a total income of £9,232,063, compared with £10,462,832 in 1918-19, and expenditure amounting to £7,545,829, against £7,040,747. From the balance of £1,686,234 carried to net revenue account had to be deducted provision for depreciation, pension liability, and other charges, aggregating £3,698,015, and the net deficit for the year amounted to £1,961,710.

The accrued revenue for the year amounted to £8,119,323, compared with £6,746,500 in 1918-19. On the other hand, the value of services rendered to other Government Departments fell from £3,716,332 to £1,112,740, so that the gross receipts declined by £1,230,769 to £9,232,063.

On the telegraphs the deficit in 1919-20 was £2,636,183, so that the two services together incurred a loss of £4,597,893. As the balance of profit on the postal business amounted to only £3,469,828, there was, therefore, a net deficiency on the year's working of the Post Office of £1,128,065. This compares with a surplus in 1918-19 of £7,4 7,556.—*Daily Telegraph*.

New Exchange.—The new Langham public telephone exchange, situated at the Western District Post Office in Wimpole Street, W. 1, was opened on Saturday last. It will accommodate 1,900 subscribers' lines, and 1,300 lines were transferred from the Mayfair Exchange.

Telegraphic Errors.—The Postmaster-General disclaims liability for loss sustained in consequence of an error in a telegram. Such errors may involve business firms in serious losses, and the Federation of British Industries has invited its members to communicate with Head Office giving particulars of cases in point, with a view to making representations to the G.P.O. on the matter.

The Wireless Press.—Service Suspended.—The Wireless Press, a subsidiary organisation of the Marconi Co., which furnishes news by wireless telegraphy from foreign countries, will, on April 2nd, cease sending out its service of news. It is felt that the gathering of news should be performed independently of the "carrying" of it, says the *Daily Mail*.

United States.—Cable Dispute.—The controversy between the State Department and the Western Union Cable Co. relative to the laying of the Barbados Miami cable came to a head on the 5th inst., when an American submarine-chaser open fire upon the cable ship engaged in connecting up the cable, which was already laid last summer, with the shore station. The incident took place four miles off Miami beach, where the cable ship had picked up the loose end of the cable attached to a buoy. The captain alleges that the cable ship disregarded his warning signals, whereupon the submarine-chaser opened fire. Work then promptly ceased, and the entire crew were arrested.—*Daily Telegraph*.

Wireless Telegraphy.—At Leafield, near Oxford, and Abu Zabal, near Cairo, the first two stations of the wireless Empire chain are being constructed and according to the Assistant Postmaster-General, will be finished this summer.

Improvements in wireless telegraphy to ensure safety of life at sea were referred to by Senatore Marconi at the annual dinner of British shipmasters, held at Liverpool, on March 1st. The new system of direction-finding, which had not yet been applied anywhere, had been perfected, and Senatore Marconi believed it would do much more than ever was thought possible.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—April 19th. P.M.G. Telephone switchboards (Schedule No. 1 670).* (February 25th.)

April 27th. Victorian Railway Commissioners, Spencer Street. Caustic soda primary cells, complete (Contract No. 33.914).*

May 2nd. Victorian Railway Commissioners. Twelve miles of ·015 sq. in. two-core, lead-sheathed, wire armoured, 2,200-V cable.*

Brisbane.—March 30th. P.M.G.'s Department. Switchboard apparatus and parts.*

Ballinrobe.—March 15th. Ballinrobe Electricity Supply Co., Ltd. Erection of poles and overhead line in connection with the electric lighting supply. (March 4th.)

Batley.—Electric lighting installation at the Purlwell Store (No. 4) of the Batley Co-operative Society, Ltd. Particulars from the Secretary.

Belgium.—March 23rd. The Société Nationale des Chemins de Fer Vicinaux, 14, Rue de la Science, Brussels. Laying of the underground armoured cables required in connection with the supply of current to the Brussels-Haecht line. Particulars can be obtained for 3 francs from the Services Electriques, 48, Rue Montoyer, Brussels.

Belgrade.—May 1st. The Commercial Secretary to H.M. Legation at Belgrade has forwarded to the Department of Overseas Trade particulars of a call for tenders by the Serb, Croat, and Slovene Ministry of Public Works, for the erection of a power-station, main conductors and transforming stations in connection with an electrical scheme at Kostolac for the supply of energy to Belgrade, Semliu, &c. Tenders should be addressed to the Director, Ministry of Public Works, Belgrade. A translation of the specification and conditions of tender, together with a plan showing the disposition of the various stations and lines, may be inspected at Room 48, Department of Overseas Trade, 35, Old Queen Street, S.W.1.

Dundee.—March 26th. Tramway Department. Twelve months' stores, including insulated wire, lamps, switches, and overhead equipment. The Manager.

France.—April 5th. The French State Railway authorities, 43, Rue de Rome, Paris. Supply of four 8-ton electric travelling cranes for the new railway workshops at Sotteville-Quatre-Mares, Rens. Particulars may be obtained from the Services Electriques (1st Division) at the above address.

Johannesburg.—March 30th. Municipal Council. Forty 50 h.p., 500 to 600-V tramcar motors. Tenders to Town Clerk, Municipal Offices, Johannesburg. A copy of the specification may be seen in Room 48 of the Department of Overseas Trade up to to-morrow (Saturday), after which date it will be available for loan to firms in the provinces.

London.—Hammersmith.—March 16th. Electricity Department. Erection of an overhead coal conveyor, brick chimney shaft and replating coal bunkers with steel sheeting. (See this issue.)

Macclesfield.—March 14th. Cheshire County Asylum, Parkside. Stores, including electrical goods, for six months. W. G. F. Tingay, Clerk.

Manchester.—April 7th. Electricity Committee. High-pressure steam and water valves; high-pressure steam and water pipes, steam receivers, &c.; weighbridges and automatic coal-weighing machines; electric and hand-operated cranes. (See this issue.)

Perth.—March 21st. Electricity Department. One 1,000-kW, d.c., geared turbo-generator, with condensing plant. (March 4th.)

Rhondda.—April 5th. Electricity Department. A.c. house service meters, cable, joint boxes, &c. (February 25th.)

Runcorn.—March 19th. Castner-Kellner Alkali Co., Ltd. Construction of light railway and sidings to connect their works with the L. & N.W. Rly. Co.'s Runcorn Dock branch. Lt.-Col. H. F. Stephens, engineer to the company, 23, Salford Terrace, Tonbridge, Kent.

Turton.—March 16th. Urban District Council. Electrical supplies. Particulars from Electrical Superintendent, Council Offices, Bromley Cross, near Bolton.

Uruguay.—Monte Video.—March 29th. State Power House. Single and three-phase meters.*

Wimbledon.—March 29th. Electricity Department. Annual contracts for cables and conduits, joint boxes and jointing materials, transformers, meters, &c., lubricating oils. (See this issue.)

Worksop.—April 6th. Electricity Committee. E.h.p. and l.p. cables; e.h.p. and l.p. switchgear; transformers; 500 kW rotary or motor converter. (See this issue.)

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1

CLOSED.

Algeria.—The Algerian Posts and Telegraphs have lately placed a contract with the Compagnie Française des Métaux, of Paris, for a quantity of high-conductivity copper wire, and with the Compagnie Générale d'Electricité, Paris, for bronze wire.

Australia.—Victoria.—With a view to relieving the pressing demand for power, the Victorian Electricity Commissioners have accepted a tender made by the Parsons Company for two turbo-generators, each of 15,000 kilowatts, at the price of approximately £100,000, to be shipped within eighteen months.—*Reuter's Trade Service* (Melbourne).

Bradford.—Tramways Committee. Recommended:—

Portable crane for tramway track renewal and construction work, £145.—John Smith (Keighley), Ltd.

Electricity Committee. Recommended:—

Steel reinforcement for foundations for No. 4 boiler-house at Valley Road generating station.—Expanded Metal Co., Ltd.

Escape pipes for safety valves for boilers at Valley Road Works.—Stewarts and Lloyds, Ltd.

Dartford.—Board of Guardians:—

Electric-light installation, Round House, and officers' quarters, £ E. E. Beaver; V. D. Ward, £68.

Gillingham (Kent).—Town Council:—

Two heads for Diesel engine, £180 each.—Mr. A. Coy.

Liverpool.—Tramways, Electric Supply and Lighting Committee. Accepted:—

Insulated cables and wires.—Liverpool Electric Cable Co.

Electric meters.—Landis & Gyr.

Stoneware troughing and insulators, &c.—J. Place & Sons, Ltd.; J. Bourne and Sons.

Brass and copper castings.—R. Roberts & Sons.

City Council. Accepted:—

Supply of cables and accessories for street mains and for stoneware troughing and insulators, &c.—Callender's Cable and Construction Co.

Spain.—The Spanish Government has just placed a contract with the Compagnie Française Thomson-Houston, of Paris, and the General Electric Co., of New York, for the electrification of the Pajares section of the Northern of Spain Railway.

FORTHCOMING EVENTS.

Edinburgh Electrical Society.—Friday, March 11th. At the Philosophical Institute. At 8 p.m. Apprentices' night. Short papers on "Every-day Work" for the Society's prize.

Electro-Harmonic Society.—Friday, March 11th. At the Cannon Street Hotel (Grand Hall). At 8 p.m. Last smoking concert of the season.

Junior Institution of Engineers.—Friday, March 11th. At 39, Victoria Street, S.W. At 8 p.m. Lecturette: "Electrical Drive in the Cotton Trade," by Mr. A. T. McGuire.

Physical Society of London.—Friday, March 11th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Sixth Guthrie Lecture: "Some Recent Applications of Interference Methods," by Prof. A. A. Nicholson, University of Chicago.

Birmingham and District Electric Club.—Saturday, March 12th. At the Grand Hotel, Colmore Row. At 7 p.m. Paper on "Common-sense Methods of Recording Costing and Progress in Shop Management," by Mr. H. C. Young.

Royal Institution of Great Britain.—Saturday, March 12th. At Albemarle Street, W. At 3 p.m. Lecture on ""Electricity and Matter," by Sir E. Rutherford, F.R.S. (Lecture II.)

Royal Society of Arts.—Monday, March 14th. At John Street, Adelphi, W.C. At 8 p.m. Lecture on "X-Rays and their Industrial Applications," by Major G. W. C. Kaye. (Lecture II.)

Institute of Cost and Works Accountants.—Wednesday, March 16th. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Lecture, "Some Observations on the Proposed Amendments of the Workmen's Compensation Act, 1906," by Mr. H. G. Simmons.

Paisley Association of Electrical Engineers.—Wednesday, March 16th At the Y.M.C.A., 25, High Street. At 7.30 p.m. Students' papers.

Illuminating Engineering Society.—Thursday, March 17th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Discussion on "Motor-car Headlights: Ideal Requirements and Practical Solutions," by Major A. Garrard.

Institution of Electrical Engineers.—Thursday, March 17th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Paper on "The Long-distance Telephone System of the United Kingdom," by Sir W. Noble.

Informal Meeting.—Monday, March 14th. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Discussion on "Rectifiers." To be opened by Mr. R. L. Morrison.

Scottish Centre (Students' Section).—Friday, March 11th. At the Royal Technical College, Glasgow. At 7.30 p.m. Paper on "Machinery Operations in Automobile Construction," by Mr. R. J. Hird.

North-Eastern Centre.—Monday, March 14th. At Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Discussion on the various regulations of the Board of Trade (now Electricity Commissioners) for electricity supply. To be opened by Mr. C. Vernier.

South-Midland Centre.—Wednesday, March 16th. At the University, Birmingham. At 7 p.m. Lecture, "Possibilities of Power Production," by Prof. F. W. Burstall.

Wireless Section.—Wednesday, March 16th. At the Institution of Mechanical Engineers, Storey's Gate, S.W. At 6 p.m. Papers on "The Effect of Electron Emission on the Temperature and Anode of a Thermionic Valve," by Mr. G. Stead; and on "Some Thermionic Tube Circuits for Relaying and Measuring," by Miss W. A. Leyshon and Dr. W. H. Eccles.

Chelmsford Engineering Society.—Thursday, March 17th. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Ball and Roller Bearings," by Mr. T. W. Cooper.

Manchester Wireless Society.—Thursday, March 17th. At the Manchester College of Technology, Sackville Street. At 7.30 p.m. Lecture on "Direction Finding," by Mr. J. Hollingsworth.

Institution of Mechanical Engineers.—Friday, March 18th. At the Institution, Storey's Gate, S.W. At 6 p.m. Paper on "Contact Pressures and Stresses," by Prof. E. G. Coker, F.R.S., Mr. K. C. Chakko and Mr. M. S. Ahmed.

NOTES.

E.P.E.A. Dinner.—The second annual dinner of the Newcastle and District Section of the Electrical Power Engineers' Association was held on March 2nd, Mr. A. W. Crompton presiding over an attendance of about 100. Occasion was taken to present to Mr. G. L. Porter a silver coffee pot and a gold watch in recognition of his services to the Association. Mr. Crompton, in making the presentation, said Mr. Porter took over the duties of secretary of the Divisional Council in 1918, and was divisional chairman in 1920. The membership was now 372. A musical programme followed the dinner.

The Curie Radium Fund.—It is announced from Paris that Madame Curie is to go to the U.S.A. in May, at the invitation of a group of prominent American women connected with the above-named fund, and that she is to receive as a gift from them of one gramme of radium.

To Relieve Congestion in Paris.—A proposal has been put forward to remedy the congestion of passenger traffic in Paris at busy hours of the day. M. Emile Desvaux has suggested to the Municipal Council, and his suggestion has been agreed to, that the possibilities of establishing an underground moving pavement should be discussed. This pavement would follow the line of the Grands Boulevards, which are not served by an underground railway; the public would be admitted in the same way as to a railway, by means of tickets, and the advantage of such an arrangement would be that it would never be necessary to wait for the "pavement," which would be moving all the time, and which would presumably be somewhat less crowded than the underground trains. The scheme was laid before the Municipal Council as early as 1900, by the inventor of a moving pathway, which was shown at the Exhibition, but it is considered that, in view of the many improvements which might be added, a competition should be held in order that the pathway may be provided with all the most modern devices.—*Reuter's Trade Service* (Paris).

Diesel-Electric Ship Propulsion.—The much-discussed Diesel electrically driven freighter is to be given a trial through the conversion of the American steel ship *Fondonian*, owned by the American Mediterranean Steamship Co. The vessel, when the installation is completed, will be driven by an electric motor, the energy for which will be generated by power derived from two Diesel engines. It is estimated that the two engines, each developing 500 b.h.p will provide sufficient power to drive her loaded at a rate of nine knots.—*Reuter's Trade Service* (New York).

Ministry of Transport. — Mr. Bonar Law announced in the House of Commons on the 4th inst., that Sir Eric Geddes, Minister of Transport, was to retire from the Government at the end of August next. It is assumed in certain quarters that the Ministry of Transport is itself to be abolished at an early date.

Fire.—Damage to the extent of £2,000 was caused by a fire which broke out, on the night of February 25th, at the electrical engineering works of Messrs. Goodenough & Co., Barnstaple. The highly-inflammable character of some of the contents caused rapid and extensive destruction of a considerable quantity of motor materials.

Fatality.—An inquest was held at Birmingham on March 4th into the death of William Smith, of Saltley, who was employed as a works engineer by the Pitney Rolling Mills Ltd. It was stated in the evidence that Smith went to attend to a transformer which required filling up with oil. Apparently he forgot to ensure that the power was cut off, and he came into contact with the terminals, receiving a shock at 3,000 volts. A verdict of "Accidental death" was returned.

Factory Lighting.—The Departmental (Home Office) Committee on Lighting of Factories and Workshops has now resumed its investigations. The Committee's work was temporarily abandoned after the publication of its First Report in 1915, owing to the war. The Committee is now constituted as follows:—

Mr. C. Dampier Whetham, F.R.S., chairman; Mr. Leon Gaster; Sir Richard Glazebrook, K.C.B., F.R.S.; Dr. C. S. Myers, C.B.E., F.R.S.; Mr. J. Herbert Parsons, C.B.E., F.R.C.S.; Prof. C. S. Sherrington, P.R.S., University of Oxford; Miss R. E. Squire, O.B.E.; Sir Arthur Whitelegge, K.C.B.; and Mr. D. R. Wilson, M.A.

The Committee will for the present restrict its inquiries to the following points:—(1) The conditions necessary to secure suitable lighting in factories and workshops; and (2) the effects of mixed natural and artificial lighting, with special reference to the lighting of underground workrooms.

The secretaries to the Committee are:—Mr. J. W. T. Walsh, M.A., M.Sc. (of the National Physical Laboratory, Teddington), and Mr. H. C. Weston, M.J.Inst.E. (Investigator to the Industrial Fatigue Research Board) to whom communications should be addressed at the offices of the Board, 6, John Street, Adelphi, W.C. 2.—*The Times.*

Appointments Vacant.—Assistant inspector of wireless telegraphy for the Post Office (£275 +); plumber-jointer, for the Nelson Corporation Electricity Department. See our advertisement pages to-day.

Electro-Harmonic Society.—The last smoking concert of the season will be held at the Cannon Street Hotel, in the Grand Hall, on Friday, March 11th, commencing at 8 p.m. Chairman, Mr. Hugo Hirst. Artistes:—Mr. Sydney Pointer, tenor; Mr. Thomas Howell, bass; Mr. Fred Gregory, baritone; The Three Freds: Mr. Fred Gregory, Mr. Fred Gibson, Mr. Fred Wildon, humorous songs, phonofiddleoddities; Mr. Paul Brunet, violin; Mr. Bernard Flanders, A.R.A.M., solo pianoforte and accompanist.

Birmingham and District Electric Club.—The annual dinner of this club was held at the Grand Hotel, on Friday, March 4th, when about 100 members and friends enjoyed an excellent dinner and musical evening. Mr. H. C. Wynne, the president of the club, occupied the chair. In response to the toast of "The City of Birmingham," Mr. Chattock, chief of the City of Birmingham Electric Supply Department, expressed his confidence in the future of electricity supply in the city, notwithstanding the present financial stringency which had delayed their projected extensions.

Mr. McKenna on Taxation and Industry.—Speaking at a conference held under the auspices of the Industrial League and Council, Mr. McKenna said that in order to meet the high national expenditure heavy taxation was imposed. It was usually thought that all was well, provided the Government paid its way and raised in taxation all it spent. People believed the Government was only taking away from the consumer that which he would otherwise spend himself, but which the Government now spent for him. There never was a greater fallacy in the world. The great instrument of taxation in this country was the income-tax. The income-tax was 6s. in the £, and the 6s. was drawn not only from everybody's income, but from the whole of the profits earned by every business. Part of the profits of business should be put every year to a reserve fund. They would not be in a position to compete with foreign rivals unless a considerable part of the profits of business were put back in reserve in order to build up the industry. When the tax collector took money from business, it was largely taken from savings and spent on consumption, and they had in that increased expenditure on consumption, one of the strongest factors leading to high price. If his conclusions were right, it was really within the power of the nation to get stable prices, and if they got stable prices, they would then be able to sell abroad. The most urgent need of this country at the present moment was economy and efficiency. They could then have a good standard of living for the workman and real hope for the future. They must first re-establish their industry before they could begin their social reconstruction, and when they had done that, they would attain a much higher plane than they had ever reached yet.

Wireless Ship Control.—It is understood that in June, July, and August, exhaustive experiments will be made regarding the possibilities of wireless control of certain sea-going craft; such experiments have been more or less successfully carried out in the United States Navy. The old battleship *Agamemnon* will be fitted up as a target ship and equipped with a wireless installation, by which she will be manœuvred whilst guns and torpedoes in turn will work their will on her. Of course, the target ship will not be manned.

An Electrically Equipped Ship.—The s.s. *Somersetshire*, which has just been launched at the Queen's Island, Belfast (Messrs. Harland & Wolff's), is electrically fitted in every way. Her auxiliary engines, windlass, winches, patent steering gear, &c., will be electrically controlled, and the lighting will be of the latest and most powerful type.

Neon Lamps.—A new type of Neon lamp, with a consumption of five watts, has been brought out (says *Helios*) for purposes where lamps are only required for indicating or signalling, and the smallest size of metal filament lamp available for ordinary voltages has a greater consumption than is desirable. The lamps are stated to be very durable, and give a reddish light; even smaller sizes are made suitable for illuminated signs, &c.—*Technical Review.*

Photometric Errors.—According to an article by Mr. F. E. Cady, of Nela Research Laboratory, in the *Electrical World* of February 12th, the error due to the selectivity or lack of whiteness of the paint, and the milk-glass window, of the Ulbricht sphere in comparing gasfilled with vacuum lamps is less than 5 per cent.

Electrically-Soldering Commutators. — A Canadian correspondent of the *Electrical World* says:—The difficulty usually encountered in soldering very large commutators may be diminished by heating the commutator connections with a small electric arc. An arc of approximately 5 amperes at 125 volts direct current has been found satisfactory for this purpose. The intensity of the arc can be regulated with an adjustable rheostat. For use in this process, an electrode holder has been constructed with an insulated handle. The electrode used is a carbon rod an arc-light carbon serving well. This holder is attached to a flexible lead which is connected to the positive side of the direct-current line. The negative connection is made by means of a bare wire wrapped two or three times around all the commutator bars. If the arc is regulated to the proper size, a very rapid and clean job is possible. Care should be taken not to use an arc so large that it will burn the risers. The use of such a method will eliminate much of the trouble usually encountered in soldering heavy connections to heavy strap conductors. Even with extra-heavy soldering irons of special shape, soldering large commutators is usually a very slow and tedious undertaking.

INSTITUTION NOTES.

Institution of Electrical Engineers. — Informal Meeting Section.—At the successful smoking concert on February 28th, at Anderton's Hotel, Mr. W. E. Bradshaw and his orchestra were highly appreciated. Individuals of the orchestra also gave solos, Mr. Le Roy with baritone songs; Mr. Hunt, violin solos; and Mr. R. Christmas, a most dexterous effort "The Ragtime Bass Player." Mr. Gill's tenor songs were encored, and Mr. Callieu and Mr. Harry Hearne provided some excellent humorous items. An unexpected treat was the conjuring display of Mr. Jardine Ellis, who was in the building, and kindly gave two short shows of his skill. Mr. F. Pooley was in the chair, and except when he was making a touching reference to the loss sustained by the Informal Section and engineering generally through the death of Mr. Rankin, all went very merrily.

Western Centre.—At a meeting of the Western Centre, held at Cardiff, on March 7th, congratulations were tendered to the joint hon. secretary (Mr. C. T. Allan) on his recovery from his recent illness. After the transaction of the routine business, Mr. W. T. Kerr, borough electrical engineer, Hereford, delivered a lecture entitled "The Prospects of Electricity in Agricultural Centres." The information imparted by Mr. Kerr came as a big surprise to those supply engineers whose activities are confined more or less to industrial centres. Mr. Kerr gave in extensive detail the lay-out of his system in Herefordshire and particulars of the various consumers connected. He enunciated the principle that the future welfare of the agricultural labourer depended on the utilisation by farmers of the acknowledged advantages which electricity gave over any other source of energy. The lighting of country residences, village public houses, and farm buildings secured prominence in the lecture and the comparative costs, both capital and working, of the electrical equipment in operation were very illuminating. He maintained that the food supply of the United Kingdom could be wholly home produced when electricity arrived at its proper place in agriculture. An active discussion followed the lecture, the feeling being expressed that a copy of the lecture should be in the hands of all supply engineers and the Ministry of Agriculture

North-Eastern Students' Section.—On February 18th Mr. W. S. Kilner read a paper on the use of thermo-couples and resistance thermometers in connection with electrical machinery. The efficiencies of various couples were dealt with, and Mr. Kilner also raised the question of generator protection by means of thermocouples. On February 25th this Section visited the Lemington Glass Works. The tour of the works was excellently organised by the secretary, Mr. M. Ryle, together with Mr. J. W. Ball, works engineer, and Mr. G. Barras, works manager. The latter gave a demonstration by making several very artistic ornaments, and showed a remarkable skill only to be attained by years of experience. In these works huge quantities of bulbs and tubing used in the manufacture of electric lamps were being made, both by hand and by machinery. A special point of interest was the automatic bulb-blowing machines.

Chelmsford Engineering Society.—On February 24th Mr. P. T. Harrison read a paper on "Engineering as Applied to Town Planning." Mr. Harrison laid stress on the importance of good roads, and said that, in his opinion, it ought not to be beyond the skill of the road engineer to construct roads suitable for carrying the new class of traffic, and that they must not wait for the transport engineer to design vehicles to suit the roads.

Diesel Engine Users' Association.—The first meeting this year of the Association since the election of its new president (Mr. C. O. Milton) was held on February 24th. A paper on "Oil-Engine Progress," by Mr. J. L Chaloner, aroused considerable interest, and was followed by a useful and instructive discussion. The author referred in very favourable terms to the position of the British internal-combustion-engine industry, and the lines on which it was likely to develop in relation to Continental and American competition. He gave figures in support of a statement that of the high-pressure engines in this country, 25 per cent. worked on the mechanical-injection principle, and that 50 per cent. were two-stroke engines. In the case of medium-pressure engines, 96 per cent. worked on the mechanical-injection principle, while 58 per cent. were two-stroke engines. He urged the imperative necessity of further flexibility on the part of the engines, in order that heavy-grade oils might be used to a greater extent.

Manchester Wireless Society.—At a general meeting, on March 2nd, Mr. E. Samuels was elected honorary secretary in the place of Mr. Y. W. P. Evans, retiring. The chairman (Mr. J. McKernan) paid a grateful tribute to Mr. Evans, whose work had placed the Society on a firm basis, and announced that, as some slight recognition, Mr. Evans had been elected an honorary member. Mr. R. Hallam (late wireless operator on the "R 34") then delivered a highly-instructive discourse of "Workshop Hints as Applied to Wireless Telegraphy." The working and finishing of ebonite, the lacquering of brass, and the making of many small parts were all fully described.

Royal Institution.—"Severn Crossings and Tidal Power."—Lecturing before the Institution on the 4th inst. on the above subject, Mr. W. A. Tait, M Inst.C.E., in referring to the proposed Severn barrage scheme, is reported by the *Birmingham Post* to have said that it would appear that the result which might be obtained was sufficiently promising to justify the Government in spending a considerable sum of money on investigation and experiments. The French Government, proceeded Mr. Tait, had prepared a scheme for the utilisation of 750,000 h p on the Rhine, and Britain need not shrink from a proposal for a 500,000-h.p. installation for a 10-hour working day on the Severn. Mr. Tait proposed that a suitable place for a trial would be Loch Seaforth, near Stornoway.

All-India Institution of Engineers.—The Viceroy has inaugurated the All-India Institution of Engineers, the full members of which are entitled to designate themselves "M I E. India." Among the speakers at the inauguration were the Earl of Ronaldshay, Sir Thomas Holland, Sir Thomas Callender, and Sir Rajendra Nath Mookerjee, first President. The Institution is all-embracing, for every branch of engineering throughout the whole country is represented.—*Morning Post.*

Institution of Production Engineers.—At a meeting held at Cannon Street Hotel, London, on February 26th, it was decided to form an Institution of Production Engineers. There was a large attendance when Mr. Honer, the convener of the meeting, opened the proceedings, and Mr. Cecil F. Hammond, of Coventry, was elected to the chair, and it was decided by a large majority to proceed with the formation of a separate Institution. A representative committee was appointed to draft rules, &c, and to report progress at a general meeting to be held on April 2nd. In the meantime, it is requested that all interested, particularly those who wish to become members, will communicate with the Hon. Secretary, Mr. A T. Davey, 6, St. James's Square, Holland Park, Kensington, W. 11.

The British Electrical Development Association (Inc.)—At the adjourned general meeting of the Association, on March 4th, the new Council and Executive Committee were elected, as follows:—

President.—Mr. Hugo Hirst, M.I.E.E.

Vice-Presidents.—Messrs. Alderman Walker, A.M I.E.E., and W. B. Woodhouse, M I.E.E.

Members of the Council.

Messrs. C. H. Wordingham, O.B.E., *H. Hardie, and B. Welbourn. Representing I.E.E.

Messrs. *A. P. Ambler, C. O. Bastian, *A. F. Berry, *D. N. Dunlop, *W. A. Gillott, *H C. Palmer, and A. E. du Pasquier. Representing B.E.A.M.A.

Messrs. *S. T. Allen, *F. Ayton, S. E Britton, J. Christie, *A. C. Cramb, E. E. Hoadley, and *T. Roles. Representing I.M E.A.

Messrs. *R. S. Downe and F. J. Walker. Representing Conference of Chief Officials of London E.S. Cos.

Messrs. *E. T. Ruthven-Murray and W. B. Woodhouse. Representing Inc. Association of Electric Power Cos.

*Mr. T. W. Cole. Representing Provincial Electric Supply Companies.

Messrs. *Ll. B. Atkinson and *W. F. Bishop. Representing the C.M.A.

Messrs. *J. E. Edgcoombe, S. H. Callow, and *E. A. Marx. Representing E.L.M.A.

Messrs. *L. G. Tate, *H. Marryat, and S. H. Webb. Representing E.C.A.

* New Executive Committee.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

An official list of municipal employés' salaries, prepared on the instructions of the Southport Finance Committee, shows that in 1913 the salary of Mr. A. E. Black, borough electrical engineer, was £400, while to-day, in salary and bonus, he is receiving £726. This figure is the amount of salary and bonus being paid to the general manager of the electrical tramways, Mr. T. J. Kendrew, who, in 1913, was in receipt of £200, and the manager of the gas department, Mr. J. Bord, is now getting £1,341, as compared with £650 in 1913.

Watford Urban District Council has added £50 to the salary of the electrical engineer for February, and decided to fix the salary from March 1st at the rate of £850 per annum.

Mr. Walter White, who holds an engineering employment with the Western Electric Co, was married at Blackburn last week to Miss Gladys Peters. The presents included one from the employés of the above company.

Mr. A. J. S. Waddell, of Manchester, has been appointed generating engineer at Valley Road generating station, Bradford, at a salary of £500 per annum.

Halifax Tramways Sub-Committee, last week, reduced the number of applicants for the post of general manager from 26 to 6, who are to be interviewed by the full Tramways Committee.

Leeds Corporation has decided that the question of salary advances for all the higher-paid Corporation officials is to be postponed for six months. The decision affects all members of the various Corporation departments whose present salaries exceed £400 per year. The electrical officials concerned are Mr. J. B. Hamilton, tramways manager and city commercial manager (at present £2,530); Mr. C. N. Hefford, electrical engineer (£1 500); Mr. J. Burbridge, tramways electrical engineer (£780); and Mr. W. T. Green, assistant electrical manager (£760).

Obituary.—The death, on January 4th, of Herr Ernst Körting, head of the well-known firm of Körting Bros., gas engine builders, at the age of 89, is reported. The deceased founded his firm in 1871, in Hanover, and later opened branches and works in Vienna, Sestri Ponente, near Genoa, Buda-Pesth, and Moscow.

Lord Moulton, F.R.S.—We regret to learn that Lord Moulton passed away in his sleep on Tuesday night at the age of 77 years. During the day he had been engaged in a case at the House of Lords, and was in good health on retiring to rest. Lord Moulton was for many years, while at the Bar, greatly in demand for electrical and other patent and scientific cases in the High Courts. Subsequently he was made a judge. He was interested in electrical and chemical research, and during the war rendered valuable service to the nation in connection with high explosives.

Mr. Mortimer Evans.—*The Times* deaths column records the death of Mr. Mortimer Evans, M Inst.C.E., F.G.S., M.I.E.E., F.R.A.S., which occurred in February.

Mr. G. H. Barlow.—The death occurred on March 3rd of Mr. George H. Barlow, electrical engineer, aged 36, a member of the staff of the Wigan Corporation electricity works.

Mr. E. Greek.—The death has taken place of Mr. Ebenezer Greek, late traffic superintendent on the Blackburn Corporation Tramways. He had been in the service of the department for 34 years, and was 52 years of age. About 70 of the tramway employés attended the funeral.

Wills.—The late Mr. Walter Pitt, chairman of Messrs. Stothert & Pitt, Ltd., of Bath, left £104 376.

The *Daily Telegraph* states that Dr. Alexander Muirhead, F.R.S., D.Sc., left estate of the gross value of £105,806, with net personalty £94,542. The testator left, on the death of his wife: £3,000 to the Royal Society of London for the general purposes of the society.

NEW COMPANIES REGISTERED.

Leeds Battery Co., Ltd. (173,325).—Private company. Registered February 23rd. Capital, £1,500 in £1 shares. To adopt an agreement with the Leeds Alliance Electrical Manufacturing Co., Ltd., and to carry on the business of manufacturers of and dealers in electrical batteries, fittings, and electrical accessories, &c. The first directors are: J. M. Firth, "Glenside," Holly Lane, Swinton; E. Hawkins, 151, Headingley Mount, Leeds; E. E. Barrett, Whitesmacks, Durham; C. E. Sheard, 2, Allerton Street, Kirkstall Road, Leeds; G. Higginbottom, 14a, Baxtergate, Doncaster. Qualification, £50. Secretary: E. Hawkins. Registered office: 44, Silver Royd Hill, Wortley, Leeds.

Electro-Freezers, Ltd. (11,635).—Private company. Registered in Edinburgh February 23rd. Capital, £1,000 in £1 shares. To carry on the business of engineers, &c. The first directors are: G. B. Arcari, 85, Thistle Street, Garnethill, Glasgow, engineer; T. M. Hunter, 45, Bishops Road, Jordanhill, Glasgow, engineer. Secretary (pro tem): T. M. Hunter. Registered office: 243, North Woodside Road, Glasgow.

Horsa Electrical Contracting Co., Ltd. (173,346).—Private company. Registered February 24th. Capital, £1,000 in £1 shares. To carry on the business of mechanical and electrical engineers, manufacturers of motors, engines, vehicles, and accessories, &c. The first directors are: H. T. C. F. Jalink, 112, Horsa Road, Erith, Kent; E. J. B. Bevan, 8a, Holly Hill Terrace, Erith, Kent; S. T. Weaver, 7a, Holly Hill Terrace, Erith, Kent. Secretary: S. T. Weaver. Registered office: 112, Horsa Road, Erith, Kent.

F. B. Hellon & Co., Ltd. (173,480).—Private company. Registered March 3rd. Capital, £4,000 in £1 shares. To carry on the business of electrical engineers and contractors, suppliers of electricity, &c. The subscribers (each with one share) are: F. B. Hellon, St. Aubyn, Agnes Road, Blundellsands, Lancs., electrical engineer; E. J. Barker, The Cottage, Altcar Road, Formby, Lancs., electrical engineer. The first directors are: F. B. Hellon (chairman) and E. J. Barker. Solicitor: P. M. Quiggin, 8, Harrington Street, Liverpool.

Brierleys' Premier Welding Co., Ltd. (173,371).—Private company. Registered February 25th. Capital, £3,000 in £1 shares. To acquire the business carried on by W. Brierley and Mrs. F. Brierley at 140, Manor Street, Clapham, as the Premier Welding Co., and to carry on the business of electricians, general engineers, acetylene and electric welders, &c. The first directors are: W. Brierley, 2, Gauden Road, Clapham, S.W.; Florence Brierley, 2, Gauden Road, Clapham, S.W.; T. C. Evans, 2, Gauden Road, Clapham, S.W.; F. A. Broadey, Lion Lodge, Deepcar, near Sheffield. Solicitor: H. Watkins, 53, Haymarket, S.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Midland Electric Light & Power Co., Ltd.—Particulars of £30,000 debentures authorised January 17th, 1921; present issue, £20,000, charged on the company's undertaking and property, present and future, including uncalled capital.

Southern Brazil Electric Co., Ltd.—Particulars of £146,500 8 per cent. notes authorised January 19th, 1921; whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital, subject to £750,000 6 per cent. first mortgage debentures.

Electrical Contracts & Maintenance Co., Ltd. (101,757).—Return dated December 31st, 1920. Capital, £3,000 in £1 shares. All shares taken up. £1,331 paid, £1,669 considered as paid. Mortgages and charges: Nil.

City of London Electric Lighting Co., Ltd. (34,406).—Capital, £1,200,000 in 80,000 ordinary and 40,000 preference shares of £10 each. Return dated April 7th, 1920. 70,595 ordinary and 40,000 preference shares issued, £1,105,950 paid. Mortgages and charges: £800,000.

South African Lighting Association, Ltd.—Satisfaction to the extent of £24,550 on or before December 31st, 1920, of debentures dated July 24th, 1901, August 13th, 1908, securing £25,000.

Hexham & District Electric Supply Co., Ltd.—Particulars of £10,000 debentures authorised August 6th, 1920; whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital.

Leatherhead & District Electricity Co., Ltd.—Satisfaction in full on December 20th, 1920, of trust deed dated July 2nd, 1912, and supplemental deed dated June 30th, 1915, securing £25,000.

Steyning Electric Light Co., Ltd.—Deposit on February 18th, 1921, of deeds of Borough House, High Street, Steyning, to secure all moneys due or to become due from company to Barclays Bank.

Harland Engineering Co., Ltd.—Mortgage dated February 9th, 1921, to secure £4,000, charged on certain land and premises in Salford, Lancs. Holder: W. E. Ashworth, 13a, Rosamond Street, Salford.

Yorkshire (Woollen District) Electric Tramways, Ltd.—Issue on June 28th, 1911, of £50,000 debentures, part of a series (notified February 28th, 1921). Satisfaction in full on February 22nd, 1921, of debentures dated January 18th, and June 28th, 1911, securing £100,000 also notified.

Stols Electrophone Co. (1914), Ltd.—Mortgage debentures dated February 18th, 1921, to secure £5,000, charged on company's property, present and future, including uncalled capital. Holder: A. Hyman, 4-5, Copthall Court, E.C.

Hale, Pearn & Co., Ltd.—Two mortgages dated February 9th and 10th, 1921, to secure £6,000 and £2,000 respectively, charged on certain land in Manchester. Holders: Mrs. S. Benger, The Grange, Knutsford, Cheshire, and Mrs. E. Linney, The Limes, Denton, near Manchester.

M. L. Magneto Syndicate, Ltd.—Debenture dated February 23rd, 1921, to secure £80,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: R. L. Meats, 26, High Street, Coventry, and E. A. Raybould, 71-73, Edmund Street, Birmingham.

CITY NOTES.

Mather and Platt, Ltd. Presiding at the annual meeting, held at Manchester on February 28th, the chairman, Mr. L. E. Mather, said that 1920 had been the best year in the history of the company. The increased profit was due to the larger volume of business transacted, and the percentage of profit on turnover was no greater in 1920 than in 1919. Though the available total was much larger they had considered it wise to recommend the same dividend and to increase the carry forward. The capital had been increased by 313,660 shares issued to the ordinary shareholders and the employés. With regard to the increased turnover, the tonnage output for the last six months of 1920 was 30 per cent. greater than for the similar period in 1913, the previous record year as regarded tonnage output. He took six months only because of the moulders' strike, which had had such a serious effect on the first half of 1920. They had made considerable extensions at Park Works, and had had to purchase premises in London for the use of the London and overseas organisation. While unemployment was so severe around them, the company had more men employed now than ever before in the life of the company. The moulders' strike compelled them to order considerable supplies of castings from abroad, and this had had a distinct effect on the present unemployment in many industries. In their own works the output per man, as far as they could judge, was practically up to the pre-war standard. There was a need for greater co-operation in industry. If they were to hold their own against foreign competition all sections of the community must pull together and cut out extravagance, waste, and restrictive measures, whether affecting labour, capital, Government, or trade as a whole.

Underground Electric Railways of London, Ltd. Lord Ashfield took the chair at the annual meeting held on March 3rd. In his opening remarks, Lord Ashfield said that a loss of £55,000 had been incurred in the payment of the coupons on the 4½ per cent. bonds and the 6 per cent. income bonds, owing to the adverse exchanges upon New York and Amsterdam. He characterised as most unsatisfactory the fact that only £20,000 remained to carry forward after payment of dividends; the latter were also lower than in the previous year. The chairman reviewed the considerable progress made during the year. He outlined the main points of improvement embodied in the new rolling stock (which has been described in previous issues of the Electrical Review), and said that the car-mileage of the railways had increased by 7,340,000, while that of the 'buses rose 11,814,000 car miles, and the tramways 55,000. 1,487,000,000 passengers were carried by the group during 1920; this represented more than half the total traffic of the Metropolis. The increase in the number of passengers carried amounted to 110,000,000, or 8 per cent. In spite of these increases the financial result had been unsatisfactory, and the immediate cause was the absence of reasonable rates for passengers during the first nine months of the year. Lord Ashfield was pleased to announce, however, that since these revised fares had been put into force, affairs had assumed a brighter aspect. In the first three months of the year covered by the report the railways had carried 108,000,000 passengers, which brought in a revenue of £982,000. During the last quarter of the year, although the number of passengers fell to 98,000,000, the income amounted to £1,252,000. The same results were obtained from the tramcars and omnibuses. The chairman thought this indicated success, but the trade depression was having an adverse effect upon the number of passengers carried. Unless this phase passed the increased revenue from fares would only just balance the falling off in passengers. Fresh capital expenditure was needed, but before money was borrowed it was essential that the capital already invested should receive a fair return. The operating companies were financially independent, and it had been found that the withdrawal of the Government guarantee had been amply compensated for by the increased fares. The chairman said that the Associated Equipment Co. had not been so successful during the year, although the same dividend had been paid. In conclusion, Lord Ashfield referred to the negotiations with the L.C.C. and the Ministry of Transport in connection with the co-ordination of the London traffic systems, and said he hoped for tangible and useful results. The Ministry of Transport railway grouping scheme was mentioned, and the speaker said that the group was an earnest of the acceptance of the principle in so far as the London railways were concerned.

Tramways, Light & Power Co., Ltd.

Presiding at the ordinary general meeting, held on March 1st, the Rt. Hon. Viscount Chilston, G.B.E., said that industrial disputes and the general trade depression had affected the company's revenue and delayed the completion of works under construction. Regarding the latter, he said that the new station on the Avon had been completed, and for the last three months had been supplying electricity to Warwick; the Leamington Spa district would soon be supplied from this station. A big industrial consumer whose annual bill would amount to about £30,000 was also about to be supplied from the Avon station. Considerable extensions had been carried out to the Hinckley station in the Leicestershire and Warwickshire Co.'s area. In the Derbyshire and Nottinghamshire area extensions had been kept down to a minimum in anticipation of a bulk supply from a proposed station on the Trent, but the high-pressure cable system had been extended considerably. In the opinion of the directors, the Government's scheme for the re-organisation of electricity supply could not succeed, and their opinion was derived from a study of the proceedings at recent inquiries held by the Electricity Commissioners. The directors deprecated the action of the Commissioners in withholding approval to the company's scheme for the erection of a large station on the Trent in favour of the Nottingham Corporation's proposals, although the Corporation had no statutory powers of supply outside its own boundary. The Commissioners' idea was that the company should receive a bulk supply, when available, from a station practically run by the Corporation. The Chairman said it would be agreed that municipal control and efficiency were not compatible. So far nothing had been done to commence operations upon the new station except a proposal to erect a small temporary station on the site. The Commissioners' action would result in many years of delay in meeting the requirements of this area.

The directors were confident that, unless unforeseen circumstances arose, there would be a substantial increase in the company's revenue during the current year.

The report and accounts were adopted unanimously.

Bournemouth and Poole Electricity Supply Co., Ltd.

Mr. J. A. Hosker, J.P., presiding at the annual meeting, said that the receipts from sale of energy and meter rentals had increased by £26,512, or 31 per cent. The total receipts on revenue account showed an increase of £28,978. The working costs amounted to £84,313, an increase of £23,792. Coal and other fuel showed an increase of £13,801, salaries and wages an increase of £4,200, repairs an increase of £1,662, and rates, taxes, and insurance an increase of £2,912. The total amount standing to the credit of the net revenue account, after adding the balance from last year and net profit on trading account, was £47,104, and the balance available for distribution was £22,549, as compared with £20,641 last year. They were paying the same dividend as last year, namely, 6 per cent. The figures could only be regarded as satisfactory, bearing in mind that they were still suffering from the abnormal conditions resulting from the war. Applications representing 1,942 kW had been obtained, as compared with 1,695 kW in the previous year, which was satisfactory having regard to the existing trade depression. The units consumed amounted to 6,198,302, as against 4,680,347 last year. The issue of 7½ per cent. 7-year notes was successfully made during the year. They succeeded in placing all they required, namely, £90,000, and he thought the company was to be congratulated on the success of that issue, having regard to the stringency of the money market when it was made and the fact that the market had declined steadily since.

Philips' Glow Lamp Works.

The report for 1920 of the N. V. Philips' Gloielampen Fabrieken, of Eindhoven, states that a portion of the new issue of ordinary shares has been taken up by the American group with which the company had concluded a community of interests. At the express wish of the group it had been decided to modify the articles of association so that only shareholders, with the exclusion of the other groups of participators in the profits, would have right to the reserves. In connection with this matter, it was also considered reasonable that those who were entitled to a percentage on the profits (the directors) should not suffer from possible large amounts being written off for depreciation and placed to reserve funds, and the method of profit distribution had been modified accordingly. The new group also urged that the profit-sharing certificates should be withdrawn, and the directors proposed to do so. Through the projected withdrawal of the profit certificates, which received 15 per cent. according to the articles of association, 10 per cent. in future would devolve upon the shareholders, and 5 per cent. on the directors, but the latter had expressed the wish to relinquish their rights in this respect in favour of the "*personnel* interests" which would in future consequently receive 15 instead of 10 per cent. of the profits.

Coming to consider more particularly the commercial side of the question, the report states that the directors took up an interest in various glow lamp works during the year. One of these manufactured too many other kinds of electrical articles, and had got into a less prosperous condition. The amount invested in the factory by the company had been for the most part written off, and the directors were acting so as to reorganise the business in such a manner that they would continue to be interested in it only in the manufacture of glow lamps, while the possibility existed that the factory would be able to be restored as a productive undertaking in the course of a few years. After dealing with the additions made to the dwellings provided for workpeople and officials, the report mentions that the bonuses payable to the *personnel* were again to be distributed half in cash and half in 6 per cent. cumulative preference shares issued at par.

The report proceeds to state that it is impossible to predict the future of the industry, especially in present times. From the technical point of view the directors were proud of sharing the leading position in the glow lamp industry, both in the old and the new world. As a result of the known community of interests the factories were mutually inspected, and patents and the latest inventions were interchanged. The company's sales organisation was again extended in 1920; but activity since the beginning of 1921 was suffering from the world crisis, and although it was possible to carry on at full output in January and February, the new orders received in these months were considerably less than in the corresponding period in 1920. The purchasing capacity of the whole world has declined, the public is reserved, and considerable stocks of lamps both at the company's branches and at customers abroad were lying in the stores. Nevertheless, the directors regard the future with confidence.

The working results for 1920 show profits of 10,150,000 fl., as compared with 11,208,000 fl. in 1919. It is proposed to write off 3,005,000 fl. for additional depreciation, and devote 750,000 fl. to the redemption of profit-sharing certificates, and to set aside 936,000 fl. for *personnel* interests, and apply 1,124,000 fl. as the directors' share in the profits. Out of the balance remaining the ordinary shares will receive a final dividend of 20 per cent., making 31 per cent. for the year, and the preference shares a final dividend of 4 per cent., making 11 per cent. for 1920. The dividend for 1919 was at the rate of 151 per cent. on the ordinary shares, of which 100 per cent. was paid in the new shares and 51 per cent. in cash, and 35 per cent. on the preference shares, of which 20 per cent. in ordinary shares and 15 per cent. in money. The ordinary share capital taken up now amounts to 10,200,000 fl., and the preference capital to 4,500,000 fl., as contrasted with 3,500,000 fl. and 2,250,000 fl. respectively a year ago.

Smithfield Markets Electric Supply Co., Ltd.

The annual general meeting of shareholders was held on February 25th. Sir Herbert S. Leon, Bart., who took the chair, said that the removal of Government control from the meat markets caused a revival of the pre-war competition among the tradesmen which reacted favourably upon the company's business. "Installation charges" paid by customers for alterations and extensions also added to the income of the company. The speaker could not say how the company would be affected by the London district electricity supply scheme, but the directors were carefully watching the progress of events in order to protect the interests of the shareholders should occasion arise. The output of the company was still increasing, and the prices charged were lower than those of other London companies.

The report and accounts were adopted, and the retiring director and auditors were re-elected.

Westminster Electric Supply Corporation, Ltd.

At the annual meeting, held on February 23rd, Capt. Edmund I. Bax (chairman) referred to the death of Lord Downham, the late chairman, and said that is was due to the latter that many objectionable clauses in the Electricity (Supply) Bill, 1919, were rejected. During the year nearly £60,000 had been spent on extensions of plant, mains, buildings, &c., and this sum would have been considerable larger if all the new plant on order had been delivered. Owing to this delay they had been unable to shut down the old steam plant at Eccleston Place and Davies Street to secure greater economy in working. The increase in revenue of £40,000 had been due only to the extent of £7,000 to increased charges. The units sold showed an increase of nearly 1,200,000. Special attention had been paid to the cooking and heating business of the company. The depreciation, sinking, and reserve funds now exceeded £562,000, and the financial position of the company could be considered very sound. Owing to the removal of lighting restrictions and the necessity of economising coal the business showed healthy signs of expansion, in spite of increased prices. Acting under the advice of Sir Alexander Kennedy, the board did not propose to erect any more generating machinery at the two stations mentioned above, and it was hoped to shut them down before the end of the year. The necessary new machinery and plant for the Central Co. was in course of erection at Grove Road, and consisted of two 10,000-kW turbo-generators, steam raising plant, and switchgear. The supply from this station would be brought to the company's sub-stations and distributed from there. In conclusion, the chairman referred to the scheme of electricity supply prepared by the leading London companies for submission to the Electricity Commissioners. The scheme had been framed with a view to an extension of the tenures of the various undertakings.

Mr. Harold E. Young, referring to a former issue of shares to shareholders at a premium, hoped that this course would not be followed again, as it resulted in a loss to the shareholders, who were entitled to some advantage.

The chairman said he would bear the matter in mind in connection with any future issue.

The report and accounts were adopted.

Midland Electric Corporation for Power Distribution Ltd. Mr. James Taylor took the chair at the meeting held at Liverpool on February 28th. In presenting the report and accounts, the chairman said he considered the action of the directors in issuing £130,000 of ordinary shares in July last was wise in view of the present difficulty of obtaining money. The question of fresh plant was before the directors for, in spite of the trade depression, the demand for power was increasing. Referring to the delimitation of the Midlands into various electricity areas, the speaker said the company had protested against the separation of its area as had been suggested, and the position was being watched very closely. Some figures given indicated a steady growth in the strength of the company. In 1911 the gross revenue was £43,159, the net profit £2,500, and the number of units sold was 10,254,412. During the year under review these figures were £331,518, £83,278, and 38,341,675 respectively. The report and accounts were adopted, and the retiring director and auditors were re-elected.

Kensington & Knightsbridge Electric Lighting Co., Ltd. During 1920 the consumers increased by 228 to 5,637, and the connections (30 watt equivalent) by 38,519 to 641,738. Units sold 5,810,662. Net profit £16,344, plus £1,223 brought forward. After paying the preference dividends and 9 per cent. on the ordinary shares for the year, £2,617 is to be carried forward. The balance of the renewal and reserve fund now stands at £164,548. The report refers to the forthcoming electric supply legislation and the need for amendment.

Meeting: March 17th.

Newcastle-on-Tyne Electric Supply Co.—According to the *Financial Times*, Messrs. Lazard Bros. & Co. have purchased £500,000 4½ per cent. first mortgage debenture stock of the Newcastle-upon-Tyne Electric Supply Co. at 68.35 per cent., and they are offering their stock for sale at 69½ per cent., less a brokerage of ½ per cent. This £500,000 stock ranks *pari passu* in all respects with the existing stock, the total amount of which is limited to one-half of the amount of the share capital for the time being issued and fully paid up.

Para Electric Railways & Lighting Co., Ltd.—Gross receipts for the year ended November 30th were £296,897, and operating expenses £175,032; net revenue earned in Para, after allowing for loss on exchange, being £112,124. Transferred to depreciation and renewals reserve £10,000, to general and contingencies reserve £10,000. Preference dividend 6 per cent.; ordinary dividend 6 per cent.; carry forward £18,156.

Davis & Timmins, Ltd.—Dividend for the year 1920 8 per cent., and a bonus of 17 per cent., both free of tax. Carried forward, subject to special taxation, £53,535.

Electrical & Industrial Investment Co., Ltd.—A dividend of 6 per cent., less tax, for 1920 is announced on the preferred ordinary shares; £21,028 is carried forward, subject to corporation profits tax.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following to be officially quoted:—

Armstrong (Sir W. G.), Whitworth & Co.—£2,000,000 6½ per cent. second debenture stock.

Vickers.—£1,500,000 7 per cent. 7-year notes, Nos. A1 to A4,000 (£100), B1 to B700 (£500), and C1 to C750 (£1,000).

Companies Struck off the Register.—The names of the undermentioned companies have been struck off the register, and such companies are therefore dissolved:—

Electric Wiring & Fittings Co., Ltd.
Radium Lamp, Ltd.

London Electric Wire Co. & Smiths, Ltd.—Final dividend on the ordinary shares making 7½ per cent., less tax, for 1920. £50,000 to reserve. Carried forward £38,926. Issued capital increased by final calls on new issue of preference shares.

County of London Electric Supply Co., Ltd.—Further dividend on fully-paid ordinary shares at rate of 11 per cent. per annum, less tax, making 8 per cent.; carry forward £18,594.

City of London Electric Lighting Co., Ltd.—Dividend (subject to tax) on the ordinary shares of 12 per cent. for the year 1920 and a bonus of 2 per cent. on account of reduction of dividend for 1916. £23,649 carried forward.

Telegraph Construction & Maintenance Co., Ltd.—The accounts for 1920 show net profit £110,187, plus £114,840 brought forward. Dividend 7½ per cent., free of tax, making 10 per cent. for the year. To reserve £20,000, carrying forward £115,388.

Notting Hill Electric Lighting Co., Ltd.—Expended on capital account during 1920 £19,791. The lamps connected (30 watt) increased from 280,087 to 303,188; profit increased from £31,225 to £33,816. The number of consumers is now 5,809, and all except 13 are supplied at 200 volts. There is put to depreciation, renewal, and reserve £3,000; to special reserve, £3,000; debenture interest, less tax, £1,792; Kensington & Notting Hill joint debenture stock interest and sinking funds, £4,292; income tax, £5,978; preference dividend 6 per cent., less tax; distributed to staff under co-partnership scheme £431; dividend on the ordinary shares at the rate of 8s. per share, less tax, £7,574; carried forward £3,647. Mr. R. G. Rawkins, manager and secretary, has been elected to the board in place of the late Sir William Crookes. Units generated or purchased 4,358,489; units sold 3,035,553. Meeting: March 15th.

Chelsea Electricity Supply Co., Ltd.—Profit for 1920 £41,874, plus £1,522 brought forward and £2,159 interest, making £45,555. Interest on debenture stock, £4,260; to reserve for renewals, depreciation, and contingencies, £17,312; written off cost of extinction of founders' shares, £2,178; written off investments, £2,925; 6 per cent. on preference shares; final dividend on ordinary shares at rate of 7 per cent. per annum, making 6 per cent. for the year, carrying forward £2,249. Units sold 4,916,128, an increase of 691,623. Meeting: March 16th.

Ward & Goldstone, Ltd.—Interim dividend at the rate of 7 per cent. per annum, less tax, will be posted to preference shareholders on March 31st.

Brazilian Traction, Light & Power Co.—A quarterly dividend of 1½ per cent. on the cumulative preference is announced.

STOCKS AND SHARES.

Tuesday Evening.

Remarkable rises occurred this week amongst Home Railway stocks, more especially those in the ordinary and deferred list. To name a precise explanation for the rally would be difficult. The simple reason, however, would appear to be the fact that prices last week got down to levels at which the fall certainly appeared to be overdone. Even in days like these, when there is so little money about, a certain proportion of capital can be trusted to become available for securities that are manifestly flat, and which require little buying for a complete change to be wrought in the aspect of the market. The Undergrounds, not having shared to the full extent in the previous slump of the steam stocks, have been left out of the recovery, and the changes on the week are downward. Underground income bonds are weak, and there is no recovery in either issue of the company, nor in Districts, Metropolitans and Central Londons.

Various reports have appeared from the Electricity Supply companies in respect of the year just ended, and most of them are decidedly satisfactory. The County of London report is a case in point. The company secured increases in most branches of revenue, and, although the working costs have also gone up, the result of the year's working is that the net revenue accounts gets £27,000 more than it did last year at £244,250. The increased dividend of 8 per cent. inaugurated last year is maintained, and £18,600 goes forward. The Metropolitan Electric Supply Co. shows an increase in gross revenue of £103,000, of which £7,000 was retained in net. The reserve has been increased to £615,000. The Notting Hill Co. shows a rise in net profit to £34,000, and the dividend on the ordinary is 8s. per share. Another interesting report is that of the Telegraph Construction Co. The meeting is due for Thursday in this week. Profits show a falling off of £14,000, but the company maintains its dividend of 10 per cent., free of tax (equal to 20 per cent. on the old capital), and puts the usual £20,000 to reserve, making the latter £160,000.

In the list of share prices, London Electrics have risen 5s. to £1, and Metropolitan preference are a good market at 2 13/16. On the other hand, Westminsters weakened to 4⅞, and once more the return is over 10 per cent. on the money. Metropolitans parted with half of their rise of the preceding week.

Manufacturing shares remain heavy. Edisons have fallen to 8s. 9d. English Electrics are weak at 12s. 6d. General Electrics fell 3s. to 20s. 9d. The reason for this decline is simply the fear of dividends being reduced, more or less substantially, in respect of the year just ended. There is a pretty general agreement that the 1919 distributions will certainly not be maintained, and, having regard to the all-round slump in trade, the question arises as to whether half the previous dividends will be paid in respect of the year just ended. These considerations affect the whole of the manufacturing group, and, indeed, industrials of every description in the Stock Exchange. Those who looked for settlement of commerce are disappointed at the turn which diplomatic affairs have taken. The occupation of German frontier towns does not promise hopefully for re-establishment of trading conditions with Germany, while the position in Russia, in spite of the lip-service paid to the idea of setting up a credit export scheme and the like, cannot disguise the extraordinary difficulties that still exist in the way of entering into trade relations with a country whose principal asset for the time being is the printing press.

Great Northern Telegraphs have gone back to 20½ owing to the movement of the French Exchange. Western Telegraphs are easier at 16 and Eastern ordinary at 160½. Chili Telephones went back to 5½. The general tendency of the market is not quite so good as it has been of late. Marconi's have been down to 1 21/32, rallying, however, to 1¾. Anglo-American issues are quiet, and there is nothing of fresh consequence in other cable stocks.

Amongst foreign issues, Brazilian Tractions have given way to 36½, and Mexico Trams 6 per cent. bonds to 23½. Mexican Light and Power first mortgage bonds are lower at 62½. There is neither interest nor support for Mexicans at the present time, and the failure of the Mexican Government to provide the monthly remittances promised to the Mexican Railway Company is exercising the minds of those who had pinned their faith to the power of the new President to start an era of progress and prosperity. Argentines are quiet, and amongst dollar stocks the tendency during the past week has been irregular. Shawinigan Water at 115½ and Canadian Generals at 126½ are both lower. Toronto Power debenture has risen 4 to 76.

North Metropolitan 5 per cent. debenture hardened to 57½. Tees Power Sixes at 89 are a point lower. The market in iron, coal and armament shares is despondent. Vickers ordinary and the 5 per cent. tax-free preference are dull at 10s. 7½d. and 11s. 3d. respectively. Rubber market conditions are practically unchanged. Leading shares are again lower on the obvious impossibility of producing companies making anything but a loss while rubber rests at a shilling or so per lb.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1919.	Dividend 1920.	Price March 8, 1921.	Rise or fall.	Yield p.c.*
Brompton Ordinary..	12	12	6⅝	—	£9 16 0
Charing Cross Ordinary	7	8	3⅞	—	10 6
do. do. do. 4½ Pref. ..	4½	4½	2⅞	—	8 3 8
Chelsea..	4	6	8⅜	—	9 10 6
City of London	18	14	25/-	—	11 4 0
do. do. 6 per cent. Pref. ..	6	6	17/8	—	6 17 2
County of London	8	8	7⅜	—	10 9 10
do. do. 6 per cent. Pref.	6	6	8½	—	7 5 5
Kensington Ordinary	7	9	4	—	11 6 0
London Electric	2½	2½	1	+ ⅛	7 10 0
do. do. 6 per cent. Pref...	6	6	2⅜xd	—	10 18 2
Metropolitan..	6	7	8⅛	— ⅛	11 8 6
do. 4½ per cent. Pref. ..	4½	4½	2 13/16	— ⅛	8 15 8
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	6	—	2⅜	—	9 2 10
South Metropolitan Pref... ..	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	4⅞	— ⅛	10 5 2

Telegraphs and Telephones.

	1918	1919			
Anglo-Am. Tel. Pref.	6	6	80½	—	7 9 8
do. Def.	33/6	1¼	16½	—	9 6 6
Chile Telephone	8	6	5½	— ⅛	6 8 6
Cuba Sub. Ord.	7	7	6½	—	10 15 4
Eastern Extension	10	10	15⅞	—	*6 8 0
Eastern Tel. Ord.	8	10	160½	—1	6 4 7
Globe Tel. and T. Ord.	8	10	15⅝	—	6 8 0
do. do. Pref.	6	6	9	—	6 13 4
Great Northern Tel.	22	22	20½	- 1	10 14 8
Indo-European	18	10	80	—	8 6 8
Marconi	25	25	1¾	— 1/16	—
Oriental Telephone Ord.	10	12	2 3/16	—	*6 9 7
United R. Plate Tel.	8	8	8½	—	6 8 0
West India and Panama	1/3	Nil	9/16	—	Nil
Western Telegraph..	8	10	16	— ⅛	*6 5 0

Home Rails.

	1919	1920			
Central London Ord. Assented ..	4	4	48½	—	9 4 0
Metropolitan	1¼	1½	20½	+ ⅛	7 6 4
do. District	Nil	Nil	15½	—	Nil
Underground Electric Ordinary	Nil	Nil	1½	— ⅛	Nil
do. do. "A" ..	Nil	Nil	5/-	— 6d.	Nil
do. do. Income ..	4	2	65½	- 2	2 19 6

Foreign Trams, &c.

	1918	1919			
Anglo-Arg. Trams, First Pref. ..	Nil	5½	2⅝	—	10 9 6
do. do. 2nd Pref. ..	Nil	Nil	8⅛	—	Nil
do. do. 5 % Deb. ..	5	5	60½	—	8 8 0
Brazil Tractions	Nil	Nil	36½	- 1	Nil
British Columbia Elec. Rly. Pfce.	5	5	56	—	8 18 6
do. do. Preferred	2½	5	63½	—	*8 16 0
do. do. Deferred	Nil	8	60½	+2	*11 18 2
do. do. Deb. ..	4½	4½	67½	—	7 10 0
Mexico Trams 5 per cent. Bonds..	Nil	Nil	89	—	Nil
do. 6 per cent. Bonds..	Nil	Nil	23½	—1	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	18	—	Nil
do. 1st Bonds	Nil	Nil	62½	- 1	Nil

Manufacturing Companies.

Babcock & Wilcox	15	15	2⅜	—	*7 1 2
British Aluminium Ord.	10	10	17/-	—	11 15 4
British Insulated Ord.	12½	15	1⅝	—	9 5 10
Callenders	25	15	1⅜	—	10 18 2
,, 6½ Pref.	6½	6½	17/8	—	7 6 7
Castner-Kellner	20	17	2⅞	—	7 12 9
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	10	8/9	— 1/16	—
do. do. 6 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	15/9	—	12 14 0
English Electric	—	8	12/6	— 6d.	12 16 0
Do. Pref.	—	8	13/6	—	8 17 10
Gen. Elec. Pref.	6½	6½	18/6	—	7 2 6
do. Ord.	10	10	1 1/16	— 1/16	*9 13 8
Henley	25	16	1½	— 1/16	10 18 2
do. 4½ Pref..	4½	4½	8½xd	—	8 18 8
India-Rubber..	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	1 13/16	—	8 18 4
Siemens Ord...	10	10	3 3/32	—	*10 6 2
Telegraph Con.	20	20	21½	—	*5 11 3

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

Tuesday, March 8th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	11d.	3d. dec.
a Ammoniac Sal	per ton	£75	£27 dec.
a Ammonia, Muriate (large crystal)	,,	£65	£8 dec.
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£38	...
a Copper Sulphate	,,	£35	...
a Potash, Chlorate	per lb.	7d.	...
a ,, Perchlorate	,,	10d.	...
a Shellac	per cwt.	£16	...
a Sulphate of Magnesia	per ton	£15	...
a Sulphur, Sublimed Flowers ...	,,	£21	£1 dec.
a ,, Lump	,,	£18	...
a Soda, Chlorate	per lb.	4½d.	...
a ,, Crystals	per ton	£7	...
a Sodium Bichromate, casks ...	per lb.	1/-	...
METALS, &c.			
p Babbitt's Metal Ingots	per ton	£96 to £300	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/0	½d. dec.
c ,, Tubes (solid drawn)... ...	,,	1/1¾ to 1/2	¾d. dec.
c ,, Wire, basis	,,	1/0¾	½d. dec.
c Copper Tubes (solid drawn) ...	,,	1/8½	1d. dec.
c ,, Bars (best selected) ...	per ton	£116	£4 dec.
c ,, Sheet	,,	£116	£4 dec.
c ,, Rod	,,	£116	£4 dec.
d ,, (Electrolytic) Bars ...	,,	£72	£7 dec.
d ,, ,, Sheets ...	,,	£143	...
d ,, ,, Wire Rods..	,,	£88	£7 dec.
d ,, ,, H.C. Wire ..	per lb.	11⅜d.	¾d. dec.
f Ebonite Rod	,,	8/6	...
f ,, Sheet	,,	8/-	...
n German Silver Wire	,,	2/9	...
h Gutta-percha, fine	,,	14/- to 16/-	...
h India-rubber, Para fine	,,	11½d.	...
i Iron Pig (Cleveland Warrants) ...	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£45	£5 dec.
g Lead, English Pig	,,	£19 10s.	25/- dec.
g Mercury	per bot.	£12 10 to £12 15	...
e Mica (in original cases) small ...	per lb.	4d. to 4/-	2d. to 6d. dec.
e ,, ,, ,, medium ..	,,	6/- to 10/-	...
e ,, ,, ,, large ...	,,	12/6 to 25/- & up	...
p Phosphor Bronze, plain castings	,,	1/4 to 1/9	1d. dec.
p ,, ,, rolled bars and rods	,,	2/4 to 2/7	...
p ,, ,, rolled strip & sheet	,,	2/4 to 2/8	...
d Silicium Bronze Wire	per lb.	1/4	...
r Steel, Magnet, in bars	,,	1/8	...
n Tin, Block (English)	per ton	£148	£16 to £17 dec.
n ,, Wire, Nos. 1 to 16	per lb.	4/6	...
p White Anti-friction Metals ...	per ton	£76 to £300	...

Quotations supplied by—

a G. Boor & Co.	*g* James & Shakespeare.
c Thos. Bolton & Sons, Ltd.	*h* Edward Till & Co.
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	p ————

r W. F. Dennis & Co.

The Peltier Effect and Low-Temperature Research.—In a letter under this heading in *Nature* of February 24th, Mr. A. A. Campbell-Swinton inquires whether the Peltier effect has ever been considered as an aid to the production of very low temperatures. The lowest temperatures yet obtained are those produced by Dr. H. K. Onnes, of Leyden, who, by reducing the temperature of metals to that of liquid helium, has got down to within less than 4° of the absolute zero of temperature, or more than 450° below zero Fahrenheit. Onnes, moreover, found that at such a temperature pure metals lose practically all electrical resistance, and become nearly perfect conductors. Mr. Swinton's suggestion is to apply the Peltier effect, which consists in an observed diminution in temperature when an electric current is passed in a particular direction through a thermo-couple, to obtain still lower temperatures. At ordinary temperatures, when the metals composing the thermo-couple have appreciable resistance, the Peltier effect is largely masked by the C^2R heat produced in the metals by the passage of the current. At the temperatures attained by Onnes, when resistance practically vanishes, this condition should not obtain, with the result that the application of the Peltier effect would appear to give possibilities of obtaining materially lower temperatures than have yet been reached.

Electric Cooking at Ilford.—The electrical engineer reports that in consequence of statements made at a Council meeting recently with regard to the electric cooker at the fire station, he has investigated the matter and finds the following are the facts:—The cooker in question is an old "Tricity" oven fitted with new elements. In addition there are two boiling plates in use, these being the property of the consumer. The energy consumption for the September quarter was 549 units, the cost of which amounted to £9 3s. (not £15 as stated), and for the December quarter, 411 units, or £6 17s. From December 20th to February 1st, only 44 units were used. "There is no doubt that during the two quarters referred to the whole of the cooking has been done electrically. It has been conclusively proved that when care and common sense are used, electricity can compete very favourably with gas for cooking."

THE ELECTRICAL FUTURE OF NORWAY.

Though trading prospects in Norway are rightly described by H.M. Commercial Secretary as gloomy, there is much in the future of the country which will prove of interest to the electrical engineer. In his view, as expressed in his report on the industrial and economic situation of Norway in December, 1920 (Cmd. 1145), it is improbable that trade will recover and approach normal dimensions until an outlet has been found, either at home or by re-export abroad, for the accumulation of imports which has been piling up for many months. Even then, if the country is to make a good recovery, strict economy, hard work, and social and industrial peace are essential. Labour in general in Norway, as in Great Britain, does not yet appear to have arrived at a clear understanding of the situation, but it cannot be doubted that rapidly increasing unemployment has opened the eyes of many workers to the precarious state of affairs.

Owing to general industrial stagnation, the demand for machinery, machine tools, belting, &c., is very slack. German firms are making great efforts to recover their market in Norway for machinery and tools, and are able to undersell all competitors in this class of goods. Several large German exporting firms have now sales offices in Christiania.

German Competition.

Unless the rate for sterling and dollars falls, such business as can be done is likely to be secured by countries whose currency is not at a premium, particularly Germany. The latter country, besides being in a position to undersell all competitors, appears to be able also to offer quicker delivery of electrical machinery, turbines, machine tools, &c.

In fact, in electrical machinery, German firms have re-established their position in the Norwegian market, and an expert estimates that they have secured 25 per cent. of the business in all kinds of such apparatus. Imports from the United Kingdom are stated to have remained small, owing to the fact that British manufacturers have been in a position to obtain a sufficiency of work which pays them better than deliveries to Norway. In the case of cables British exporters have secured a fair share of the business, which has been considerable.

At the present moment the demand in Norway has relaxed owing to the stringency of the money market. It is, however, the opinion of an expert that the rapid development will not be retarded long. He bases his opinion on the following factors: It is estimated that about 1,300,000 h.p. generator capacity has been installed in the country, and available figures appear to indicate that a large proportion of this power still remains to be disposed of among consumers. There will, therefore, necessarily continue to be a large demand for cables and smaller kinds of machinery such as transformers, motors, and cooking and heating apparatus. The use of electricity for cooking and heating has increased very greatly owing to the high cost of coal, and there is a great future for cooking and heating apparatus.

It is, howover, obvious that the exploitation of water power, whether harnessed or unharnessed, must depend very considerably upon the position of the money market and the possibility of raising the requisite capital.

The Commission appointed by the Storthing in 1918 to inquire into the question of a national plan for the supply of electricity for the whole of Norway has not yet submitted any recommendation, being still engaged upon technical preparatory work.

The new administration of electricity came into force on January 1st, 1921, when an Electricity Board of nine persons took over the daily conduct of affairs. The Board consists of one director-general, with three expert sub-directors working under him, one in charge of questions concerning watercourses, the second in charge of waterfalls, and the third in charge of electricity, while the remaining five members of the Board will be representatives chosen by the Storting.

Municipal Power Schemes.

The completion of municipal power schemes has been hampered considerably by the stringency of the money market, which has rendered it difficult to raise the necessary funds. Only a few new municipal power schemes have been initiated during the past year, viz., the following:—

The municipality of Drammen, having completed the extension of the Labro power station, which was under construction last year, is now considering a further extension of the same power station for the production of an additional 3,600 kW. The Bergen municipality is considering the question of procuring 6,000 kW from the Herlandsfos.

The Christiania municipality, which is badly in want of power, has received the offer of 12,000 kW from Rjukan, and also an offer of 20,000 to 60,000 kW from Tysse. In the event of its accepting the offer of power from Tysse the transmission voltage would be 150,000. In discussing the desirability of accepting this offer, the Christiania municipality has to take into consideration the comparative advantages to be obtained from the harnessing of the Raanaasfos and Solbergfos (see below).

The following municipal power schemes have lately been completed.—

Honefos and Norderhov have completed the installation of 8,000 h.p. at Honefos Mill. The town of Haugesund has completed the harnessing of the Etne watercourse. The town of Christiansund N. has completed the harnessing of the Skar watercourse. The Vaagsfjord Power Co. has completed the harnessing of a small watercourse for the supply of power to the Troms county.

The following municipal schemes are still being proceeded with, but are hampered by financial difficulties:—

That of the town of Fredrikshald for power stations on the Brekke and Krappeto waterfalls. The harnessing of Faslefos at Bægna. The scheme of the Nord Tröndelag county for harnessing the Folla watercourse. It is anticipated that the originators of this scheme will have difficulty in disposing of the 30,000 h.p. which it is estimated to produce.

Work has proceeded on the harnessing of the Raanaas waterfall on the river Glommen, and it is expected that 24,000 h.p. will be ready for delivery in the course of next year. The dam has been completed, and work upon the power station has commenced. In the case of the Hoge Waterfalls, purchased by Aust Agder county, the construction of the power house has been completed, the transmission line is being erected, and transformers are in process of installation.

Work is proceeding on the scheme of the Kristianssand town for the harnessing of the Nomeland fall, which is expected to yield 16,000 h.p. One generator, yielding 11,000 h.p., is now working. The work on the Tafjord watercourse has been continued, and the scheme is now partly in operation. The work on the Aalfot watercourse has been suspended owing to financial difficulties.

Government Power Schemes.

Work has been continued upon the harnessing of the waterfalls at Nore, on the river Laagen. The regulation of the Tunhovd lake has been completed, and tunnelling has commenced. Owing to a strike among constructional workers employed by the Government, work on the building of the railway from Kongsberg to the falls has made little progress, and it is now difficult to say when the railway will be completed.

Between 13 and 15 million kr. has now been expended upon the Nore scheme, and the future of the scheme depends largely upon the question whether it is decided to arrange for the transmission of power from Tyssefaldene to the east of Norway (see above). Work upon the Hakavik installation has been continued, but has been interrupted by the strike of constructional workers, which is still proceeding.

At Glomfjord, in the Nordland county, the State has now completed the installation of two machines of 25,000 h.p. each. An extra pipe line is under construction, which is to serve a reserve machine of 27,000 h.p.; it is probable that another machine of 27,000 h.p. will be installed later. The power from the two machines installed is delivered to a zinc smelting works. Inquiries for the delivery of power from the Glomfjord power station have been received from various sources, including American and British firms, but no contracts have yet been made.

The scheme for harnessing the waterfall on the river Laagen at Kongsberg has been postponed in view of an offer of 18,500 kW, which has been received from the Rjukan power station. If the offer from Rjukan is accepted, 4,000 kW will be delivered to the Buskerud county, 2,500 kW to the town of Drammen, and 12,000 kW to Christiania. The Norwegian Government would, in that event, complete the power line from Rjukan to Kongsberg, while the Buskerud county and the towns of Drammen and Christiania would construct the transmission lines for the remainder of the distance.

Work is being continued on the harnessing of Solbergfos on the river Glommen. The main dam and the power station are in process of construction, but it is possible that the scheme may be delayed if the Christiania municipality decides to accept the offer of power from Tysse. About 22 million kroner has already been expended upon the scheme, while orders have also been placed for machinery to the value of about 8 million kroner.

The electrification of the railway from Christiania to Drammen is now nearing completion, whilst that of the section of railway from Norway to the Swedish frontier (the Ofot Railway) has been resolved upon, and that of other sections is under consideration.

A Commission has been appointed by the Norwegian Government to consider the possibility of transmitting electrical power from Norway to Denmark. It would appear improbable that such transmission will become a practical proposition in the near future.

JOINT ELECTRICITY AUTHORITIES.

A Second West Riding (Aire and Calder) Scheme.

Consequent upon the provisional delimitation of the above-named area,* a conference of local authorities owning and operating generating stations within the district was held at Bradford in July, 1920, and was attended by representatives of 18 authorities, comprising the whole of such authorities excepting Heckmondwike U.D.C. The conference appointed a committee of eight members to prepare a scheme for improving the existing supply in, and the formation of a Joint Electricity Authority for, the district. The committee's report and scheme were duly approved by a further conference, held on February 24th, of representatives not only of local authorities owning and operating generating stations, but also of those in the district who are authorised distributors and purchase their supplies of electricity in bulk.

It will be remembered that an outline of another scheme having similar aims for the same district, but prepared by the Leeds Corporation, has already been published.†

The Committee's Report.

The first meeting of the committee, which consisted of the electrical engineers of the electricity supply undertakings at Batley, Bradford, Halifax, Huddersfield, Keighley, Leeds, Shipley, and Spenborough, with Mr. Thomas Roles as its chairman, first met in August, 1920; an abstract of its report follows:—

The Committee considers that any scheme which does not provide for the formation of a Joint Electricity Authority would only be in the nature of a palliative, and unless some authoritative body is formed having the duty of continually supervising matters relating to electricity supply in the district, efforts in the direction of improvement are likely to be spasmodic and carried out on individualistic rather than on co-ordinated lines. Any Joint Electricity Authority formed for the district should have full operative powers, as it is felt that an authority possessing merely advisory powers could only carry out its duties with the aid of a staff of inspectors, and that its recommendations would be often questioned, and friction and delay would result.

The only alternative to forming a Joint Electricity Authority would be for the Yorkshire Electric Power Co. to be appointed the Authority to control the generation and main transmission of electricity in the district. From an engineering point of view this should prove a most satisfactory arrangement, and the fact that under the Yorkshire Electric Power Act, 1901, that company has powers enabling it to become such an authority for the whole of the district, with the exception of a fringe on its northern and north-eastern boundaries, would greatly facilitate giving effect to such an arrangement. Moreover, the company has already in existence a considerable network of mains in the district which could be utilised to some extent for linking-up the various individual supply systems.

In the event of the Electricity (Supply) (No. 2) Bill‡ becoming law, under the provisions of Clause 12 of the Bill, a Joint Electricity Authority formed for the district could, providing a special Order to such effect were obtained, delegate its powers to the Yorkshire Electric Power Co., by which arrangement the Joint Electricity Authority would become an advisory body whose duty it should be to protect the interests of consumers in the district. This course would appear to be preferable to the company being appointed an authority directly. It is believed that the company would not be averse to entering into an arrangement on these lines with the local authorities in the district. The committee, however, realises that none of the above proposals, although sound from an engineering standpoint, will be acceptable to the majority of the local authorities in the district. The principle of the control of public utility undertakings by local authorities has obtained firm root in Yorkshire, and the total output of the Power Co., both to areas in the West Riding (Aire and Calder) and the North-East Midlands Electricity Districts, is exceeded by the output from the Leeds Corporation alone, and is not much (if any) greater than that from the Bradford Corporation.

With regard to main transmission, any Joint Electricity Authority which may be formed will be placed in a position of considerable difficulty so long as the Power Co. remains in existence and retains its present powers. Moreover, whereas the company has full rights of generation, main transmission, and supply in bulk throughout the greater part of the district, any Joint Electricity Authority which might be constituted would have its hands tied by the provisions of Section 12 of the Electricity (Supply) Act, 1919.

The Committee considers it possible that it may not be found advisable that the transfer of any but a few of the smaller generating stations should be effected, at any rate in the immediate future. Should such prove to be the case, the supplies which could be given by the Joint Electricity Authority would be so small that the heavy expenditure entailed in erecting a main transmission system could not be justified, unless the Joint Electricity Authority was prepared to build such a system for giving supplies to the Power Co. in certain parts of its area and so assist the company in continuing its development.

The Committee is, therefore, of opinion that if a Joint Electricity Authority is established, it is essential that the whole of the main transmission of electricity throughout the district should be placed in its hands. It is abundantly clear that if the Power Co. were given representation on the Joint Electricity Authority the voting power of its representatives would possibly in years to come have an equal if not a preponderating influence on the Joint Electricity Authority.

It must be clearly realised that the Power Co. is in possession of very different powers from those vested in companies working under the Electric Lighting Acts, and if a Joint Electricity Authority is formed its duties will be almost exactly similar to those of the Power Co., but, in addition, it may be granted distributing powers not possessed by the Power Co. If, therefore, the Joint Electricity Authority is to be a success, and no overlapping of rights and duties is to be permitted, it would appear that the only course which can be pursued would be for the Joint Electricity Authority to preferably consist of representatives of local authorities only, and that the Authority should take over the Power Co.'s undertaking, and with it the sole rights of main transmission in the district. Such portion of the Power Co.'s undertaking as is situated in the North-East Midlands Electricity District would in all probability be purchased by the Joint Electricity Authority to be set up for that district.

There are no Parliamentary powers in existence under which the Power Co. can be compelled to dispose of its undertaking to a Joint Electricity Authority, and the Government has decided that for the present the Bill under which powers were sought for the formation of District Boards, which could compulsorily acquire power companies' stations and main transmission lines, shall not be proceeded with. The Electricity (Supply) Act, 1919, however, does contain powers under which such an undertaking may be taken over by agreement.

The following is an extract from the reply of the engineer and manager of the Power Co. to the above proposal:—

"I am directed to say that in their (the directors of the company) opinion it is premature to ask the company to consider the sale of its undertaking to a body which does not exist and whose formation and constitution is not yet definitely decided. To reduce the company's area of supply would be, in the views of my board, a direct contravention of the vital principle of which the Power Act was an expression. The company is prepared to consider and to take part in any developments which will, in its opinion, be to the interests of the community in the area as a whole, but for the reasons above mentioned it is not prepared at present to discuss with you the sale of a portion of its undertaking."

The Scheme.

The draft scheme, which has already been definitely adopted by a number of Town Councils, proposes, *inter alia*, that the Joint Electricity Authority shall consist of 40 members representative of all local authorities (*a*) being authorised distributors within the district, (*b*) having the right to purchase the whole or any part of any undertaking of authorised distributors within the district, and (*c*) the county council as representing the local authorities of all areas in which electricity is (i) supplied otherwise than under a Provisional Order, and (ii) not at present supplied.

The basis of representation shall be: Local authorities who are acting as authorised distributors and the populations of whose areas of supply do not exceed (1) 25,000, to be grouped and given one representative for every 25,000 inhabitants; (2) from 25,000 to 50,000, one representative each; (3) from 50,000 to 100,000, two representatives each; (4) over 100,000, three representatives each, plus an additional one for every complete 100,000 in excess of the first 100,000; (5) local authorities (other than county councils) in whose areas electricity is supplied by other authorities or companies under provisional orders, to be grouped and represented according to item (4) on the aggregate of the populations of their areas; (6) county council, one representative for every complete 150,000 of the total population in the areas of urban and rural districts for which the councils of such districts are not entitled to appoint or take part in electing members other than those under item (6).

The rest of the provisions in connection with the administration of the scheme are generally similar to those of other schemes, outlines of which have already been published. It is proposed that the purchase powers of local authorities in the district shall, at the expiration of 12 months from the date of the establishment of the Joint Electricity Authority (unless otherwise arranged) be transferred to and vested in the Joint Electricity Authority, subject to a right of appeal to the Commissioners.

The undertaking of the Yorkshire Electric Power Co., and all its rights and interests therein, shall as from such date prior to December 31st, 1922, as shall be specified in the order constituting the Joint Electricity Authority vest in the Electricity Authority absolutely (the intent being that so much of the said undertaking as is not situate within the district shall be transferred to and vested in the Joint Electricity Authority for the North-East Midlands Electricity District (if and when established) on such terms as shall be agreed or, failing agreement, as may be determined by arbitration.

Regarding the technical provisions of the scheme, the supply will be on the three-phase, 50-cycle, a.c. system. The main transmission pressure will be 33,000, and the local secondary transmission pressures 11,000 and 6,600 volts according to the voltage at present in use at the distributing centre concerned, but for reasons of economy 11,000 volts will be adopted wherever possible at distributing centres in which the pressure is at present 6,600 volts. The generating stations at Bradford, Halifax, Huddersfield, Leeds, Thornhill, and Wakefield will ultimately become the distributing centres for the areas surrounding them, and will be linked together by main transmission cables. Extensions from these centres will be made by 33,000-volt cables to sub-distributing centres, at such times as may become necessary.

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* Elec. Rev., p. 815, June 25th, 1920.

† Elec. Rev., p. 95, January 21st, 1921.

‡ Elec. Rev., p. 844, Dec. 31st, 1920, and p. 196, Feb. 18th, 1921.

The main transmission lines will consist of 3-core, 0.15, 0.2, and 0.25 sq. in. cable, 11.25 miles of which will be at 11,000 and 80.5 miles at 33,000 volts, and it is proposed to complete 38.75 miles by August, 1922; 10 miles by August, 1923; 22.75 miles by August, 1924; 7.75 miles by August, 1925; and 12.5 miles by August, 1926.

It is proposed that throughout the period covered by the scheme, and possibly for some time afterwards, the existing generating stations at Bradford, Halifax, Huddersfield (St. Andrew's Road—general supply), Leeds (Whitehall Road—general supply), Thornhill, and Barugh, so far as the generating plant which is operated by means of waste heat is concerned, shall be utilised in conjunction with the new capital stations. The proposed extensions of plant (including extensions already authorised) at the existing generating stations above named, and the ultimate capacity of such generating stations on the completion of the proposed extensions are as follows:—

Station	Proposed extensions. (Max. cont. rating.)	Ultimate capacity of stations. (Max. cont. rating.) kW.
Bradford	Two 15,000-kW turbo-alternators	50,000
Halifax	Two 10,000-kW turbo-alternators	29,500
Huddersfield	One 10,000-kW turbo-alternator	24,000
Leeds	Two 12,000-kW turbo-alternators	75,000
Thornhill	Three 12,500-kW turbo-alternators	49,500
Barugh (waste heat)	Nil	1,500
	Totals ... 10 sets	229,500

Until the capital stations are erected and operating to their full capacity it will be necessary to utilise the remaining generating stations, with a few exceptions, and possibly to extend the plant in some of them; as these stations become linked up with the existing stations their running hours will be reduced, and finally they will be discarded. It is proposed that the erection of two capital stations shall be immediately commenced, one in the vicinity of the existing station belonging to the Wakefield Corporation, on the river Calder, and the other in the vicinity of Apperley Bridge, on the river Aire, and that three turbo-alternators each having a maximum continuous rating of 20,000 kW shall be in commission in the Wakefield capital station, and two turbo-alternators each of the same rating shall be in commission in the Esholt capital station, by August, 1924. The ultimate plant capacity of each of the capital stations will be 100,000 kW.

It is proposed that the Minister of Transport shall immediately commence the construction of the two capital stations, and shall from time to time commence the construction of the main transmission lines mentioned above in order that such stations and lines may be respectively in commission by the dates mentioned, it being the intent that the Electricity Authority shall become responsible for financing the works, whether commenced by the Minister of Transport or otherwise, as early as possible after the establishment of the Electricity Anthority.

The Electricity Authority is to repay to the Minister of Transport within a period of five years from the date of the order constituting the Electricity Authority the sum expended by him up to the date when the Electricity Authority becomes responsible for financing the works of construction as aforesaid, together with interest thereon to enable him to repay the Treasury.

There are 25 existing generating stations in the district, of which four are used mainly (if not solely) for tramway supply, namely: Huddersfield (Longroyd Bridge); Leeds (Crown Point); Yorkshire (West Riding) Electric Tramways Co., Ltd. (Belle Isle, Wakefield, and Castleford). It is intended that these stations shall remain in the hands of the present owners, but provision has been made for providing bulk supplies to such owners on their stations being shut down. On a scheme of any magnitude for the electrification of the railways in the district being decided upon it will become necessary to consider the advisability of erecting a further capital generating station and the provision of additional main transmission lines.

Finally, the financial details of the scheme are set out, which are generally similar to those relating to other schemes that have already been outlined.

The Yorkshire Electric Power Co.'s representation referring to the above scheme, and the L.C.C.'s scheme for the London and Home Counties District, will be outlined in our next issue.

The Chester and North Wales Inquiry.

Summary. (*Concluded from p. 234.*)

On Monday, February 21st, it was admitted that the Power Co. had written up its assets in the year 1918-19, from £331,459, to £532,882, on the ground that they had appreciated in value; the debenture interest was then eleven years in arrear. A considerable amount—£111,800—stood in the balance sheet in respect of railways, of which only a short length had been constructed, and this was worked by one horse which, when in good condition, made one journey each way daily. The one-horse railway caused considerable amusement, and was *the* joke of the Inquiry.

An important feature in the complicated financial arrangements is that the Aluminium Corporation owns the principal water power (at Dolgarrog), and is to give a bulk supply as required to the North Wales Power Co. to the extent of 11,000 kW on demand, but the Power Co. is to pay ¾d. per unit on a 45 per cent. load factor, and invest £250,000 in the corporation, as second debentures. The load factor of the company at present is about 25 per cent., and it is quoting the Rhyl Council 1¼d. per unit on a present load factor of somewhere about 12½ per cent. and a consumption of 350,000 units per annum. One can only say that Mr. Jack, of the North Wales Power Co., has shown great confidence in the future generosity of Mr. Jack of the Aluminium Corporation, when, as seems inevitable, the former approaches the latter to ease his burden.

The proposed advisory committee was shown to give one representative to Holyhead, with an area of 731 acres, a population of 10,636, and a rateable value of £25,031, and also one only to the Crewe and Nantwich areas, with an acreage of 122,760, a population of 82,413, and a rateable value of £485,907. There are to be 26 area representatives, two for large consumers, and four or five for railways, and, of course, the company need not take any advice given by the committee.

Another interesting point was the allowance of ½ per cent. for depreciation, which is little enough to make a corporation engineer's mouth water. Of course, a large portion of the expenditure is on civil engineering work, but an equslly large proportion is on overhead trunk mains. Sir Philip Dawson supported this figure on the Tuesday, so that, perhaps, the evidence of such an authority given to the Commissioners will ease the way of proposed joint board engineers who depart from the time-encrusted L.G.B. schedule in their estimates.

A most astonishing and gratifying state of things was divulged when a financial expert, Mr. Wells, stated that it would be possible for a company in the position of the North Wales Power Co., now paying 10 per cent. interest on second debentures, to raise all its new capital by means of bonds on a basis of 8 to 8½ per cent. interest, without any further ordinary or preference share subscription. Sir Harry Haward appeared to doubt it; in fact, that part of him which was evolved from L.C.C. methods was distinctly shocked. Sir Philip Dawson generally confirmed the view of Mr. Wells, basing his opinion on cases he knew of where large sums were being raised abroad by bond issues, with no cash subscription on ordinary shares. Indeed, it appears that a company is to be judged no longer on its past, but upon its hopes for the future. This, if it happens, is sure to be a great help to other schemes, and with regard to Joint Authorities, one is consoled by the reflection: If a company can do this, how much more, then (to use the language of the ancients), can a Joint Authority, with a rate backing and no "past," raise money at a lower rate of interest for the greater benefit of the community!

There was, throughout the Monday, considerable confusion as to the Parliamentary position with regard to the scheme. The company proposes to take the rights and obligations of a Joint Authority under the 1919 Act (if a company can do such a thing—and even its counsel was doubtful), yet it proposes a new Act of Parliament embodying its draft proposals. It is obvious that the company's proposals are quite different from those of a Joint Authority, and it did not seem to be appreciated—even by the Commissioners—that this new Act would take precedence of the 1919 Act on any points of difference, rendering the statement as to rights and obligations of no effect. It was clearly realised, however, that owing to bad drafting of the proposals, a very pretty tangle resulted. This bad drafting was throughout the Inquiry excused by calling it a "business scheme" and not a legal document. As a result, the Inquiry eventually closed without anyone knowing what the scheme really would be, even on its most important points, if the Commissioners approved it.

The seventh day of the Inquiry, Tuesday, February 22nd, produced much expert evidence dealing with the water power, and as previously stated, one cannot but be impressed by the company's scheme. The experts engaged have thoroughly dealt with the wonderful natural facilities. Mr. Vincent, acting for the Quarry Owners, led Mr. Jack to admit that he was a member of the Carnarvon County Council, and had actually drafted the resolution of that body in favour of his company's scheme! Mr. Vincent made an appeal for preferential reservation of Welsh water powers for Wales, and was very neatly answered by Mr. Jack to the effect that the local interest in it was belated. They had left the power unused down the centuries, and nothing adequate had been done, nor could be done until a market was provided outside the Principality—there being almost none within it.

Mr. Fennell, for the Northwich Electric Supply Co., pointed out the possible bad effect of the ¾d. bulk rate as between the Aluminium Corporation and the Power Co. in hampering the latter in quoting its distributors for high load factor business, such as pumping, and this eventually led to an assurance that a special price would be arranged—between Mr. Jack and Mr. Jack—in such cases to secure the business. The confusion referred to above between the Power Co.'s proposals and the 1919 Act as to its dealings in the areas of authorised distributors then became acute. It was also brought out that on an average revenue of 1¼d. per unit the company could, under its Act, pay 20 per cent. dividend, plus a very large sum to make dividends equal that amount from the commencement. Mr. Fennell's last question, viz.: "Has not the time arrived to shorten the inquiry by offering to supply a Joint Authority in bulk?" was probably an expression of the general feeling of those present.

The Commissioners, through Sir Harry Haward, were very inquisitive as to the finances of the company, through Mr. Booth as to the proposed Parliamentary procedure, and through Sir John Snell as to the advisory committee. Grave doubts were expressed as to the prospects of such a Bill as that suggested. Sir John Snell foreshadowed a possible solution of the difficulty on the lines of a Joint Authority formed to exercise political control—delegating these powers to a small committee to be represented on the company's board. Sir Philip Dawson then followed, and he shortly blessed the technical scheme, but his evidence was clearly sought on financial grounds, as already indicated. He gave very interesting "life" figures for the different classes of works, and these should be kept for future use by engineers in general. Mr. Page, for the Commissioners, obtained a useful opinion that "the fewer protective devices there are, the greater the safety" in the sense that substantial works were better than an excess of automatic cut-out devices.

Mr. Freeman, of Sir Douglas Fox & Partners, gave most interesting information as to the methods of obtaining storage, the rainfall, and civil engineering details in general, but they cannot be summarised. Mr. Paton, the company's electrical engineer, gave details as to the arrangement of the electrical plant—load factors, &c. The present load factor on the system is 25 per cent. on a 7-day, and 40 per cent. on a 5-day basis, and 60 per cent. during "quarry working hours." They hoped to obtain 45 per cent. by adding the eastern industrial area, but did not state whether on a five or seven day basis. The transmission losses were allowed at 10 per cent., notwithstanding the great distances contemplated. There were many further questions on the estimates of working costs, but nothing useful was added, though a great deal of time was absorbed before the case closed.

The remarkable speech by Mr. Tyldesley Jones, for the railway companies, introduced a very doubtful point. He represented one-ninth of the rateable value of the area—much of it, no doubt, at Crewe and Holyhead and along the London and North-Western lines—but it must be remembered that his rateable value was already represented heavily by each local authority; and in the absence of any promise to become a very large consumer, it was clearly a case of double representation. He plumped for the North Wales Co.'s scheme, on both technical and administrative grounds, he objected to any risking of the rates—he objects to rates, just as most other people object to railway rates, as being alarmingly high—he disliked public control of an electricity undertaking, but was careful to state that this did not necessarily mean opposition to other municipal activities. He, in fact, said all that a railway company's representative would be expected to say on the subject—but he said it very cleverly, and made a profound impression, such as can only be made by a K.C. of the first rank. On reflection, it may be said that a strong railway company needs no protection against a comparatively weak power company, and *might* even secure better terms from a company than from a Joint Authority representing consumers in general; but still that reflection may not occur to some who heard the speech. Mr. Jones was careful to state that he expressed no opinion on the company's financial proposals—he left that responsibility to the Commissioners! Supposing the Commissioners follow Mr. Jones and approve of the scheme, but find they must reject the financial part of it, what remains but the formation of a Joint Authority?

The rest of the sitting was occupied in special business, dealing with the case of Mrs. Owen, who, her representative, Mr. Kellow, stated, had commenced to construct a reservoir for a hydro-electric scheme of 1,200 kW near Barmouth, to supply that town and others, and had spent a considerable sum of money, before discovering that the North Wales Power Co. included this district in its Act. Mrs. Owen had been referred to this Inquiry by one whom Sir John Snell termed "a possibly over-cautious official" of the Commissioners. Sir John could only refer Mrs. Owen back to the officials. We did hope the Commissioners would be the one Government body which would be free from what Charles Dickens described as "circumlocution"! However, Mrs. Owen has an assurance that her case will be considered, and that promptly.

The business on Wednesday morning consisted of a statement made by Mr. Morris, counsel representing Carnarvonshire, and by the principals representing the two schemes (Mr. Miller, K.C., for the company, and Mr. Dickson for the Chester Corporation). Each set out the advantages of his clients' scheme, and the glaring defects of that of their opponents. The one scored as heavily on technical grounds as did the other on those of finance and organisation.

And so the Inquiry ended, the first which has been pushed to completion, having lasted eight days. The unfailing courtesy of the Commissioners, their expert knowledge of all branches of the subject, the tactful manner in which Sir John Snell intervened to bring out important information or to prevent irrelevant matter being introduced, leaving no sting behind, were acknowledged by all. It is with no little pride that we can record the success of the Electricity Commissioners as a tribunal during the hearing of evidence.

And now for the result. The wisdom of a Solomon, in fact of Solomons to the *n*th power, will be possessed by the Commissioners if they can straighten out the tangle and devise an acceptable compromise!

The transcript of the shorthand notes, wonderfully supplied by Messrs. Lee & Nightingale, of Liverpool, each morning, covered the previous day's proceedings, and was marvellously accurate. These notes total about 650 foolscap pages, and if supplied with an index, will be most useful and interesting reading. It is to be hoped that a copy will be supplied to the Institution of Electrical Engineers' Library.

(*Concluded from p. 270.*)

Monday, February 21st, was wholly taken up with the cross-examination of Mr. Jack.

Mr. J. H. Dickson questioned Mr. Jack at some length as to the heads of the agreement which it was proposed should be entered into between the North Wales Power Co. and the Aluminium Corporation for the regulation of the supply of power by the latter to the former company.

Mr. Miller, K.C., for the Power Co., handed in a copy of the heads of the agreement. It was intended that the agreement should continue as long as the Power Co. was the authorised undertaker for the district, and that the Aluminium Corporation should up to the limit of its 10,000 kW capacity supply energy to the Power Co. at ¾d. per unit, provided the load factor was not less than 45 per cent. This, Mr. Jack said, was the load factor which was anticipated. The price stated was subject to a clause as to wages, but that was in conformity with the agreements the Power Co. had with its customers.

Mr. Jack said the promoters would be quite prepared to seek the advice of the Commissioners as to what the load factor should be in fairness between the two companies. The intention of the agreement was to place at the disposal of the Power Co. the whole of the energy that could be generated at Dolgarrog, and when the customers of the Power Co. required it, the manufacture of aluminium at the Dolgarrog works would be suspended. The agreement would not be made if the district was not extended.

Answering Sir J. Snell, Mr. Jack said he would be prepared to give such reasonable and proper guarantees to maintain the position as between the two companies as the Commissioners might think fit to impose.

A series of questions followed relating to the capital and liabilities of the two companies. To one question as to what proportion of the total capital shown on the balance sheet of the Corporation represented water rights, and what proportion represented the works carried out, Mr. Jack objected on the ground that it was an attack upon the Aluminium Corporation. After consideration the Commissioners upheld Mr. Jack in his objection.

Mr. Jack said he was prepared to produce to the Commissioners anything and everything connected with his private figures, as well as the figures which he was willing to give to Mr. Dickson.

One of the items grouped together among the assets of the Power Co. was stated to be "railways." Mr. Dickson asked what railways the company had. Mr. Jack said the Croesor railway was completed and in operation.

Mr. Dickson: What kind of traction is being used?

Mr. Jack: One horse. It goes up and down once a day if the horse does not get lame. When the water in the two lakes was obtained, long before his time, it was proposed that the company should use some of the water to run the railway by electricity.

Interrogating Mr. Jack with reference to the financial clauses of the scheme, Mr. Dickson pointed to a clause in the Power Co.'s scheme which would give the company authority to assess upon the present users of energy supplied upon pre-war contracts a *pro rata* increase, equal to the increased cost of production, such increase to be decided, failing agreement, by the Commissioners.

Mr. Tyldesley Jones, for the railway companies, suggested that this was a new power in excess of anything contained in the Courts (Emergency Powers) Acts.

Mr. Jack said the Power Co. had been fairly met by its consumers, and the clause referred to could be omitted from the scheme.

As to the proposed "advisory committee," the witness was cross-examined on the basis of representation. He would give one representative, he said, to each distribution area, irrespective of its population and rateable value. Its resolutions, he thought, would in nine cases out of ten be acted upon by the company, and in the exceptional case the committee would go to the Commissioners. Whether the Power Co. acted on the advice or not depended upon the goodwill existing between the company and the committee. It would sit between the Commissioners and the company, and would give advice no doubt to both. He did not think a Joint Electricity Authority was needed for the district. The advisory committee would have no power as to prices charged to consumers, or as to the profit to be distributed to the shareholders of the company.

It was intended that local authorities and other consumers taking electricity should advance capital to the Power Co. for the construction of extensions of the transmission lines required for the delivery of that electricity, and the security for the capital advanced would be the poles and wires so erected. The form of security would be a mortgage upon those poles and wires, which would not, of course, be of much value for their purpose if the power at the other end ceased to flow into them, but he did not agree that they formed no security for the lender.

With regard to the question of rates and taxes, the chairman said the Commissioners were not satisfied with the allowance for these costs in either scheme.

Mr. Jack stated that depreciation was adequately provided for in the 10 per cent. added to the estimates for contingencies. The power transmission lines had to be maintained in good condition out of revenue.

Mr. Tyldesley Jones, K.C., for the railway companies, submitted that the clause in the scheme providing for the assessment of any deficiency in revenue in any year upon users of energy was illegal, impracticable, and uncommercial.

Mr. Jack said he would gladly drop the clause if he could, but for the moment could not see his way. He admitted that Holyhead was likely to be a large consumer owing to the extensive railway and harbour works there, but he preferred in the first instance to cater for the eastern industrial area, and the scheme did not provide for extension of the transmission line to Holyhead until four years hence. The railway company, if they wished, could construct a line at once, and the Power Co. would pay interest on the outlay.

Mr. Arthur Wells, managing director of the City General Trust Co., gave evidence on the Power Co.'s proposals for financing their further constructive works, which generally he approved. Cross-examined by Mr. Tyldesley Jones, witness said he did not attach much importance to the suggested deficiency clause.

Sir Harry Haward pointed out that, as proposed, the ordinary share capital of the Power Co. would be no more than 9 per cent. of the total capital of the undertaking. This was a very low proportion. Parliament, as a special concession in the Public Utility (Capital Issues) Act last year, allowed capital to be increased by borrowing not exceeding 50 per cent. of the share capital.

Mr. Wells thought that under the existing conditions it would be impossible to finance the enterprise otherwise than by bonds at a fixed interest.

On Tuesday, February 22nd, Mr. Miller announced that the Power Co. had decided to withdraw the deficiency clause in the scheme. Referring to the clauses in the Electricity Act as to certain duties which should be imposed upon a Joint Electricity Authority, he said the Power Co. was prepared to take over such duties, and if necessary to obtain powers in the proposed amending Bill.

The Chairman said the object of the Commissioners would be to endeavour to get the local authorities and the company to work together harmoniously, whatever the decision on the scheme might be.

Mr. H. C. Vincent then resumed his cross-examination of Mr. Jack, who said that Mr. Kenneth Clark, who had taken up the shares in the Power Co., was the managing director of Messrs. J. & P. Coats, Ltd. It was proposed to give him second debentures in the Aluminium Corporation in respect of the amount advanced. Mr. Clark put the money up to enable the Cowlyd dam to be completed, which made the scheme possible, and it was reasonable that the money should be returned to him. The interest paid to Mr. Clark was 10 per cent.

Mr. Vincent: Should not Wales have the first call on her own resources? and would it not be better for a clause to that effect to be put into the scheme?

Mr. Jack: If you continue that parochial attitude you will never have those powers developed.

In answer to Mr. H. J. Owen (Merioneth C.C.), Mr. Jack said he had an offer of the water power in their district, and if he did not buy it objection would be raised to his scheme.

Mr. Hugh Parry (Conway Corporation) said his was a small local authority; it was hoping to get a bulk supply through this scheme. Small local authorities were concerned as to the price they would be charged for a bulk supply at their boundary. What was the minimum quantity to come in at the low rate?

Mr. Jack: No rules have been established, but the price will be 1½d. to 2d. per unit according to the demand. The price in no place would be more than 2d.

Mr. Parry said the higher price would have a tendency to discourage small local authorities from committing themselves to take the supply in their areas.

Mr. Jack was examined by the Commissioners as to the financial aspect of his scheme, and said he did not expect any financial assistance from county councils, although a proviso had been put in to that effect, owing to an agreement having been come to with the Colwyn Bay Council, which was prepared to advance the money (provided it could get the necessary sanction) in order to get the transmission line sooner than he would be able to provide it, and he was prepared for other authorities to do the same. The development of water power meant the locking up of a large amount of capital, and the development must be left to private enterprise as public authorities could not bear the expense to do it on a large and comprehensive scale. The effect of drought depended entirely on the storage capacity, and all consideration was given to that point before the scheme was brought forward. He agreed that public control was desirable, but not to interfere with the work of generating the power.

The Chairman: The Commissioners have not come to any conclusion on the matter, but if some machinery were devised which would set up a form of public control after consultation with all the parties interested, would you be prepared to go into it heart and soul?

Mr. Jack: Yes.

The Chairman: It will be necessary for you to go to Parliament for another Bill?

Mr. Jack: I am afraid so, and no doubt there would be opposition to it.

The Chairman: If the report of the Commissioners is in your favour, we may rely on your cordial co-operation to devise the best possible method for your district?

Mr. Jack: Certainly, I am not wedded to any method.

The Chairman then thanked Mr. Jack for the work he had done with regard to the scheme, and noted his desire to co-operate with the local bodies, which was greatly appreciated.

The Chairman, on the previous evening, had stated that it would save the time of the Commissioners if counsel representing local bodies which intended to make any general observations would hand them in, and at this stage several handed in written statements.

Sir Philip Dawson, M.Inst.C.E., a member of the firm of Kincaid, Waller, Manville & Dawson, was called, and said he considered the figures given as to the revenue and expenditure of the Power Co. were reasonable, and there should be no difficulty in securing the capital. He did not think it necessary to provide a sinking fund for the dams, as there were in existence dams that went back to the Roman days. The average life of transmission lines was 40 years, and half of 1 per cent. was an ample provision for their renewal. With regard to raising the capital by bonds, this was a common procedure in other countries; his firm was engaged on a large undertaking in South Europe amounting to £10,000,000 for the erection of a hydro-electric station, and the money was being raised by bonds with the exception of a small percentage of capital which did not represent any cash. With regard to safeguards, he had recently been visiting a line in Germany 80 miles long, which ran through Berlin with bare wires, and it had been operating since 1915 without a breakdown.

Mr. Ralph Freeman, a partner in the firm of Sir Douglas Fox & Partners, was then called, and said he had been engaged on the work at Dolgarrog and Cwm Dyli for the past six years, and the proposed scheme was based on reports from his firm. He gave details of the annual rainfall on Dolgarrog catchment area which averaged 84 inches; the rainfall on some days averaged five inches. At Cwm Dyli the rainfall averaged 80 per cent. higher. The witness then, by a diagram, explained to the Commissioners the Cowlyd rainfall and storage for the past 13 years.

Mr. G. K. Paton, M.I.E.E., chief electrical engineer of the North Wales Power Co. and the Aluminium Corporation, was the next witness, and stated that a new installation which would be running in a week or so, of 1,500 kW, had cost £9 17s. 10d. per kW on actual prices paid to-day, so the price set down for new plant at £10 was a reasonable sum. At Maentwrog the cost had been set down at £8 per kW, but they were proposing to put in bigger sets.

Cross-examined by Mr. Tyldesley Jones, the witness said he agreed that the cost of production was cheaper at Dolgarrog that at Maentwrog.

Mr. Tyldesley Jones: Then why not use all your available surplus from Dolgarrog?

Mr. Paton: We will if there is any.

The Chairman: That is an important point.

After legal argument between Mr. Miller and Mr. Jones on the figures given, Mr. Miller said that they would see that the surplus from Dolgarrog would be fully utilised.

The Chairman: We shall be obliged to ask for more details as to figures supplied for the erection of transmission lines, such as wages, rating, and upkeep; these are very material.

Mr. Miller said that was his case.

Mr. Tyldesley Jones, speaking for the Railway Companies (but not for the Cambrian Railway), corrected an error he had made at the outset; the rateable value of the railways in the area was half a million, and not a million as stated. The railways on the North Wales coast had very heavy traffic in the summer time, carrying people from the Midlands to the seaside, and they were interested in any scheme of electrification which it was possible to carry out. The railways could not give their adherence to the Chester scheme; he contended that the estimates of the scheme had been shaken, and he was of opinion that public money ought not to be expended on it. Regarding the North Wales Power Co., the position needed careful scrutiny by the Commissioners, and he hoped that the consumers would be protected in every way possible by means of an Advisory Committee or public control. It had been suggested that the principle of the Act of 1919 was public control, but he questioned that. He asked the Commissioners not to bring in any public money to the North Wales scheme. Public control meant the dragging in of public money, and he asked them not to allow the Power Co. to be in a position to reimburse deficits by public money. Their objection to the Chester scheme was not against municipal enterprise. They supported the North Wales Power scheme because they thought they would be benefited by the cheap supply they would be able to get at certain points. He was not prepared to express any opinion on the financial part of the scheme.

Mr. M. Kellow appeared on behalf of Mrs. M. A. Owen, Aber Artro Hydro Electric Lighting and Power Works, Llanbedr, Merioneth, and asked for the area Barmouth to Harlech, on which money had already been expended, to be excluded from the North Wales Power Co.'s district, and a special Order to be granted to Mrs. Owen. Resolutions were put in from the Barmouth U.D.C., Harlech, and two other authorities in support of the scheme.

The Chairman said Mr. Kellow had better make an application for a special Order to the Commissioners; whether he would get it was another matter.

The proceedings were brought to a close on Wednesday noon.

At the commencement of the day's proceedings Mr. T. E. Morris, on behalf of the Carnarvonshire C.C., said he was instructed to support the North Wales Power Co. and oppose the Chester scheme because of the burden that would be placed upon the rates, which were already high enough. The joint authority proposed by Chester would be unwieldy, and the control would practically fall into the hands of a few officials. He called the attention of the Commissioners to the statement in the report of the Electric Power Supply Committee to the effect that in every case the authority should be as small in size as possible. The management of the Power Co. was in the hands of a small body of experts. The County Council had passed a resolution in favour of the setting-up of an Advisory Committee, which might consist of the chairmen of the electricity distributing authorities. If a joint authority were set up, the eastern zone, owing to its greater population and rateable value, would inevitably swamp the western zone. Having regard to the fact that the Power Co. was now supplying electricity, whereas at Chester nothing had been done, he thought the Power Co.'s scheme should be adopted.

Written statements were handed in by various representatives.

Mr. Miller submitted that after hearing the evidence on both schemes, the Commissioners could only come to one conclusion—that the Chester scheme was dead. It had been proved that the figures were all wrong, and the cost of production had been greatly understated. He then dealt with the criticisms levelled at the North Wales Power Co.'s scheme from a financial point of view, which he contended was the only real criticism that had been offered.

Sir Harry Haward: I agree that the financial position has greatly improved, but what did Mr. Jack mean in his evidence by "assured revenue"?

Mr. Miller: By that he means that if the company gets an assured market for the energy it can supply, it has the water power, it can develop it, and it can give the energy in ample quantities.

Mr. Miller, continuing his statement, said the company had promises of large contracts; an agreement had been reached with Colwyn Bay, and negotiations were proceeding with Llandudno. Not one penny was needed for the scheme from public bodies; there would be no call on the rates, and there was no possible liability on the areas. Mr. Tyldesley Jones came to the inquiry as an opponent, and as a result of the inquiry he stated that as a potential consumer the railway companies would support the scheme. Mr. Vincent, the company's largest customer, had also gone away satisfied, and most of the public authorities were in favour of the scheme.

Mr. Taylor pointed out that Mr. Tyldesley Jones did not state that he was in favour of the Power Co.'s scheme from a financial point of view, but from an engineering point of view.

Proceeding, Mr. Miller said the company was prepared to give a cheap supply of energy without a penny of public money being utilised, but if the public had a right of control, then the company would have a right to demand public financial support.

Sir Harry Haward: But if a company is given a monopoly, some equivalent to public control should be given, if no assistance is given out of public funds?

Mr. Miller: The company is prepared to meet it at its own expense Mr. Jack appreciated that the scheme was for a public service, and was prepared to accept a form of public supervision.

The Chairman: Some clause should be inserted so that in the event of the company being unable to carry out its obligations, public authorities could carry out the work.

The Town Clerk of Chester, in his reply with regard to the Chester scheme, contended that the cross-examination of Mr. Britton had not shaken the latter's evidence in any material respect, on the financial side of the scheme. The Commissioners had ample powers to secure the land on the banks of the Dee for the erection of the proposed low-fall power stations. He then went on to criticise the Power Co.'s financial position, and said that if it were granted an Order and proceeded to Parliament for a Bill, the severest opposition would be set up by public authorities, and the scheme would be delayed for two years.

After Mr. Miller had briefly replied to the points made, the inquiry closed.

Mersey and West Lancashire Inquiry.

Objections to the scheme for a Joint Electricity Authority for the Mersey and West Lancashire District were considered on Tuesday last, when the Electricity Commissioners resumed their inquiry at the Liverpool Town Hall. The earlier proceedings were reported in our issues of February 4th and 11th.

At the outset, Mr. Honoratus Lloyd, K.C., who appeared for the authorities supporting the scheme, intimated that he had received a letter from the Town Clerk of Warrington enclosing a resolution to the effect that the time was inopportune for schemes involving great capital expenditure, and requesting the Commissioners not to proceed with the constitution of the Joint Authority. A resolution of the St. Helens Town Council was also read, stating that having regard to the evidence given by the Liverpool electrical engineer and the attitude adopted by Birkenhead, Wallasey, Bootle, Warrington and Southport it could not give further support to the present scheme. It considered the preparation of a scheme for another area advisable.

The Chairman asked the representatives of the two Councils to give an explanation of the reasons for the withdrawal, but both considered the time inopportune, and promised a statement later.

At the conclusion of the day's proceedings the Commissioners asked the representatives of Warrington and St. Helens to meet them in their private room. The counsel for the schemes which were under consideration were also invited to meet the Commissioners.

The proceedings were mainly occupied by the opposition of the Mersey Power Co. to inclusion in the Joint Authority. Mr. G. W. Malcolm, managing director of the company, gave an account of the utility of the company's electricity services, and although very guarded in his replies and obviously reluctant to disclose certain information, promised to convey certain particulars to the Commissioners privately. He declared himself very emphatically against the Joint Authority, describing it as communal control.

Mr. James Nelson, the company's electrical engineer, then gave evidence, and was about to be cross-examined—and Mr. Honoratus Lloyd, K.C., said he had a lot of questions to ask witness—when the inquiry was adjourned until 10 a.m. on Wednesday morning.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Annual Dinner.

On Thursday, March 3rd, the annual dinner and reunion of the Institution was held at the Hotel Cecil; the attendance created a new record, there being 440 present, compared with 380 last year—which was also a record number. Mr. Ll. B. Atkinson, the president, occupied the chair, and the guests included Profs. C. S. Sherrington, F.R.S. (president, Royal Society), and Sir W. H. Bragg, K.B.E., F.R.S. (president, Physical Society), Sir John Bland-Sutton, F.R.C.S. (president, Royal Society of Medicine), Sir W. J. Pope, K.B.E., F.R.S. (president, Society of Chemical Industry), Mr. A. W. Berresford (president, American Institute of Electrical Engineers), Lieut.-Col. Sir F. Younghusband, K.C.S.I. (president, Royal Geographical Society), Sir John Snell, Sir Harry Haward, Mr. W. W. Lackie, C.B.E., Mr. A. Page, and Mr. H Booth, O.B.E. (Electricity Commissioners), Prof. Sir J. E. Petavel, K.B.E., F.R.S. (director, National Physical Laboratory), Mr. W. O. Smith (chairman, B.E.A.M.A.), Sir Frank Heath, K.C.B. (secretary, Department of Scientific and Industrial Research), Sir W. Noble (engineer-in-chief, G.P.O.), Capt. H. R. Sankey, C.B., C.B.E. (president, Institution of Mechanical Engineers), Major H. Richardson, O.B.E., M.C. (president, I.M.E.A.), Dr. R. Knox (president, Röntgen Society), Dr. S. G. Scott (president, Electro-therapeutic Section of the Royal Society of Medicine), Prof. A. W. Porter (president, Faraday Society), Mr. E. C. Wansbrough (chairman, C.M.A.), Mr. Hugo Hirst (president, E.D.A.), and many other distinguished men, whilst past and present members of Council, including Col. R. E. Crompton, Dr. S. Z. de Ferranti, Mr. C. H. Wordingham, C.B.E., Mr A. A. Campbell Swinton, F.R.S., Dr. W. H. Eccles, Sir James Devonshire, K.B.E., Mr. J. S. Highfield, Mr. R. T. Smith, and Mr. C. P. Sparks, Mr. A. Carpmael (hon. solicitor), and Mr. P. F. Rowell (secretary) were present.

After the loyal toasts, the president read telegrams of greeting from the Italian Electrotechnical Society and the American Institute of Electrical Engineers, and dispatched replies. Prof. Sir W. H. Bragg then proposed "The Institution of Electrical Engineers," expressing the pleasure that any physicist must feel in wishing success to an institution whose aims were so closely akin to his own. In the early days the physicists had shared in the development of electrical science, and now again they were in close co-operation with electrical engineers in dealing with atomic and electronic magnitudes. The Institution embodied very high ideals—it taught everyone who belonged to it to be an efficient servant of his country, and that success depended not on what one received, but on what one had to give. An institution like an individual must seek to render service; the Institution had fulfilled that great ideal; moreover, it had found a great president, a man in whom they were all honoured.

In his reply, the President pointed out that Sir William Bragg was no stranger to the Institution; his recent Kelvin lecture on the electron and the atom was one of the most profound yet simple addresses they had ever been privileged to hear. The roll of the Institution now numbered over 9,400; besides the public work in which it was engaged, there were 14 committees meeting frequently and carrying on departmental work; the Institution was also represented on 40 external bodies, and in January and February 47 meetings and discussions were held in London and the Provinces. All this voluntary and co-operative activity must have its effect on the scientific and industrial work with which they were associated, in advancing the interests of the industry, and in engendering good fellowship. The frank confidence that existed between the members and the Council was recently exemplified when new proposals were laid before the members. He wished he could speak in the same vein of the industry of the country; a great change had come over it since the armistice. An immense accumulation of purchasing power, augmented by credits advanced by the banks, was then set free, and an orgy of spending set in, with the result that the purchasing power soon left this country, credits were locked up, taxation reached an unexampled intensity, deposits were exhausted, and the banks began to call in credits. The nation had been spending more than its total income, and more than its total production, and it was brought up with a round turn. Most of the people were insisting on living on a higher scale than before the war, or alternatively on receiving money which they had not earned. The electrical industry lived on new construction, not on the replacement of past construction. Before the war the country saved 300 millions a year—now he doubted whether it saved 100 millions; it needed 20 millions a year put into new electrical construction—where was the money to come from? The only possible source was America; much American money was being spent here now, in the belief that the exchange would improve, and that might pull us through. The reorganisation of the electrical industry contemplated during the war, and embodied in an Act in 1919, amounted to a quasi-nationalisation; the Institution held that it would be sufficient to appoint Commissioners and let the existing organisations work out their own expansion. The Commissioners had been at work for nearly a year, and had been considering proposed schemes, but these had proved disappointing; they would not carry conviction to the minds of engineers or financiers, and it was further disappointing to find that the old struggle between companies and municipalities had begun again. He sounded a note of warning: the public had made up its mind to have a large and efficient electrical distribution; under the Commissioners the electrical engineers had the opportunity of doing the work themselves—but if they did not succeed, the public would come in and do it, and the public would then have the support of the manufacturing and employés' interests, as the only way to get a move on. A campaign had already begun in the financial and other papers, belittling the work of the Commissioners; the Institution did not support that campaign—the Commissioners knew their business, and there was no fear that they would lack ability—but he feared the inefficiency of the schemes put before them. The members must face these difficulties and use their individual influence to overcome them.

Mr. A. A. Campbell Swinton proposed "Our Guests," remarking that there were no politicians among them this year, but that was not a matter to worry over; electrical engineers thought more of people who did things than of people who only talked about doing them.

Sir Frank Heath, in responding, said that the impression that he had formed of the Institution of Electrical Engineers was that it had a capacity for long-sighted statesmanship equalled by no other society. Mr. Wordingham's scheme for a National Proving House would sooner or later be realised. Among the 26 Research Associations which had come into existence, not one had provided for the representation of the scientific man to the same extent as the Electrical Research Association.

Sir John Bland-Sutton also responded, referring to the conspicuous services which electrical science had rendered to his profession, and reviewing the wonderful progress made during a lifetime.

The company then adjourned to the reception room, where old friendships were renewed and new ones begun, and conversation was kept up till a late hour. During the evening a programme of music was performed by the Imperial Orchestra, and the arrangements were all very satisfactory.

REVIEWS.

Industrial Electric Vehicles and Trucks. By W. Worby Beaumont, M.Inst.C.E., &c. Pp. xii + 183; 189 figs. London: Charles Griffin & Co., Ltd. Price 15s. net.

In view of the rapidly increasing importance of the industrial electric vehicle, both indoor and outdoor, this book comes at an opportune moment. The author has for many years been an authority on automobilism, and though he has latterly appeared to champion the cause of the petrol-driven type of vehicle, his heart has been in the right place all the time, for, as he points out, as long ago as 1902 he wrote: "Given the electricity supply, nothing would be better than the electric motor for the propulsion of vehicles." That supply is now available, the electrical method of propulsion with secondary batteries has been proved to be "a practical commercial proposition," and experience has shown, he says, that in many fields the electric vehicle may be more convenient and profitable than any other type. We heartily agree; but much still remains to be done in providing charging stations and garage accommodation, before the "electric" will be able to achieve the position to which it is justly entitled.

In the work before us the author first sets forth particulars regarding the construction and operation of the various industrial vehicles that are on the market in this country, with numerous illustrations of vans and wagons, lorries, chassis, driving gear, controllers, and other components. A chapter follows on industrial trucks, of which he speaks in terms of highest commendation; we need not say "industrial electric trucks," because there are no other automobile trucks fit to be used inside factories and workshops, in railway stations, works' yards, &c. In this sphere electricity is supreme, not only because unique, but also because so singularly well adapted to the purpose. Next the author deals with the components—the motor, which he regards as "a beautifully adapted electromechanical instrument"; the batteries, of which the field of choice is very limited; and the controllers, after which he turns to battery-charging equipments, motor-generators, and plugs and sockets. The concluding chapters give costs of working, as published by various municipal and private users, and some notes on rubber tires.

It will be seen that the book is almost wholly descriptive; criticism is practically absent, and the author—or should we say compiler?—has modestly refrained from expressing his own opinions, except on certain subjects, such as the power required for traction, and the choice of tires, in connection with which he has carried out tests. For the bulk of the information contained in the book the manufacturers, the Electric Vehicle Committee, and similar sources are obviously responsible. This is not to say, however, that the book lacks utility; far from it. Here will be found abundance of facts and figures, from which the reader may draw his own conclusions, and in justice to the author, it should be said that he claims no more for it. The illustrations are generally good, and the text is well printed on good paper. We have found few misprints, though we may say that the illustration of the Tirrill regulator on p. 131 is upside down, and the title of *The Electric Vehicle* is mis-spelt in a few places. In the next edition some space should be given to the mercury arc rectifier, which is only named once in this volume, we believe. We know of no other work covering the field dealt with in this book, which therefore is sure to be widely read.

Problems in Physical Chemistry, with Practical Applications. By Edmund B. R. Prideaux, M.A., D.Sc., F.I.C. Second edition, Revised. Pp. xii+294. London: Constable & Co. 1920. Price 18s. net.

The only way to obtain a real working grasp of any branch of physical science or engineering is to reduce it ultimately to arithmetic. The application of physical chemistry to the solution of industrial problems is of recent date, and it is gratifying to welcome a second edition of this useful book—the first edition appeared in 1912—for it shows that physical chemistry is coming to its own. The problems stated include thermochemical reactions, the properties of one and two component systems, reactions in gases and in solutions, electrochemical reactions, and the kinetics of molecular and radioactive changes. Some of the examples chosen are highly suggestive of the increasing part physical chemistry is destined to play in industry. It seems likely that soon no engineer who has to deal with power production will be regarded as being completely equipped if he has not some knowledge of the fundamentals of this science.

A Large E.H.P. Insulator Order.—The *Electrical World* says that an order for 45 000 units of suspension-type insulators has been received by the Locke Insulator Manufacturing Co., Victor, N.Y., from the Southern California Edison Co., Los Angeles. They will be used on an experimental section of transmission line approximately 20 miles in length for operation at 220,000 volts. The Southern California Edison Co. is at present operating at 150,000 volts with nine suspension insulator units per string.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

An Inclinable Power Press.

Regent Shears, Ltd., of Wakefield, have sent us particulars of an improved type of inclinable power press for the production of all classes of sheet metal stampings, and particularly electrical stampings, which they have recently put on the market. The machine is illustrated in fig. 1, and it will be seen that the beam has slides of broad and long proportions ensuring the utmost rigidity during operation. The coupling is very robust, and a new type of tilting gear has been embodied in the design. Among the special features are the "Regent" patent safety clutch motion and automatic mechanical brake. The clutch is foot-operated, depression of a lever allowing one stroke by releasing a key to engage with the flywheel. The withdrawal of a pin enables the press to operate continuously while the foot lever is depressed. The brake has been designed with a view to reducing the power required for driving the machine during periods when the braking action is not necessary. By its means brake friction is reduced to a minimum, giving reduced power consumption.

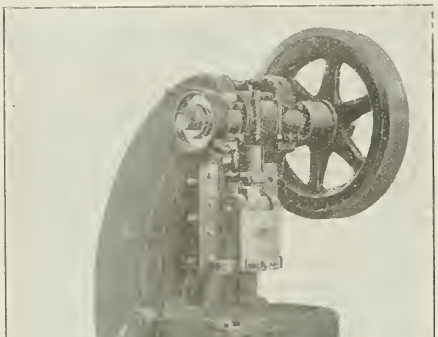

Fig. 1.—An Inclinable Power Press.

A Suspended Rivet Heater.

A very useful form of electric rivet heater has been placed on the market by the A.I. Manufacturing Co., Industry Works, Sunbridge Road, Bradford. The apparatus is made suitable for suspension from an overhead runway or crane hook, which gives great portability in cases where work is distributed throughout the length of a shop or factory. The transformer is fixed to a counter-balanced bar suspended by its centre from a hook. Its primary is generally wound for a.c., 50 cycles, 230 V, and it is provided with a change-over plug switch giving five different degrees of heat. The connections to the electrodes are of ample length and insulated from one another. The electrodes consist of 1¼ in. diameter solid hard-drawn copper fitted into round grip sockets and provided with hard wood handles.

In operation the heater is brought up to the work, and the rivet is placed in position to complete the circuit. When the rivet has reached the proper state the electrodes are opened, and the machine, controlled by the balance weight, is brought into position for the next "heat."

As regards the performance of the machine, it is said that 500 3/16 in. diameter mild steel rivets can be heated per hour, or 180 ½ in. diameter rivets in the same time.

All parts of the apparatus are well protected, and it is claimed to be practically "fool-proof."

The Blackman Stream-line Fan.

The endeavour to secure an improvement in the efficiency of propeller fan blades by making them with a section approximating the most efficient stream line, has resulted in the production of a fan giving, it is claimed, 30 per cent. higher mechanical efficiency than the next best of its class, by the Blackman Export Co., Ltd., 374, Euston Road, N.W. 1. The new fan is illustrated in fig. 2. Each of its six blades is hollow, both sides being convex with central internal stays for holding them to the boss of the wheel. There are no projections, the whole blade offering the minimum resistance to the air flow. The fan is reversible, and can be run in either direction with equal results. The blades are separately renewable without dismantling or even dismounting the whole fan. This offers great facility for shipping, as the blades can be packed in a very small space.

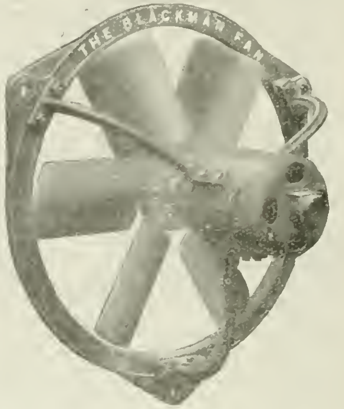

Fig. 2.—The Blackman Stream-line Fan.

The "Powerlight" Set.

A very compact small lighting and power set is made by the Hamworthy Engineering Co., Ltd., 76, Victoria Street, S.W. 1. This is known as the "Powerlight" set, and is illustrated in fig. 3. As will be seen from the illustration, the dynamo is mounted above the engine, leaving the latter free to perform other duties if required. The engine can be run on petrol or paraffin, and develops 2½, 3½, or 6 b.h.p. according to size. The dynamo is of the open protected type, shunt wound, and fitted with ball bearings. The drive is effected by a leather link belt which is very flexible. The switchboard consists of an aluminium panel upon which are mounted the control switch, an ampere-hour meter, two switch fuses, and an engine stop button. The set can be started by bringing the control switch into the starting position, and then to the "on" position, where it will remain until the battery is fully charged, when it automatically cuts the battery out. The battery consists of 14 cells with a capacity of 60 Ah when discharged at a 10-hour rate at 1.85 volts per cell. It is complete with all accessories.

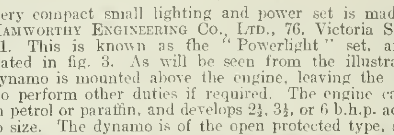

Fig. 3.—The "Powerlight" Set.

TEMPERATURE LIMITS OF LARGE ALTERNATORS.

Discussion at Newcastle-on-Tyne.

At a meeting of the members of the North-Eastern Centre of the Institution of Electrical Engineers, held at Newcastle-on-Tyne, on February 14th, Mr. G. A. Juhlin's paper on "Temperature Limits of Large Alternators," which was abstracted in our issues of February 4th and 11th, was read and discussed.

Mr. E. Fawssett, who opened the discussion, said that both manufacturer and user had much to gain by adopting methods of ascertaining temperature which would tell them what was taking place. The author stated that the sources of heat were well known, but heat was found in quite unusual places, such as were only discovered by actual practice, and he felt that it was that sort of fact which would account for the conservative limits of heating usually laid down, and although it was quite realised that insulation would stand those hot spots, yet it was necessary to allow a margin to cover any unexpected temperatures that might be experienced. As to measuring the temperature of the stator by the resistance test, that method took considerable time, and he thought the only way to get a reasonable idea of what the conditions were was to plot a time curve backwards, which would give a fairly good idea of what the temperature was when they shut down. The thermo-couple as described by the author was, in the speaker's experience, quite good enough. They started using it years ago on large machines, and found the apparatus very valuable; the thermo-couple was quite sufficient and was extremely accurate. Manufacturers should study temperature limits just as they did steam consumption.

Mr. T. Carter pointed out that there did not seem to be any allowance for overload, yet it was an important point. They should know how the machine they were using stood with regard to that matter before they used it, and not have to find out afterwards. He drew attention to the statement: "The limits for the temperature rise laid down by the British Engineering Standards Association for fibrous insulation are 55 deg. C. measured by resistance or 50 deg. C. by thermometer," and said he could not understand how they could measure 55 deg. by resistance and 50 deg. by the thermometer—nor had he found anyone who could explain it.

Mr. J. M. Waite gave some figures of resistance tests showing the great variability as compared with thermometer tests. A thermo-couple was put where they expected a hot spot, and when the machine was running they got a reading showing 84 deg. C.; the load was taken off, the plant shut down, and they got a temperature of 93.11 deg. The fact was that the thermo-couple had not been shielded from the air-blast. On the rotor where they could not get a reading by thermometer they measured it by resistance, and got 124 deg. C. when standing and 85 while running. He claimed that the instrument used for ascertaining the temperature, whatever it was, should be as simple as possible; what they wanted in all those matters was reliable relative accuracy. If they knew the margin of safety there might possibly be a saving in constantly running an alternator at a higher temperature; if it could be run at a little overload safely there might be a distinct saving.

Mr. C. H. Davidson explained that they worked machines in America at a much higher temperature than was usual in this country, and manufacturers would have to consider adopting higher temperatures, or they would find the markets closed to them. He thought the 40 deg. rise too low, and that the B.E.S.A. limits were too much on the safe side. It was a little disquieting to hear so much about hot spots, he had been working to get rid of them, and in some designs of machines they got an even temperature all through. As to the bar test mentioned, some attempt should have been made to imitate the vibration the bars were subjected to in a machine. Respecting the use of mica insulation, all the author's references were to the mica, whereas they should give more attention to the material that held the mica together —the fibre or fabric, or whatever it was—because the real difficulty did not lie with the mica, but with the other material, the life of which determined the life of the insulation. He also pointed out that the temperature limits were practically the same as recommended by the Conference held at Berlin some eight years ago.

Mr. R. M. Longman said the increase in the size of machines had made it more difficult to get at the hot spots. Regarding the difference between the 6,000 and the 11,000-volt machine, the speaker rather favoured the 11,000-volt one; they had the extra insulation and the B.E.S.A. only allowed 9 deg. difference in temperature.

Discussion at Birmingham.

At Birmingham Mr. Juhlin's paper was discussed before the South-Midland Centre of the Institution of Electrical Engineers on February 2nd.

In opening the discussion, Dr. G. Kapp said that in his opinion the most important matter was not to get cheaper but safer machines, and safer machines involved an exact knowledge of the heating conditions. He could not agree that the use of a thermometer was the simplest and easiest method; moreover, it was misleading. It was essential to know the actual temperature at the hot-spot, and to get that required a detector placed actually at the hot-spot. The speaker then discussed in detail the difficulties of accurate hot-spot temperature measurement. A null method suggested by him consisted in using in the outside circuit a couple of the same materials as that embedded in the machine at the hot spot. The outside couple was immersed in a liquid which could be heated until a galvanometer gave a zero reading. The outside couple was then at the same temperature as the embedded couple, and its temperature could be accurately measured.

Major A. M. Taylor suggested a method of deducing the hot-spot temperature indirectly from observations on, first, the increase of resistance of the whole circuit due to the combined action of the normal part and the hot-spot part, and then the increase of resistance in the complete circuit when the hot spot was not active (as, for example, when the stator was cool). To carry out the suggestion it was necessary to know the proportion of the length of the circuit covered by the hot spot.

Mr. A. T. Bartlett said that the use of temperature detectors was the only sane way of running plant. For instance, in the case of a power house, if a set was started up cold and the steam end was capable of dealing with a certain overload, the generator could also be overloaded for a time if the detector showed that the safe temperature was not exceeded. In his opinion ascertaining temperatures by balancing methods was wrong; the power house attendant already had enough to do, and all detector instruments should be of the inspectional type.

Mr. W. J. Line thought that it appeared to follow from the mechanical tests described by the author that breakdown under high voltage might be expected to occur at the same place as mechanical breakdown, namely, where the insulated conductor left the slot. He believed it was a fact that breakdowns did occur more frequently at that point than elsewhere, but he questioned whether it could be inferred that electrical failures occurred where mechanical failures occurred due to bending of the insulated conductor at its point of emergence from the slot. In connection with the results of some dielectric and other tests made some years ago by Wilson and Mitchell it was suggested that as the density of the dielectric force at the ends of the slots in which the coils were embedded was considerably increased, the ends of the slots should be rounded, and that suggestion seemed worthy of consideration.

Dr. M. Kahn favoured gradual development rather than an immediate increase of temperature limits. All firms building large units and many operating engineers were alive to the question and data, and experience were continuously increasing. The problem was not an urgent one, as it was quite possible to produce the sizes at present required within the limits of a total working temperature of 120 deg. C. Manufacturing and operating engineers who had to rely on those sets for a large proportion of the load had no interest in running risks. The accumulation of experience would naturally tend to lead to development up to a safe limit in course of time. A point not mentioned by Mr. Juhlin which might conceivably determine the safe temperature limit was the expansion of the long coils in large machines.

A New Kinematograph Projector. — According to *Nature* of February 24th, a kinematograph projector of a new type was demonstrated by Mr. R. J. Trump at the Imperial College, South Kensington, on February 10th. The invention of Mr. Kingsley-Higginson, it employs, in place of the shutter and intermittent film-feeding gear of the ordinary machine, a continuously rotating ring of mirrors to stabilise the image and effect the change of picture while the film is run uniformly through the machine. The beam of light is thus always passing unobstructed to the screen, and the alternations of light and darkness produced by the shutter, which constitute the flicker of the ordinary projector, are avoided. The new apparatus can be run quite slowly if required, and in any case there is no necessity to speed it up in the way that is at present usual. The change of picture takes place zone by zone across the screen, which always shows a full image, derived from parts of two successive pictures on the film. The facets on the ring of mirrors are so arranged and set at such an angle that the two lights from the two partial film-pictures which are present at any instant in the gate are separated and transposed into their correct positions on the screen, and joint up to form a complete image. There is no dark period and no overlapping or dissolving of the successive pictures into each other, as the first picture disappears at precisely the same rate that the second takes its place. A good and sharply defined image is obtained. The advantages of a uniform feed for the film are considerable, in that the wear and tear upon it are much reduced, and the risk of breakage is negligible. The application of the same principles to kinemaphotography is under consideration, and there is every expectation that useful results will be obtained.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

5,359/61. "Insulation for armatures." J. F. Cullin. February 16th

5,360 "Wrapping machine." J. F. Cullin. February 16th.

5,362. "Machine for positioning armature windings." J. F. Cullin. February 16th.

5,363. "Armature winding." J. F. Cullin. February 16th.

5,364 "Coil winder." J. F. Cullin. February 16th.

5,365. "Armature winding testing mechanism." J. F. Cullin. February 16th.

5,374. "Electric light fitting." J. Y. Fletcher and C. W. Saunders February 16th.

5,382. "Electric insulators." Metallurgique Electrique. February 16th. (France, September 27th, 1920.)

5,393. "Electric accumulators." G. W. Richards. February 16th.

5,394 "Electric measuring instruments of the hot wire type." A. Lederer. February 16th. (Austria, February 25th, 1920.)

5,398. "Sparking plugs, &c." L. Febbraro and J. Narizzano. February 16th.

5,404. "Sparking plugs." W. Bragger. February 16th

5,411. "Electric motor controllers." G. N. Cadbury. February 16th.

5,412. "Electrical locking device for vehicle doors." A. J. Cordell. February 17th.

5,432/3. "Fittings for gas or electric light." T. J. Saveker. February 17th.

5,436. "Electrical transmission systems." A. M. Taylor. February 17th.

5,456. "Wireless, &c., signalling systems." Radio Communication Co., Ltd., and J. Scott-Taggart. February 17th.

5,459. "Commutators." J. E. Calverley and W. E. Highfield. February 17th.

5,460. "Electrical insulating members." J. E. Calverley and W. E. Highfield. February 17th.

5,465. "Vent plugs for electric accumulators, &c." A. L. Davis. February 17th.

5,467. "Interrupters." E. E. Greville and F. W. Read. February 17th.

5,468. "Electro-medical apparatus." E. E. Greville and F. W. Read. February 17th.

5,490. "Electric signalling." B. Davies and Eastern Telegraph Co., Ltd. February 17th.

5,491. "Electric cables or conductors." J. Drennan. February 17th.

5,500. "Dentures." J. Lavine. February 17th.

5,504 "Electric hand lamps." J. Lewington and T. W. Lewington. February 17th.

5,521. "Automatic electric couplings." A. V. Tomlinson (Westinghouse Air Brake Co.) and Westinghouse Air Brake Co. February 17th.

5,524. "Electromagnet switches for controlling circuits of train lighting, &c., installations." A. H. Darker and J. Stone & Co., Ltd. February 17th.

5,553. "Device for preventing vibration destroying the filaments in electric globes." A. McArthur. February 18th.

5,557. "Securing wires, cables, &c., for ignition magnetos, &c." F. H. Farrer, F. Pountney, and Villiers Engineering Co., Ltd. February 18th.

5,614. "Electrically heated muffle furnaces." Akt.-Ges. Brown, Boveri et Cie. February 18th. (Switzerland, February 18th, 1920.)

5,619. "Sparking plugs." C. S. Harrison. February 18th.

5,620. "Electrically operated rotary advertising devices, &c." J. M. Robertson. February 18th.

5,621. "Electric discharge tubes." Naamlooze Vennootschap Philip Gloeilampenfabrieken. February 18th. (Holland, April 20th, 1920.)

5,627. "Electro-mechanical pocket lamp." Soc. Blot-Garnier et Chevalier. February 18th. (France, July 24th, 1920.)

5,628. "Combined switch and plug for electric circuits." J. R. Middleton and Watts, Williams & Co., Ltd. February 18th.

5,629. "Dimming electric lights." J. R. Middleton and Watts, Williams and Co., Ltd. February 18th.

5,630. "Magneto generators." J. R. Middleton and Watts, Williams and Co., Ltd. February 18th.

5,643. "Insulators for suspended high-tension electric wires." A. Renaudin. February 18th. (France, February 23rd, 1920.)

5,648. "Recording electric currents." J. H. Jones and L. Kecskemeti. February 18th.

5,655. "Electrical apparatus for railway signalling." F. Downs and Tyer and Co., Ltd. February 18th.

5,671. "Electric switches." H. B. Cornish. February 19th.

5,674. "Charging boards for electric accumulators." C. E. P. Gabriel, February 19th.

5,708/9. "Dynamo-electric machines." C. P. Bramley, Lancashire Dynamo and Motor Co., Ltd., and W. Stansfield. February 19th.

5,713. "Trolley wheels for poles of electric tramcars, &c." E. Nightingale. February 19th.

5,730. "Automatic cut-out and indicating apparatus for electrical accumulators." C. E. Cox and White Electrical Instrument Co., Ltd. February 19th.

5,743. "Wireless receiving apparatus." British Thomson-Houston Co., Ltd., and R. C. Clinker. February 19th.

5,754. "Casings for electric pocket lamps." B. Rogge. February 19th. (Germany, March 24th, 1920.)

5,755. "Electric meters." Chamberlain & Hookham, Ltd., and S. James. February 19th.

5,757. "Automatic switches." J. Bogopolsky. February 19th.

5,783. "Permanent way of tramways." D. McDonald. February 21st.

5,803. "Electric drilling-machine." W. Bairstow. February 21st.

5,807. "Radio signalling systems." Radio Communication Co., Ltd., and J. Scott-Taggart. February 21st.

5,810. "Duplex, &c., telegraphic systems." H. W. Sullivan. February 21st.

5,828. "Portable dynamos for electric lighting sets." H. Humphrey. February 21st.

5,837. "Sparking plugs." A. E. Heath. February 21st.

5,847. "Hand-operated mechanism for operating electric controllers, &c." A. West and West & Co., Ltd. February 21st.

5,849. "Electric control systems." British Thomson-Houston Co., Ltd., and General Electric Co. February 21st.

5,855. "Electric heating devices." P. M. A. Mounier. February 21st. (France, February 19th, 1920.)

5,857. "Wall-plug connections for electric circuits." J. Hall & Co. and G. F. Ostins. February 21st.

5,887 "Cable tips." F. Forg. February 21st. (Germany, July 21st, 1920.)

5,894 "Thermionic valve transmitters." Ges. fur Drahtlose Telegraphie. February 21st. (Germany, February 28th, 1920.)

5,916. "Conduits, tubing, connections, bends, &c., for electric light wiring, &c." T. Hayward. February 22nd.

5,920. "Adaptor for sparking plugs." A. M. Porter. February 22nd.

5,947. "Lathe attachment for re-surfacing commutators." W. E. Irons. February 22nd.

5,956. "Signalling systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). February 22nd.

5,971. "Sparking plug." H. S. H. Hughes and J. W. Hughes. February 22nd.

6,009. "Coupling-rod drive of driving axles of electrically-driven vehicles." E. C. R. Marks and Western Electric Co. (Akt.-Ges. Brown, Boveri et Cie.). February 22nd.

6,011. "Electric furnaces." A. E. Reid. February 22nd.

6,013. "Thermal ammeters." Weston Electrical Instrument Co. February 22nd. (United States, March 24th, 1920.)

6,021. "Means for indicating failure of filament in one of a number of incandescent lamps." M. Latour. February 22nd. (France, March 18th, 1920.)

6,040. "Appliance for indicating location of faults in section feeder-boxes of overhead-wire systems of electric tractions." Brecknell, Munro & Rogers, Ltd., and F. W. Brecknell. February 22nd.

6,058. "Emergency electric signalling-device for warning locomotive driver." W. Boller. February 23rd.

6,059. "Tumbler switch." M. Munday. February 23rd.

6,078. "Electric circuit-breaker." S. Jones. February 23rd.

6,110. "Electric switch." T. W. Rogers (F. Krupp Akt.-Ges.). February 23rd.

6,119. "Lighting devices for motor vehicles, &c." Benjamin Electric, Ltd. February 23rd. (United States, October 27th, 1920.)

6,121. "Protective apparatus for dynamo-electric machines." G. A. Juhlin & J. A. Kuyser and Metropolitan-Vickers Electrical Co. February 23rd.

6,134. "Electric terminals." W. H. Egginton and H. Lucas. February 23rd.

6,137. "Electric storage-battery or accumulator cells." Chloride Electrical Storage Co., Ltd., and B. Heap. February 23rd.

6,138. "Secondary electric batteries or accumulators." Chloride Electrical Storage Co., Ltd., and B. Heap. February 23rd.

6,141. "Electric lamp." E. de Lorenzi. February 23rd.

6,146. "Electric motors." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. February 23rd.

6,153. "Thermionic steam-reducing valves." Steam Fittings Co., Ltd., and B. R. Wingfield. February 23rd.

6,156. "Electric fittings." N. W. Scaife. February 23rd.

6,158. "Alternating-current circuits comprising condensers." E. W. Dorey. February 23rd.

6,161. "Means for actuating repeater signals on locomotives of electric railways." J. Bethenod. February 23rd. (France, February 24th, 1920.)

6,167. "Arrangement for transmission of energy by resistance coupling." S. Loewe. February 23rd. (Germany, February 23rd, 1920.)

6,168. "Apparatus for testing electric resistance of fluid materials, &c." V. Planer. February 23rd. (Germany, May 17th, 1920.)

6,189. "Arrangements for operating tools, &c." Automatic Telephone Manufacturing Co., Ltd. February 24th.

6,201. "Switches for electric irons." A. G. Bullen and R. L. Jenkinson. February 24th.

6,205. "Electrically-operated reciprocating tools, &c." T. F. Wall. February 24th.

6,225. "One-way transmission gear for train-lighting apparatus, &c." L. C. H. Mensing. February 24th.

6,229. "Manufacture of telephone receiver cases." S. O. Cowper-Coles. February 24th.

6,240. "Electric driving equipment for reversing machine tools." H. T. Millar. February 24th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

9,364. "Electro-magnetic wave navigational systems." M. Jeance. April 12th, 1919. (158,284.)

20,398. "Wireless telegraph transmitters." H. J. Round and W. T. Ditchen. August 19th, 1919. (158,291.)

26,470. "Process for recovering selenium and noble metals from electrolytic slimes and the like." M. Chikashige and D. Uno. October 28th, 1918 (134,556.)

26,621. "Installations for electrically lighting, heating, and ventilating railway carriages and other vehicles." H. D. Rohman. October 29th, 1919. (Addition to 145,120.) (158,328.)

26,721. "Controllers for electric motors." British Thomson-Houston Co., Ltd. (General Electric Co.). October 30th, 1919. (158,334.)

27,039. "Means for supporting antennæ used in wireless telegraphy." R. St. George-Moore and G. S. Whitmore. November 3rd, 1919. (158,353.)

27,083. "System of distant control without additional line wires for electric supply systems." W. Joice. November 4th, 1919. (158,357.)

27,143. "Electric power-generating units." E. L. Russell. November 4th, 1919. (158,361.)

27,151. "Electric resistance units." British Thomson-Houston Co., Ltd. (General Electric Co.). November 4th, 1919. (158,353.)

27,222. Alternating current electric motors." W. E. M. Ayres and Metropolitan-Vickers Electrical Co., Ltd. November 5th, 1919. (158,372.)

[illegible] "[illegible] switches." R. H. Baker and C. W. Parsons. November 6th, 1919. (158,377.)

[illegible] "Electric arc lamps or projectors and carbons or electrodes therefor." C. B. Burdon (Siemens Schukertwerke Ges.). November 6th, 1919. (158,380.)

27,431. "Electric circuit-breakers, particularly for the electric-ignition systems of internal-combustion engines." N. C. F. Jensen and M. J. E. Tilney. November 6th, 1919. (158,385.)

27,463. "Cable connectors for use with electric motor lamps and other purposes." C. A. Miller, F. J. Miller and E. A. Sanders. November 7th, 1919. (158,386.)

27,721. "Frequency meters." Nalder Bros. and Thompson, Ltd., and C. L. Lipman. November 10th, 1919. (158,393.)

27,922. "Electric motor control." British Thomson-Houston Co., Ltd (General Electric Co.). November 11th, 1919. (158,396.)

28,518. "Phonic motor drive for telegraph machines." D. Murray. November 18th, 1919. (158,413.)

28,712. "Portable electric lamps or torches." H. M. Koretzky. November 19th, 1919. (158,415.)

28,975. "Magneto-electric machines." British Thomson-Houston Co., Ltd., H. W. H. Warren and A. P. Young. November 21st, 1919. (158,419.)

29,683. "Electric motors." T. Zweigbergk. November 28th, 1919. (158,436.)

30,266. "Automatic or semi-automatic telephone systems." Automatic Telephone Manufacturing Co., Ltd. March 10th, 1919. (140,053.)

32,164 "Electrical heater for wells." D. Diver. December 23rd, 1919. (158,452.)

1920.

347. "Wireless telegraphy and telephony receiving instruments." H. P. Rees. January 5th, 1920. (Cognate application 2,005/20.) (158,455.)

730. "Electrical circuit-breaker." R. Simpson. January 9th, 1920 (158,457.)

1,659. "Electric discharge devices." British Thomson-Houston Co., Ltd. January 19th, 1920. (158,458.)

2,461. "Electric pocket lamps." E. Blondy. February 20th, 1919 (143,190.)

4,239. "Measured service devices for use in telephone systems." Automatic Telephone Manufacturing Co., Ltd. February 12th, 1919. (138,914.)

4,829. "Automatic telephone systems." Automatic Telephone Manufacturing Co., Ltd. April 11th, 1919. (141,674.)

5,429. "Electric fusible cut-outs having replacement devices." P. Davies. February 23rd, 1920. (158,462.)

8,341. "Automatic telephone systems." Automatic Telephone Manufacturing Co., Ltd. June 30th, 1919. (146,082.)

8,444. "Electric furnaces." Soc. Metallurgique Du Frayol. January 7th, 1920. (157,051.)

12,372. "Electric crucible furnaces." C. Soncini. April 25th, 1919. (143,836.)

13,793. "Magnetos." D. V. L. Fellows. May 19th, 1920. (158,486.)

15,347. "Electric lamps with luminous discharge." British Thomson-Houston Co., Ltd. (General Electric Co.) June 6th, 1914. (Divided application on 13,759, 1914.) (158,488.)

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THE GERMANS AND THE FEDERATION OF BRITISH INDUSTRIES.

THE Federation of British Industries appears to be gaining an unfavourable reputation in Germany, judging from two instances which have just arisen in that country. In the first place, the Central Union of the German Electrotechnical Industry (Central Verband der Deutschen Elektrotechnischen Industrie) has raised a protest against the Federation, while in the second, the latter's Export Register, or rather a card accompanying the register, has also evoked protest.

The Central Union has issued a statement which alleges that the Federation has succeeded in exercising a strong influence on the political economic measures of the British Government, examples of which are discerned in the abolition of the E.P.D. and in the fact that the Federation is consulted by the Government before any action is taken in the matter of political economic questions. The Union proceeds to state that those acquainted with British conditions know that the Federation has long been preparing the ground for anti-dumping laws, and the French efforts to burden German export trade with a 12 per cent. tax are said to be strongly supported in these circles, and certainly with means which cannot always be characterised as free from objection. A very popular means, the Union states, is for the Federation to get reports sent to it from its German correspondent concerning the situation of German industry and German trade, from which the conclusion can be drawn which is needed for its purposes. Unfortunately, it is asserted, there are now in Germany correspondents who apparently let themselves be influenced in order to represent the facts not as they really are, but in the form wished for by the Federation of British Industries, so that the latter can draw the desired conclusions by means of publicity. Thus, for instance, the correspondent of the Federation, after having previously utilised the high dividends of the German engineering industry as a basis, reports that as a consequence of the high costs of production in certain branches, the electrical industry is only able to carry on and increase its export trade by selling abroad at very low prices, and in point of fact at prices which are below the inland sale prices. The correspondent is alleged to have derived this from the "Official Labour Gazette"—a further misleading statement, for an official or prominent newspaper organ whose title could be so translated does not exist in Germany.

The Union goes on to say that the conditions are quite otherwise. The export prices which the German electrical industry is required to demand are fixed monthly by means of the co-operation of the individual trade groups with the Foreign Trade (State) Bureau for electrical engineering. In the case of countries having a high rate of exchange, as England, for instance, prices are still fixed at present considerably above the German inland prices in order in some measure to equalise the difference in exchange. The Union does not know of any single product of the electrotechnical industry for which the fixed export prices have been below the home prices. The statement of the correspondent of the Federation, in the opinion of the Union, is consequently directly untrue. The correspondent who claims to be able to give an opinion on the situation of German industry must at least be so far informed as to know that the German Foreign Trade Bureaux never would give sanction to exports at lower prices than the inland prices, especially not in the electrical industry. If he was in doubt an application to the Bureau concerned would have been able very quickly to enlighten him. The Union remarks that the other representations of the correspondent, with regard to both the objectivity and accuracy of the statements, move on the same level as those respecting the electrical industry. In earlier reports the correspondent repeatedly also put forward the false assertion that the export prices were lower than the inland prices. Although the Federation when publishing the reports expressly points out in a cautious manner that it does not agree in all parts with the views of the correspondent, the Central Union submits that these representations find their way into the daily newspapers.

The second instance relates to the Export Register, copies of which are reported to have been sent to numerous merchant firms in Germany accompanied by a printed postcard asking whether the book met the practical requirements of the German merchant. Having regard to the decisions of the Paris conference, a German firm at Kiel, which had received a copy of the register, is reported to have sent a fairly long letter to the London offices of the Federation. The letter, although not of an electrical nature, seems worthy of being summarised.

The firm states that the Federation will probably meet with but little success with the register so long as the British Government continues to swim completely in the navigable channel of French policy and supports the latter's demands. "If you have a debtor," the writer states, "whom you burden with a load of debts of such a height that it is completely impossible for him to pay them, the consequence will be that the debtor, seeing the hopelessness of his efforts, will only work just as much as is requisite to defray the cost of his life maintenance, as he knows that he must deliver everything beyond that to his creditor. You may send the finest catalogue to him and quote the cheapest prices, but you will never receive an order from him because he has become incapable of buying through your attitude. The result will be that your finest efforts will take the way unread to the waste paper basket." After mentioning that before the war only English clothing materials were made up in the best tailors' shops, the writer states that England will never again attain to her former sales in this respect. He proceeds to remark that if no alterations in the Paris decisions were made at the London Conference, a boycott of English and French goods would begin in wide circles of the German population, so that no practical results would ensue from the sending of catalogues.

Supply Authorities and new Connections.

Judging by the number of inquiries that we are constantly receiving of late, with regard to the law on the subject of connecting new consumers to public supply mains, we are justified in deducing (1) that some supply authorities are making charges and imposing conditions for connections which are wholly unauthorised by law; (2) that there are many contractors outside the ranks of the Electrical Contractors' Association who in their own interests ought to be members of it; who, apparently, are totally unaware of the benefits and privileges to which they would be entitled, of the legal assistance that the Association would afford them, and of the information which would be at their disposal, if they were members.

With regard to the questionable conduct of the supply undertakers above referred to, we can do nothing but refer them to their own consciences (though it is alleged that a business corporation has no soul) in respect of the moral aspect of their procedure, and to their revenue account in respect of the commercial aspect of the matter. Who ever heard of a gas company which deliberately put obstacles in the way of prospective consumers? Absurd! The gas suppliers, who are all out for business, welcome new clients with open arms, and would rather pipe their houses gratis than lose their custom! Many electricity suppliers, on the other hand, still maintain that "take it or leave it" attitude, with the stress on the "leave it," against which we have so often inveighed, and apparently seek to choke off would-be consumers, by excessive (and sometimes illegal) charges for connection, and in some cases by excessive prices for electrical energy. Where the generating plant is fully loaded, and the Electricity Commissioners refuse to sanction extensions, it is true, new consumers cannot be coupled up; but the proper course is then to state the facts to applicants, and worry the Commissioners—no good manager in such circumstances would try to limit the demand by making overcharges, and thus creating an unfriendly atmosphere towards the undertaking which would persist in future years. Let us, in passing, hint a warning: Power users don't want to put down their own generating plant, or to drive their machinery directly from internal-combustion engines, but they will do so if they are not fairly treated by the electric supply authorities, and *in many cases it will pay them handsomely to do so.* Explosion engine practice is not standing still—far from it. Let those who would scoff at our warning give heed to Prof. Burstall's statements during the Birmingham discussion on the Severn barrage, and to the correspondence in our columns just before that time—notably to Mr. A. Hugh Seabrook's letter of February 11th.

Lastly, with regard to supply, we may point out that statutory undertakers are entrusted with a public service; they have no right to assume a domineering attitude; it is their plain duty to do their best to serve the needs of every person in their area who requires a supply of electricity, and wilfully to fail in this is to prove themselves unworthy of that trust.

Turning to the contractors who are nursing a grievance, in the *Electrical Contractors' Year Book* they will find a clear and concise statement of the law regarding the rights of consumers; in our opinion, if they do not belong to the Association, they are neglecting their own interests.

The Water Power Resources of India.

About eighteen months ago we discussed at considerable length the Preliminary Report on the Water Power Resources of India, which formed an admirable introduction to this important subject. A "Second Report" has now been issued dealing with data collected during the season 1919-20.* As regards definite progress, the Report is to some extent disappointing, but it must be remembered that a survey of this magnitude demands an enormous amount of preparatory labour and, before tangible results can accrue, investigations must be undertaken and records prepared on a scale out of all proportion to the staff and equipment available for the purpose up to the period covered by this Report.

There is every reason to believe, however, that the technical organisation is now in good hands, and that a sound, consistent and vigorous policy is being pursued in the acquisition of that information on which alone sound projects can be based. The present Report, in conjunction with the Preliminary Report, makes clear to everyone competent to assist in collecting data, exactly what information is required. In this respect the

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* For particulars see our "Book Notices."

Reports may fairly rank as text-books which should be known and studied in every country where water power is available.

A second and more difficult and vital problem remains—that of regulating the control and development of water power. It is not sufficient to know that a certain amount of water power *can* be developed economically. It must also be ensured that it *will* be developed and distributed economically and fully, and that it will be sold at a reasonable price *regardless of the cost of other forms of energy*. The principle that water power—or any other form of energy—should be sold for what it will fetch must be excluded. National interests demand that energy—the key to industrial economy—should always be developed and sold at the lowest possible price consistent with a reasonable return on capital. Needless to say, this desideratum is far from being attained where coal and oil are concerned. In every undeveloped hydro-electric project we are "given a fresh chance" in this matter. Manipulation by financial interests must be prevented if the end in view is to be attained. This is a problem of the highest importance and greatest difficulty. Adequate financial backing is a *sine quâ non*, but the position of certain hydro-electric projects in America shows how easily public support may be enlisted for unsound schemes and how easily capital charges may be incurred which make it permanently impossible to sell energy at the true economic price.

The Report states that in more than one instance (in India) applications have been filed for the exclusive use of water power—the possibilities of which have been pointed out by the survey—with the admitted intention of selling the concession so obtained to the highest bidder. If such manipulation be permitted the consumer is for all time handicapped by the watered capital due to the bonus paid to the original speculator. Unless suitable safeguards can be incorporated in the form of lease or concession, the alternative of State control and operation of water power will apparently have to be adopted.

In the technical and financial control of water power development, India has an opportunity not only to serve her own best interests but actually to lead the world. This becomes more evident, the closer the consideration given to past and existing abuses, and to the magnitude of undeveloped hydro-electric projects as an antidote to the fuel shortage throughout the world.

The Report points out that there is much in favour of public utilities in general being operated by companies in which the municipality or Government is a powerful—if not predominant—shareholder. This system, which has given good results in Germany, appears to be a simple and effective method of safeguarding public interests whilst retaining the business methods of a commercial undertaking. If a hydro-electric project be operated purely under public ownership, it will be very necessary to keep accounts on strictly business lines—preferably, as suggested by the Report, by commercial accountants subject to audit by a chartered accountant. Due allowance must be made for depreciation and obsolescence, and a reserve fund is no less sound finance in a Government undertaking than in one under company management.

Turning from the political questions of development and control, which have been discussed at some length owing to their fundamental importance, mention may be made of the purely technical features of the Report. A series of diagrams is presented showing the varieties of "layout" usually encountered in hydro-electric work. These diagrams facilitate selection of the best method for dealing with particular sites. Many useful data are included bearing upon the development and storage of water for electrical purposes, and upon the estimation of power available. In order to be able to compare reports on sites it is desirable that data should be collected in more or less standard form—to facilitate which a form reproduced in the Report has been prepared.

Useful memoranda on pipe layouts are presented, together with two logarithmic diagrams showing the weight and safe working head for riveted steel pipes and for welded steel pipes. Important notes are included dealing with the use of aneroids in determining levels; serious errors may be made if the limitations of aneroid levelling are not recognised and the requisite precautions observed.

During the seasons 1919-20 a number of reconnaissances of power sites were made and checked, and the results of these are summarised in the Report. A good deal of additional power has been located and assessed, and it is anticipated that important progress will be made this season, now that the organisation for collecting information has been got into working order. Tabular summaries of all projects developed and investigated will, we hope, be included in future Reports.

It remains to be seen, from the work of the survey during the next year or two, to what extent it will be possible to develop the enormous water power of India at reasonable cost. In the meantime there are grounds for optimism not only as regards the outcome of this work and its influence on the agricultural and industrial future of India, but also as regards the beneficial effect of the hydro-electric survey of India in stimulating similar surveys, with equal benefit, in other parts of the world.

"Safety First."

There were 5,768 accidents in the power stations and on the distribution systems of New York City during the first ten months of 1920. Fifteen of these were fatal, and thirteen others involved grave injuries to individuals. It is strange to read reports of this nature from the country of origin of the "Safety First" movement, but the figures are official ones compiled by the New York First District Public Service Commission, and quoted by the *Electrical World*.

These statistics seem to indicate that the physicians, who so earnestly desired to eradicate the accident evil from the industrial life of England, are needed still more in their own country. No doubt the supply of electricity is carried out on a larger scale than in this country, but even this leaves a great deal to be explained. The causes of the accidents are not set out in the source of our information, but it certainly would appear that either the employés of the supply authorities were careless to a remarkable degree or adequate protection against accidents was not provided.

Whatever the cause may be, we think that a comparison of these figures, with similar statistics for the whole of the United Kingdom, will prove that the electricity supply industry is a much safer occupation in this country than in the United States.

The report of Mr. G. Scott Ram, M.I.E.E., H.M. Electrical Inspector of Factories, covering a period of four years from 1915 to 1918, showed that the total number of electrical fatalities during this time, including deaths in factories, &c., was 99. These figures, it must be remembered, covered the whole of the United Kingdom for four years, while the American figures relate only to New York City for a period of ten months.

Pit Bank Generating Stations.

After establishing generating stations at the pit bank, the next step as a natural corollary would appear to lie in the direction of the actual acquisition of the collieries themselves. This policy is now being pursued by the Rhenish-Westphalian Electricity Works Co., of Essen, which recently entered into an agreement with the Lignite Company owning the Rodder mine, and which is now taking over the management of three Stinnes collieries—the Viktoria Matthias, Graf Beust, and Friedrich Ernestine—for a period of 90 years. The supply company will guarantee a fixed rate of interest to the shareholders in the collieries, while at the same time the latter are giving the former an option to acquire their shares so that the pits will eventually become the sole property of the electricity company.

THE ELECTRICITY (SUPPLY) ACT, 1919.—OVERHEAD LINES AND WAYLEAVES.

By W. FENNELL, M.I.E.E.

Twelve months have now elapsed since Sections 21 and 22 of the Electricity Supply Act, 1919, provided what appeared to be large powers for the running of overhead lines in suburban and country districts.

The writer has, during those twelve months, been engaged largely on the arrangement and carrying out of overhead work, hoping thereby to make electricity available to outlying consumers who could not be economically reached underground.

Unfortunately, the Electricity Commissioners have been unable to devote their attention to the revision of Board of Trade regulations, and, moreover, Sections 21 and 22 of the 1919 Act are neither as lucidly drawn nor as helpful as they might be in the direction intended.

The removal of absolute veto of the local authorities, and the implied right of compulsory wayleaves in uninhabited districts, must be acknowledged with gratitude. In villages and suburbs, however, the clauses give no practical relief from the obstruction and greed of small owners.

The legal position with regard to overhead work is still one of restriction. The 1882 Act and Provisional Orders require the special consent of the Board of Trade to the placing of lines above ground, and the Board of Trade Memorandum, which is sent in response to a request for sanction, is still in the old form of a catechism, in which ingenuous questions are put respecting the proposals in matters which are covered by the Regulations themselves.

Section 21 of the 1919 Act enables the Commissioners to dispense with the consent of the local authority, but it very properly gives the latter the opportunity of being heard in opposition. This involves in practice at least three months' extra delay as compared with underground work, so that in urgent cases one cannot run overhead lines.

The first reform which the writer suggests is obtainable without legislation. Instead of individual lines requiring detailed sanction, the Electricity Commissioners might consider, with the first application for an overhead sanction, a plan of the whole area of supply, indicating by a coloured wash the areas for which the undertakers require a general sanction for overhead work. It would be as easy to settle this as one route, the files of the Commissioners would be relieved of the enormous masses of plans and papers which will accumulate under the present system, and in future there need be no delay.

Section 22 of the Act is badly drawn, and requires immediate reconstruction. Paragraph 1 gives permission to place electric lines underground, across any land, subject to the conditions of appeal, and it also gives permission to authorised undertakers to place any officially sanctioned electric line above ground across any land *other than land covered by buildings or used as a garden or pleasure ground*, subject to appeal. The reason for these absolute exceptions applying only to overhead lines is clearly a survival of prejudice. The Commissioners themselves cannot help us in such cases until the Act is amended. Overhead lines in villages and even in rural districts must, in a land of crooked lanes and roads, pass over buildings and gardens, even where the poles are in a public road or in a field along the back of a row of houses. It therefore is frequently necessary to cross a road, or otherwise upset the line, to avoid some crank or avaricious owner. There is no engineering reason for the exception of land covered by buildings; indeed, wires are very safe there, and an Act which prevents the Commissioners from sanctioning a crossing over a cowshed or a wash-house, or indeed any building, needs immediate amendment.

Again, why except "gardens or pleasure grounds" from the discretionary powers of the Commissioners? There are gardens and *adjective* gardens—small fields are said to be *market* gardens, allotments are claimed to be *vegetable* gardens, playgrounds *might* be called *kinder*gardens. In one case a heavy rental was demanded for crossing a grass-grown field which had a few fruit trees in it, on the ground that an orchard was a *fruit* garden. The only kind of garden one would not propose to cross is a laid-out garden of such an extent and degree of beauty that the presence of overhead lines would interfere with the amenities by introducing an incongruous element. The Commissioners have, however, power to prohibit in such cases, so why give an absolute exemption, and why submit to such loosely worded clauses? The wording of the Act can be twisted to exempt every cabbage patch or weedy forecourt and every chicken run. The Commissioners are entrusted with great powers—surely this very small one of seeing fair play can be placed in their hands.

There is another very objectionable feature of paragraph 1. Notice has to be served on the owner *and* occupier; and as each has the right of appeal it means double payment for one wayleave and interminable negotiations. Prior to the Act the procedure was to see the occupier, inform him as a matter of courtesy of the proposed work, obtain the name and address of the owner or lessee, and negotiate with the latter. The Act gives the tenant an absolute veto in the case of a line passing over a building or "garden," and appears to set up an entirely new vested interest, instead of regulating the old ones as intended. Incidentally, it enables a new tenant to require the removal of an existing line, although the property owner is satisfied that it may remain. The tenant, whose rights can only exist through his agreement with the owner, does not need this new protection; he has his remedy against the owner if his rights are infringed. Imagine the position of an engineer who has agreed with the local authority to supply a housing scheme (as the writer has done) by means of overhead wires run along the back line of semi-detached houses, crossing the gardens from house to house. He must start off to bargain with hundreds of occupiers, weekly tenants perhaps, before they come into residence. Suppose only one objects, this means a hold-up for two or three months while the local authority gets rid of the obnoxious tenant. Whoever drew this clause was totally ignorant of the practice of the Post Office or of any public utility undertaking in respect of wayleaves. This double bargaining really must come out of the Act.

The remainder of paragraph 1 gives the Commissioners power to grant compulsory wayleaves in those cases where the exception does not apply, and where consent is unreasonably withheld. The writer has never been able to try the effect of an appeal to the Commissioners—those objecting owners who came under this clause have always given way on the suggestion of an appeal. The difficulty has always been with the numerous cases where the wording of the Act has made it impossible to appeal, so the objection has been overcome by the usual means—an extortionate payment—or the route has perforce been changed. It would appear, therefore, that to put matters right in sub-section 1 it is only necessary to cross out a few words so that the Commissioners' power shall extend to all cases, and to confine the negotiations to owners or lessees.

In paragraph 2 of the section, one gathers that undertakers may cross railways and canals from side to side, by giving the same notices as for crossing streets. It is, however, being argued that the words "subject to the rights of the owners thereof" mean that instead of being released from former restrictions caused by private ownership (which had to be overcome by wayleave payments and expensive agreements—the latter running into 20 pages in some cases) we have all the old disadvantages, and the further yoke has been placed on us of having to give statutory notices. Of course this is absurd. The opening words are "the power conferred, &c." (see above) "shall include the power of placing lines across, &c." If the ingenious arguers are right, we should be better off without the boon "conferred" upon us. A few words inserted in the 1920 Bill would put an end to this word juggling. In order to show the urgency of this matter it may be mentioned that quite recently £5 per annum, plus a costly agreement, was demanded by a canal company for a service line crossing over a canal—no poles even being on the company's land.

The next urgent matter is the drafting of an up-to-date set of regulations, as clear as those for underground work, based on present-day knowledge and experience. One recognises that the Commissioners cannot do everything at once, but a perusal of the Regulations will show the real need for expedition.

This subject should be approached from the point of view of encouraging the use of overhead wires for giving supplies in sparsely populated areas, having in mind the national interest, rather than that of the conditions of supply in cities and large towns, which were formerly the only ones likely to arise.

The new Draft Regulations should be left open for discussion in the Press, and should come before a special Committee of the Institution of Electrical Engineers (not a Committee of the Council, which would probably be composed of City supply engineers). After this inquiry the Commissioners should reconsider the draft and issue their regulations. If the regulations are properly drawn there will be no need to catechise the engineers as to their intentions, just as it is not necessary to do so to-day in the case of power stations, mains, sub-stations, services and meters.

It will be seen from the wording of the Low and Medium Pressure Regulations that they were for the most part drawn many years ago, when the engineering of overhead work was not in an advanced state. The object in view was not so much the minimum requirements reasonably to protect the public as that of making it impossible for any injury to result to the most careless member of the public, irrespective of expense to the community. If the rules were drawn on these lines for gas supply, or for tramways, road traffic, or even ordinary electricity supply, there would be an end of public utilities. Imagine a gas supply given in such a manner that the gas could not escape unlighted, or a gas jet placed under a ventilating cowl leading directly to the open air, or lamps in public buildings and roads placed at a height of not less than 22 feet from the ground on unclimbable poles. Conceive a limit of 250 volts d.c. (or 125 volts a.c.) for unguarded tramway overhead lines, and where the pressure exceeds that, a guard so arranged that a falling wire must be caught and earthed. Visualise a double decker provided with an earthed wirework or expanded metal cover and sides. The brain reels before the idea of drawing regulations to secure a dangerless street. Obviously all ponds, canals, rivers, and railways should be guarded along their entire length by unclimbable fences—having a height of at least 8 feet. Deaths due to drowning are very numerous, and the probability of walking into a canal exceeds that of being struck by a falling wire in the ratio of a thousand to one. The above suggested crazy regulations are, in fact, just as necessary for protecting the public from the risks they run daily as are the majority of those for overhead wires. It is simply the familiarity of the old set of risks which minimises their apparent importance. The public is to-day being protected from ordinary traffic risks by a "safety first" educational campaign—not by restrictive regulations. Why not extend the movement, adding the following maxims?:—

"Safety first—look up and move on!" Or, "Yes they *might* fall—*need* you loiter!"

It is too much to expect that we shall be allowed the same "right to kill" as that accorded to gas and transport authorities, but the criticism of the regulations does show that while there is a certain reasonable standard of precaution which should be taken, there are also certain commercial risks which must be run if the best interests of the public are to be served. It is also fairly clear that a thorough investigation is needed into the restrictions imposed on overhead work in this country, with a view to the removal of all unnecessary handicaps.

Widespread distribution of electricity is now being undertaken in sparsely populated areas where overhead mains form a suitable and reasonably cheap method of supply. The cheap and abundant supply that we hear so much of will never be given by retaining expensive and cumbersome regulations, nor by exposing distributing authorities to continual extortions of unreasonable owners and occupiers along the "rivers of electricity" which may be thinned down to brooks in the guise of No. 11½ S.W.G. service lines along the back gardens of our villages.

There is another matter requiring serious reconsideration—namely, the position of H.M. Postmaster-General in relation to overhead lines. The privileged position of telegraphs and telephones is one requiring very delicate handling. The defect of the present arrangement is not so much the rules made by the G.P.O., sometimes contrary to technical accuracy and reasonableness, as the fact that there is apparently no appeal in respect of their application to anyone but the Postmaster-General, which in fact means the official who made or interprets the rule, and whose experience is confined to his own work. Surely this is a case where the Commissioners should be constituted as an appeal authority to act in conjunction with the chief engineer of the G.P.O.

JOINT ELECTRICITY AUTHORITIES.

Mersey and West Lancashire Inquiry.

Three days sufficed to complete the resumed inquiry by the Electricity Commissioners in connection with the scheme for the constitution of a Joint Electricity Authority for Mersey and West Lancashire District. Summarised, the proceedings of the inquiry have revealed (1) a strong opposition on the part of the Birkenhead and Wallasey Corporations to inclusion in the big scheme (Scheme A) and they made a proposal for the constitution of an electricity authority for the Wirral peninsula (Scheme B); and (2) the antagonism of the Mersey Power Co., which objected to the inclusion of its undertaking in any scheme which the managing director called "communal control," because it believed that the best results had accrued, and would continue to accrue, from private enterprise. On the concluding day of the inquiry, which was continued to a late hour, the Commissioners intimated that to save time, they would accept up to Saturday (March 12th) written statements on behalf of the smaller local authorities. This would make it unnecessary for speeches to be made on their behalf. On Friday (11th inst.) the Commissioners visited the much debated and growing industrial district of Ellesmere Port, where an electricity supply had been held up for some years owing to the local council's not acting on a Provisional Order. They also intended to visit the Mersey Power Co.'s works at Weston Point, and other stations, as time permitted.

The Commissioners were Sir John Snell (chairman), Sir Harry Haward (vice-chairman), Mr. H. Booth, and Mr. W. W. Lackie. They were accompanied by Mr. E. W. Hudson (legal adviser) and Mr. D. S. Cumberledge (clerk).

On Tuesday (8th inst.) Mr. Honoratus Lloyd, K.C., for the promoters of Scheme A, intimated that he had received a letter from the town clerk of Warrington stating that the council had come to the conclusion that the present time was inopportune for schemes of great capital expenditure, and requesting the Commissioners not to proceed with the constitution of the joint authority. Mr. Lloyd also read a letter and a resolution from the St. Helens Council stating that, having regard to the evidence of Mr. Dickinson (Liverpool electrical engineer), and the attitude of several of the local authorities, it could not give further support to the present scheme.

The Chairman asked the representatives of the two councils to give an explanation of their reasons for the withdrawal, but they considered the time inopportune, and promised a statement later.

The Chairman said that in the recess the Commissioners had applied themselves to the figures which had been submitted by both sides, and as a result they intended to invite counsel for the two schemes to meet them that afternoon in order to go into figures which the Commissioners had prepared. If necessary they would recall Mr. Dickinson and Mr. Sparks to speak on them. He also invited counsel for the Mersey Power Co. and the representatives of St. Helens and Warrington. After all, the Commissioners were there to bring about improvements in the organisation of the supply of electricity in the district, and it did not help them very much when authorities, without giving reasons, withdrew from the scheme.

The case for the Mersey Power Co. was then opened by Mr. Tyldesley Jones, K.C. He said that the scheme for the Mersey and West Lancashire electricity district, which had been proposed, should not include the district in which his company operated, as it could be better dealt with by the Mersey Power Co.'s undertaking at Runcorn. That was the first big inquiry under the Electricity Supply Act of 1919, in which the principles that would be drawn would come into very great prominence. The circumstances of the Llandudno and North Wales inquiry were entirely different. In dealing with a district where there were so many undertakings, municipal and otherwise, the Commissioners should consider very carefully what would be the effect on the future of the supply industry of a decision on the issues which would come before them. These matters were to a large extent technical, but they also, to a large extent, involved considerations of public policy and business policy. The first consideration he desired to emphasise was that in laying down a policy which would be adopted in other areas, the Commissioners should put in the forefront fair treatment for existing undertakings. It would be fatal to the future of electricity supply in the United Kingdom if those who had brought about the supply that existed to-day had their interests sacrificed in the pursuit of some idea of an age when all authorities in the district would meet harmoniously and settle to their mutual advantage questions of policy involving discordant interests. The second point which Mr. Jones desired to emphasise was that in every scheme which was put forward under the Act, compulsion was and must be absent. If they had certain areas where the supply was efficient and authorities could combine for producing a greater efficiency, it would be a perfectly proper thing for them to combine, but if they found in one of those districts a highly organised supply of electricity, and that no benefit was shown to that or any other district, then there was, he submitted, no case for including in any scheme embracing those districts if it would be disadvantageous to those that were highly organised. There was no foundation for the idea that compulsion would be applied to bring an authority into the scheme. The Mersey Power Co. supplied Widnes and Runcorn. The Urban District Councils had electricity orders for many years, but nothing was done. Both places were important industrial centres; there was a load waiting for the supply, there was the local authority, which had the financial ability to raise money on the rates to provide the supply, but what was lacking was the business enterprise. The Salt Union had vast interests in the valley of the Weaver, and the idea was conceived of producing electricity by the use of waste heat. In 1910 a new Order was granted for Runcorn—a remarkable one, because the maximum price was to be 4d. per unit. There was no other Order that he knew of where such a price was included. Nine-tenths of the output of the Mersey Power Co. was for power purposes, and it was supplying at the same price as before the war, except that in many of the contracts there was a coal clause by which the increase in the cost of coal was put on to the consumer. His company supplied in its first year, 1912, one and a half million units; in 1920 the number of units was 25,000,000. The average price was 1d. per unit. New industries had been attracted by the cheap power it supplied.

The company desired to supply Ellesmere Port, and since 1911 negotiations had been proceeding with the local council, but until recently they could get no further. His company supplied 369 units per head of the population of the district which it covered, compared with Liverpool's 95 and St. Helens' 129.

Sir Harry Haward questioned the fairness of such a comparison, and Mr. Jones replied that Liverpool had been at work 38 years, whereas they had only been at it for a comparatively short time. Of course, the chemical factories were large consumers.

Mr. Jones, continuing, asked if the efficiency possible in his district was going to be enhanced by being grouped with Liverpool, or was the efficiency of Liverpool going to be enhanced by being grouped with the Mersey Co. There was nothing in common between them.

Mr. G. W. Malcolm, managing director of the Mersey Power Co., said the company was formed to work the Electricity Orders for Runcorn and Widnes. It was his original idea that the Salt Union, the owners of the Power Co., should produce electricity in 1909. The company was putting up a new station that would have a capacity of 25,000 kW—two sets of 12,500 kW—and there was an idea of ultimate extension to 100,000 kW. There were production possibilities for the use of waste heat from salt, and they were being investigated by the experts of the Salt Union in connection with processes employed by them. Waste heat was now being employed in connection with their electricity undertaking. At Winsford there were 12,000 tons of waste steam each week from the salt pans, and in his opinion there was no inherent difficulty in arranging pan covers to trap the steam. The main obstacle was one of capital outlay. He felt that his firm would be hampered by being brought into an electricity district.

The Chairman: Why?—Because of communal control. We are certain that private enterprise can do better than large unwieldy bodies. Private enterprise alone can develop the industry.

Mr. Malcolm added that within three months his company would be supplying Ellesmere Port, and as soon as the load warranted it the company would probably be prepared to extend the area of supply. If it were left out of the Joint Authority, it might be an advantage to it to join with electricity authorities on the east, west, and north. It would willingly give any help it could on commercial terms, but he objected to control in any shape or form.

Cross-examined by Mr. Honoratus Lloyd, who appeared for the promoting authorities, Mr. Malcolm said that at one time the company regarded electricity as a by-product, but not so now. He objected to control by anybody but the Commissioners. He regarded a spirit of rivalry as the main spur to efficiency. Within three months from now the output from waste heat would be relatively insignificant, owing to the erection of the large steam power station.

In re-examination, Mr. Malcolm said that vacuum plant was used for making salt and absorbing heat from the turbine exhaust. When the heat was not required it was used for making electricity. The private companies, he thought, were being shabbily treated in the matter of representation on the Joint Electricity Authority. They were the second largest distributors in the area, but if all the distributors had representation, the number would make the authority unworkable and unwieldy. They had had a loan of £300,000 from the Ministry of Munitions for the new 100,000-kW power station. The present cost of the building was £487,000. The Mersey Power Co. would be willing to supply electricity to the Joint Electricity Authority, on usual terms.

Replying to Mr. Cowley (Northwich U.D.C.), whose questions were addressed through the chairman, Mr. Malcolm said that the electricity supply of the company would be extended to Northwich as soon as the load could be obtained. He thought that the charge for electricity at Northwich would be the same as at Runcorn, plus capital on mains only.

Mr. James Nelson, electrical engineer to the Mersey Power Co., said that last year they supplied 25,000,000 units, of which 12,000,000 were taken by the United Alkali Co. Two cables were now being laid to Ellesmere Port, to convey 5,000 kW at 5,700 volts; the route was along the Ship Canal. Developments were taking place on the river Weaver, and they were preparing to deal with them. They had no intention of increasing the rates when the new power station was opened.

The inquiry was then adjourned.

When the inquiry was resumed on Wednesday morning. Mr. James Nelson was cross-examined by Mr. Wooll (junior counsel to Mr. Honoratus Lloyd, K.C., for the promoters). He stated that the load factor of the system in 1920 was 59 per cent., and included the 12 million units supplied to the United Alkali Co., whose load factor was 90 to 94 per cent. There were 1,013 consumers connected with the Mersey Power Co.'s system, 950 being lighting consumers and 63 power consumers. Outside of the United Alkali Co., their main consumer took 3,500,000 units last year. The maximum load in 1920 was 4,400 kW. Nine shillings was the basis of the coal clause, and the average price of coal was something under £2.

It was suggested to witness that the object of the Mersey Power Co. had not been to provide a supply of cheap electricity, but to secure the profits from a large supply. He replied that to obtain the profits they gave a cheap and abundant supply. He admitted that their operations in Runcorn and Widnes were started at a very felicitous time. The profits of the company increased during the war, and at the close of the war it was decided to erect a main generating station. The Ministry of Munitions encouraged the idea, and had mortgaged the property to the amount of £300,000. If it were possible to lay down a new system it would be quite different to the existing system from the electrical point of view. The system, under the modern conception, would take the form of a very large generating station with a view to securing the maximum efficiency and economy. Big consumers, he thought, were likely to take their supply from very big undertakings rather than from small undertakings, because they would be more conducive to a diversity of the load, and more likely to secure and promote electrification by the railway companies. At the present time the company was supplying energy more cheaply than any of the authorities, and the average prices were less than those suggested under the scheme.

The Chairman: The scheme does not mention any prices.

Mr. Nelson added that it was part of the policy of his company to obtain Provisional Orders.

Mr. Tyldesley Jones, K.C., explained that negotiations were attempted by the Mersey Power Co. with the Ellesmere Port Council on three alternative bases, such as taking over the order and accepting the responsibility of supplying everybody, and the company giving a bulk supply, leaving the Council to supply the big users. The third was not agreed to. The Ellesmere Port Council asked for 150,000 units per annum rising to 5,000,000, which Mr. Jones suggested showed how little the Council appreciated the present position. Between Runcorn and Widnes, the company had two overhead cables, over the river, and one over the transporter bridge.

Replying to the Chairman, Mr. Nelson said that it was his opinion that the continuance of local power stations was not desirable if it could be avoided. In the course of time, they would, he thought, be used as sub-stations, and not as generating stations. The chemical load was practically a continuous load, and was peculiar to the district. He estimated that the load in the year 1930 would be 22,000 kW; that excluded transport and a certain consumer.

The Chairman considered this figure very conservative.

Witness, continuing, said that the Weston Point station could be designed to have an effective load of 100,000 kW. Asked what they would do with the balance, Mr. Nelson said that it would not be produced until the load warranted it. He agreed that they would have to supply Northwich, Middlewich, Warrington, and St. Helens to utilise their capacity fully.

Mr. William McLellan, consulting engineer to the Mersey Power Co., said that the new power station of the company should not necessitate increased charges. The company was a small undertaking which was an excellent example of a system excellently handled and developed. The proposed Joint Electricity Authority could not supply in the company's area at lower rates than were now being charged, having regard to capital costs. It might be possible to utilise steam from the open salt pans, and this was a question very present in the minds of the directors of the Salt Union. They would not be benefited by the Joint Electricity District, because the Mersey Power Co. had a very efficient system, and could supply as cheaply in the future as now. Their new capital station would compare with the station at Liverpool. Administration was a matter of vital importance, and should be managed by a small body. The United Alkali Co. had two 5,000-kW sets. He thought the cost was £470,000 capital outlay, or £94 per kW of operative capacity. From the technical point of view, he thought there should be a linking-up of capital stations in the area, the stations mentioned being the Riverside, Wallasey, and Weston Point stations. He feared that the proposed Joint Electricity Authority would be composed of warring elements. It was difficult to get local authorities and councils to act together. If they were prepared to sink their personal differences and think only of cheaper electricity, he thought there would be some possibility of progress, but local authorities would not do this. He thought *all* Joint Electricity Authorities would be cumbersome and some impossible. As to the provision of the capital required for laying cables, he was of the opinion that this would be a difficult problem. He would not put down two stations within five or six miles of each other, but taking the whole of the area, he thought the district could be economically supplied from two stations situated east and west. Difficulties arose, however, on questions of administration and policy. He did not think that the enhanced cost of plant and money had rendered less desirable the general principle laid down in 1918, and generally accepted by the electricity industry with reference to schemes for the generation of electricity. Witness would not put capital stations at Northwich and Winsford.

On behalf of the Manchester Ship Canal Co., Dr. Eastham asked: (1) When would the Mersey Power Co. give a general supply of electricity to Ellesmere Port and district, and (2) What was the earliest time this district could be supplied if the big scheme was sanctioned? To these queries it was replied that if the Commissioners granted an order under Section 6 of the Electricity Supply Act to the company, a supply would be available in June.

Mr. Malcolm was recalled, and said that the profits of his company in 1916 were £23,709 (dividend 20 per cent.), 1918 £25,500 (dividend 32 per cent.), and 1919 £17,203 (dividend 10 per cent.).

This concluded the case for the Mersey Power Co.

Mr. J. E. Singleton appeared for the Runcorn Rural and Urban District Councils, and said their case was bound up with that of the Mersey Power Co., by which they had been supplied for some years. The Runcorn authorities took up the position that they had a cheap and abundant supply of electricity, and that there was no prospect of getting a supply more abundant or more cheaply, therefore they said: "Leave us alone." If the Mersey Power Co. were impressed into the scheme it would mean that any balance of power would go Liverpool-ward, instead of southward—the river Weaver district, which was the hope of the Runcorn district. If they were included in the scheme their representation would work out at 0.25 or less member. He asked that the Commissioners should give the matter consideration.

At this stage of the proceedings, Mr. W. H. Andrew, town clerk of St. Helens, explained why his Corporation had withdrawn from the inquiry. Its first inclination, he said, was to sit tight and say nothing. It thought it could produce electricity more cheaply than the proposed Joint Electricity Authority, but recognising the advantage of co-operation, it went so far as to be prepared to make a monetary sacrifice. There was a strong suspicion that the backbone of the scheme was mainly to boost up Liverpool at the expense of her neighbours. There was also talk of schemes for a super-power station; they in St. Helens said there was no necessity for a super-power station. If the Commissioners could evolve a smaller area, satisfactory to them, they would sink their differences and come in.

The Chairman put a number of questions to Mr. Andrew, whose replies tended to ambiguity. One question was: "Is the reason why you have seceded because you are advised that both now and ten years hence it will be cheaper for St. Helens to remain aloof?" to which the answer was that the Corporation did not think that the area scheme would be a success. Sir John Snell observed that the attitude of St. Helens was not very helpful to the Commissioners.

A solicitor to one of the railway companies asked the town clerk if the Corporation could supply his company with 700 kW, rising to 1,500. "When we get our new station," replied the town clerk.

Mr. Arthur Collins, a financial expect and the city treasurer of Birmingham, then entered the witness box. He said he was dealing with the financing of six area schemes. There were three essential points upon which he thought every local authority participating in that or any other scheme should consider before committing itself: (1) Methods of dealing with existing stations; (2) methods of payment for such existing stations; (3) security for capital issued. The success of the scheme to a large extent depended upon existing authorities having control of the present stations. There would be a risk in proceeding with a capital station unless and until those responsible for the technicalities knew and could do just whatever they pleased with the existing stations. His propositions for disposing of the difficulties regarding the existing stations were: Control with acquisition; no compensation, the authority may close down stations and leave the debt a burden on the local authorities; consideration of the matter by authorities before they subscribe to the scheme in order that they may know the measure of agreement likely to be reached before handing over their individual stations; take over stations at capital cost; acquire stations at their then value, under the Electric Lighting Acts, which would mean a great deal of arbitration; and take over the stations on a valuation determined by the Commissioners, which would apply equally to the companies and authorities. He suggested the following formulæ in connection with the last consideration: Valuation on the basis of the capital value per kW available, the value sliding up or down according to its capacity for cheaper production, corrected by differences in the unexpired life of the undertaking. The question of finance was a very material factor in an electricity scheme. He was inclined to place the acquisition of the stations as a first consideration, and he did not think the authority should proceed with a capital station without first being sure of the existing stations. The capital required for the Wirral scheme he considered was not beyond the capacity of the Birkenhead and Wallasey Corporations, but at the same time he was prepared to admit that Liverpool was in an exceptionally favourable position for raising money cheaply. The Birkenhead and Wallasey Corporations under their scheme would require £250,000 within the next few years and, owing to high cost of construction, plant, and money, he thought it best for authorities to extend existing stations to meet a reasonable demand rather than commit themselves to a super-station based on an optimistic estimate.

Sir John Snell remarked, after an examination of some figures put in evidence, that it appeared that Birkenhead and Wallasey would spend more money in executing the Wirral scheme than they would be called upon to pay by participating in the larger proposal.

To abbreviate the inquiry, the Chairman at the outset of Thursday's proceedings suggested that written statements should be handed in by local authorities and interested representatives, instead of verbal statements being made.

Sir John Snell asked the clerk of the Ellesmere Port Council why the Order which had been obtained in 1913 had not been put into force.

Mr. Francis replied that subsequent to obtaining the Order, the Council acquired the gas undertaking, and negotiations proceeded with the Mersey Power Co. in connection with a bulk supply of electricity to the district, but the company was anxious to obtain a transfer of the Order, or if that were not permitted, to supply the large power users only. The Council was desirous of working the supply itself, so the negotiations fell through. They were reopened in 1917, but owing to Treasury restrictions on borrowing, the Order could not be put into operation. In October, 1918, they received communications from the Board of Trade suggesting that they might obtain a bulk supply from the Mersey Power Co. Last year they approached the company and asked for terms for supplying 150,000 to 5,000,000 units, but the company was not prepared to give a bulk supply. The Ellesmere Council felt the local authority was the right authority to operate the Order. It had been somewhat prejudiced by the Section 6 orders issued to the Power Co. If the Joint Electricity Authority was established he thought the Council would still desire to be the local distributors. It would like the Mersey Power Co. to let it have a bulk supply until the Joint Authority could let it have, at some future date, a cheap and abundant supply of electricity. The policy of the Council was to furnish manufacturers with the cheapest electricity supply possible, and it did not want to make any profit at all. The development of the district depended upon an adequate electricity supply being forthcoming. It was absurd to say that the Council had desired to hold up the electrical development of the district owing to the gas undertaking. It did not supply gas to manufacturers for power purposes.

The Chairman: I infer that whatever the Commissioners conclude would be the best method of getting the cheapest supply of electricity to all classes of consumers at Ellesmere

Port, that decision would be loyally supported by your council? —Undoubtedly.

Mr. W. Sparks, who appeared for the Birkenhead and Wallasey Corporations, in support of the Wirral scheme, said that the first development of the Wallasey station would cost £252,000, and the second £440,000. Electricity could be provided more cheaply by the Wallasey scheme than by the larger scheme. Answering the chairman, he gave details of the proportion of expenditure by the Wirral authorities of Birkenhead and Wallasey, to the total of £4,461,000, which Mr. Dickinson had put forward as the total expenditure on scheme "A." The division of the big area into two districts with the separate development on the north and on the south side to meet the estimated requirements of 1925, would as two separate districts represent a smaller expenditure than as a combined scheme.

The Chairman: Is it your considered opinion that large systems cannot be economically introduced into this country? —I am afraid it is, owing to the difficulty of financing them at the present price of plant. We have to accept compartment development to-day as against comprehensive treatment. Ultimately he admitted compartment schemes involved a bigger expenditure. Conditions in the American electrical industry having been mentioned, the same difficulty was being met there, he said; it was world wide.

Witness, in answering a series of questions, admitted that the continuance of small concerns would have an adverse effect upon the utilisation of electricity by the railway companies. He thought grouping might be accomplished on a smaller scale.

This concluded the case for the Wirral authorities.

Mr. H. Dickinson, electrical engineer to Liverpool Corporation, said it was desirable that the existing electricity stations should be under the absolute control of the Joint Authority, and so far as he was aware, all the promoting authorities of the Mersey and West Lancashire scheme were prepared to hand over, on terms, their stations.

Concluding Speeches.

For Wallasey, Mr. Jeeves, K.C., said that though no plans had been prepared in anticipation of the end of the war, delayed extensions had since been carried out, and a large amount of modern plant had been, and was being, added to stations. They were not now in the position to bear a burden that would not fructify until ten years hence, as they had more than enough to do to meet immediate requirements, owing to the great scarcity of money. Wallasey was now putting in 5,000-kW sets, and when the demand developed would put in another 10,000-kW set. Adequate and cheap capital was necessary to obtain a cheap supply. There was complete agreement between the authorities concerned in the Wirral scheme, and although it had been suggested that the bigger scheme went further in the same direction—with which he did not agree—the measure of co-operation between Birkenhead and Wallasey ensured their scheme being put into practical operation, and not being stillborn. So far as he had been able to see there had not been the same co-operation between the authorities affected on the north side of the area. He submitted that the balance of the evidence showed—under scheme B—electricity would be provided quite as cheaply as, if not more cheaply than, under scheme A, Wallasey and Birkenhead were prepared to pledge their credits on their scheme and to meet any deficiency there might be.

For Birkenhead, Mr. Miller, K.C., said that his clients were uncompromisingly opposed to inclusion in scheme A. The Wirral scheme had been propounded by Wallasey, and was supported by Birkenhead. There was no benefit to them in the Wirral being included in scheme A, because they could obtain for themselves an abundant supply of electricity, and the objects of the Act could be attained in their district without shouldering any of the obligations of the big scheme. He thought that it would be found that his district could be supplied from the extended existing station at Wallasey more cheaply than from a capital station under scheme A, assuming that it came into existence. They did not want to join the large area, because of its commitments, and because they did not think it would work. There was no measure of agreement between the northern authorities as to the terms under which stations were to be taken over, and scheme A itself seemed to be based on a pious anticipation that things would go well. The Commissioners could issue an Order for scheme B with the definite conviction that all would go well, that the plans formulated would be carried out, and that the people would get the cheap and abundant supply of electricity that the Act contemplated.

For the Manchester Ship Canal Co., Dr. Eastham said that in the Mersey and West Lancs. area his company had 16 miles of canals, and owned 2,500 acres of land adjoining the canal, which would be developed as industrial areas. There was an urgency in the need of the supply of electricity for Ellesmere Port. The interests of his company lay (1) in getting a supply, and (2) getting it cheaply. So far as scheme B was concerned, they objected to that because it gave them no benefits at all. It was too small, and did not deal with admittedly industrial areas. As regarded scheme A, his company opposed this also. The main objection to scheme A was that the Ship Canal Co. might be left without a supply for some years to come, and that was a serious matter. At Ellesmere Port and district they were crying out for electricity. The Mersey Power Co., a very enterprising concern, had exceptional facilities, and the directors of his company said: "Do everything you can to enable the Mersey Power Co. to extend their activities in the area they supply and the adjoining areas." There was a demand for electricity on the south side of the river Weaver. If scheme A were modified so that the south bank of the Mersey was brought in, he would ask the Commissioners to see that the industrial areas which depended upon a cheap supply of electricity had their needs attended to at a fixed maximum price. The Mersey Power Co. could supply cheap power, but if the big scheme were passed there would be a levelling up in prices, and they would lose an advantage by the Power Co. being taken over. If they could have a Joint Authority taken over by the Commissioners they would be satisfied. As for representation on a Joint Authority, they thought they should have at least one member. His company was not concerned who gave the supply, but it was most anxious to see that the area secured one that was plentiful. It considered that the Mersey Power Co. was the best means.

For Warrington, Mr. Wooll said that it was not antagonistic to the Joint Authority, but the borough was not favourably impressed by scheme A. The Corporation would consider the modified scheme on the lines suggested by the Commissioners.

For the railway companies, Mr. Tyler said that he represented all the railway companies excepting the L. & Y. Co., the Overhead Railway, and the Mersey Railway, and their view was that there should be some unification of control. The Mersey Power Co. and St. Helens affected the railways to some extent. The railway companies' experience of St. Helens had been unfortunate. Ten years ago they asked St. Helens for a supply for their works at Earlstown, which was outside the boundary, and difficulties arose which could have been surmounted if St. Helens had so minded, but no supply was forthcoming. They applied again recently, but St. Helens said it had not the plant. The railway companies preferred that St. Helens should not be included in the area scheme.

For Bootle, Mr. Clothier said that scheme A did not commend itself to his clients, who claimed it as their right and duty to maintain their own system of supply from their own undertaking.

For the Mersey Docks and Harbour Board, Mr. Stewart-Brown said that the board objected to scheme B, because it split the area into two smaller districts. Their estate lay on both sides of the Mersey, and the acceptance of the Wirral scheme meant that they would be within the jurisdiction of two Joint Authorities, which, from their point of view, would be a deplorable and impracticable result. The board would like to see a representative of the commercial, as distinct from the industrial, interests, on the Joint Authority.

Bebington U.D.C. favoured the large scheme (and handed in photographs and maps of their district), as also did the Formby Council.

For the promoters of the Mersey and West Lancashire scheme, Mr. Wooll, in the concluding speech, referred to the Mersey Power Co. as the electrical "Jack Horner," who having got two good plums wanted more. It was for the Commissioners to say how far aggrandisement by a private company was to go, but he was bound to confess that the company's scheme was more ambitious than he contemplated. For scheme B there seemed a remarkable absence of support. It consisted only of the two promoting boroughs and thirty villages with a population of 19,000 people. The major scheme, on the other hand, had the support of the commercial and industrial communities on the north of the Mersey. His clients said that a new main capital station was essential, and it must be on the Lancashire side where the load was densest.

Sir John Snell, on behalf of the Commissioners, expressed their thanks to Mr. T. C. Wilson, chairman of the Conference of Local Committees, and Mr. H. Dickinson, the Liverpool electrical engineer, and Mr. E. W. Pierce, the deputy town clerk, for the efforts they had put forward in connection with the preparation of the scheme.

Neon Lamps.—A recent paper in the *Zeitschrift für technische Physik*, abstracted by the *Technical Review*, describes neon arc lamps manufactured by the Studien-Gesellschaft für Elektrische Leuchtröhren m.b.H.

Each lamp consists of a glass tube filled with neon at low pressure, and provided with two or more electrodes. The cathode consists of an alloy of the alkali metals and other metals. The alloy is solid, even when the lamp is burning. The lamp is designed for use with direct current at 220 volts; the current required is about 1 amp., a suitable resistance being introduced in the circuit. In order to strike the arc a vacuum interrupter is connected in parallel with the lamp, a small choking coil being inserted in the common portion of the circuit. An inductive impulse set up by the automatic action of the interrupter by means of a magnetic coil, causes a discharge through the lamp. The colour of the light given out by the lamp is red, and is therefore specially suitable for advertising, signalling, and medicinal purposes. The lamp uses about ½ watt per candle-power, and has the great advantage over other vapour lamps that it can be lit and put out very quickly (as often as 400 times a minute).

THE DEGASSING AND PURIFICATION OF BOILER FEED-WATER.

By Paul Kestner.

(*Abstract of paper read at a Joint Meeting of the* Institution of Mechanical Engineers *with the* Society of Chemical Industry.)

The author deals in this paper with the process of continuous blowing down used in conjunction with hot purification. Hot purification effects a thermal saving, and has the further advantage of eliminating the gases dissolved in the feed-water, by the reduction in solubility at high temperature. The speed at which the reaction takes place in the purification of water by soda alone or lime and soda can be accelerated by heat, and the settlement of the precipitate can be hastened by agitation, the effect of which is to cause accretion and increase of size of the particles. If the agitation is caused by a stream of water carrying air with it the water becomes saturated with oxygen, and corrosion results.

In water-softening processes generally rise of temperature ensures:—

(*a*) Increased speed of reaction.

(*b*) Reduced viscosity of the water.

(*c*) The reduction of the bicarbonates of the alkaline earths to carbonates.

(*d*) Reduced solubility of calcium sulphate and partial precipitation without the use of reagents.

Continuous Blow-down.—Whatever method of purification is employed, all the salts carried into the boiler by the feed-water become concentrated in it. In general some calcium carbonate remains in solution in the water, and when the concentration produced by evaporation becomes sufficiently high it is deposited on the walls of the boiler or in the tubes forming incrustation, which is harder the more slowly the deposit is made. In boilers generating steam very rapidly the deposits are also formed rapidly, and may accumulate in the tubes notwithstanding the violence of the circulation. The usual remedy is periodic blowing-off from the lowest point in the boiler and, to be effective, a large quantity of water must be blown off at each operation, even though this should not form a large proportion of the boiler contents. The continuous blow-down allows the calories to be saved by passing the blow-down water through a feed-water heater, the mud being deposited in a trap during the process, together with the salts that had been retained in solution owing to the high temperature of the liquid. The only loss occurs in the actual removal of the mud and salts, which forms a relatively small quantity. The blow-down water freed from the impurities is then returned to the boiler. This prevents the concentration of the soluble salts to an extent at which they would constitute a danger.

The process of continuous blowing-down permits the contents of the boiler to be renewed frequently; it eliminates mud before it has time to accumulate, and at the same time allows the use of soda for the reduction of the calcareous bicarbonates. The feed-water, therefore, contains sodium carbonate and bicarbonate; the latter is decomposed in the boiler into carbonate, and the carbonate in its turn is dissociated in the presence of water with a reversible condition of equilibrium in functions of the initial concentration and the temperature, thus:—

$$CO_3Na_2 + H_2O = 2\ NaOH + CO_2$$

hydrolysis giving more caustic soda the higher the temperature. With continuous blowing-down the water containing caustic soda and carbonate of soda is used to purify the make-up feed, the caustic soda reacting more rapidly on the calcium bicarbonate than would calcium oxide. It is of great importance, therefore, to combine purification by soda with the continuous blowing-down process.

The author describes the Kestner continuous blow-down apparatus, consisting of a steam separator, a central reservoir receiving the blow-down liquid, and an annular chamber surrounding this reservoir, from which it receives heat, and into which the purified blow-down water is decanted. The steam passes into a reheater in which it heats the feed. The heated feed mixes with the blow-down as it leaves the central chamber and then passes to the annular chamber in which precipitation and settlement take place. Soda is added through a water-meter in proportion to the make-up feed. Valves are provided for separating the mud.

Central Stations Using Distilled Water.—The distilled water of industrial appliances differs greatly from that of the laboratory. Owing to the rate of evaporation particles of water containing salts are carried over, so that the distilled water contains numerous soluble salts in small, but by no means negligible quantity, and in boilers using distilled water it becomes in time a fairly concentrated liquor. Boilers working with distilled water, therefore, require to be blown-down occasionally, but it is not necessary to remove a large amount of liquid, the amount being usually only one or two per cent.; the saline solution is replaced by distilled water. Even when an evaporator is used the continuous blowing-down method can be adopted, and this in conjunction with degassing enables a complete closed water circuit to be arranged in a central station using distilled water.

Corrosion and its Causes.—Where distilled water is used there can be no doubt as to the cause. Oxidation of the plates can only be produced by oxygen dissolved in the feed-water and set free in the boiler, and the effect is greater with intermittent working. The author discusses the theories of corrosion, and points out the need for degassing purified water also, and he explains that the critical concentration, at which maximum corrosion by salts is effected, must be exceeded after a few hours' work in ordinary boilers. The air dissolved in water contains roughly 33 per cent. of oxygen.

Degassing.—The elimination of the oxygen dissolved in water may be effected either by physical or by chemical methods, or by both. Of the former the principal methods are: Agitation of the water, the action of temperature, and the action of vacuum; these may be used separately or, in the majority of cases, in combination. Of chemical methods, the only one that is important is the action of highly oxidisable iron which absorbs the oxygen from the feed-water. As the result of much experiment the author has found that for this purpose manganese is a catalytic agent of great importance, and a suitable manganese cast-iron has been found.

When an iron degasser that had become completely rusted was left at rest, it was found after a day to have undergone a change, and from red rust to have become greenish-black, due to reduction of ferric hydrate under the influence of the iron. This has led to the invention of the Paris degasser, which works on the regeneration principle; in one form by means of two vessels containing iron turnings, through which flow takes place alternately, and in the other form in a single vessel with filters at each end and a valve arrangement for permitting the direction of flow to be altered. The amount of iron used in the apparatus is stated to vary from 1 to 3 grammes per ton of water treated, and the amount so used corresponds to the weight of boiler-plate saved from destruction.

The suggestion of a water circuit closed from atmospheric contact is discussed, and the combination of a degasser with such a system is recommended as a means for preventing any harm due to access of oxygen from accidental causes.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New House-lighting Set.

A compact little house-lighting set has lately been put on the market by the Electrical Construction Co., Ltd., Wolverhampton. It comprises a Villiers 2½-h.p., two-stroke engine with flywheel magneto, of the type largely used on motor cycles, coupled to a two-pole, shunt-wound dynamo giving ½ kW at 25-30 volts continuously. Comprised with the set is a battery of 60 amp.-hours capacity at 25 volts, sufficient to run ten lamps for ten hours or five lamps for twenty hours, so that in a small country house it is only necessary to run the engine to charge the battery about twice a week.

An Earthing Clip.

A neat earthing clip has been brought to our notice by Mr. M. Goldsmith, of 4, Florence Terrace, London, W. 6. It consists of a stout strip of tinned copper, perforated at intervals, and provided at one end with a U-shaped lug in which the earthing wire is laid; the wire passes under a triangular washer, and is gripped by a coppered bolt which passes through the strip, thus clamping the earth wire to the strip and the strip round a water-pipe simultaneously. The washer being triangular, with one corner projecting into the mouth of the trough or lug, cannot rotate when the bolt is being tightened up. The strip is made in various sizes and thicknesses by the Windman-Goldsmith Corporation, Perth Amboy, N.J., U.S.A., which is seeking patent protection. Mr. Goldsmith is the U.K. representative of the makers.

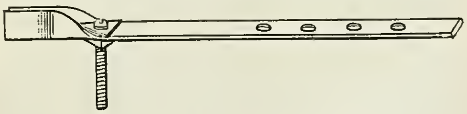

Fig. 1.—The Windman Earthing Clip.

New Switch Plates.

We have received from The Isis Electrical Co., 57, Albert Road, Aston, Birmingham, two samples of some new switch plates which the firm is now turning out. These are very substantial articles of excellent finish and appearance. The firm states that it "believes these to be the only diamond die engine-turned switch plates made." They are engraved in parallel straight lines, which besides adding to the appearance also minimise the bad effects of scratches. Various metals and metal finishes are supplied.

Extra Voltage for Battery Charging.

Mr. N. D. Blagdon Phillips, A.M.I.E.E., of Dursley, Gloucestershire, writes:—

In order to obtain the extra voltage from a generator, for giving the "gassing" charge to a battery, without increasing the speed of the set, the arrangement shown in the diagram (fig. 2) may prove useful.

The windings A B and C D represent the two field coils of a shunt machine, and S a single pole switch, connected to tappings of the field coils at E and F.

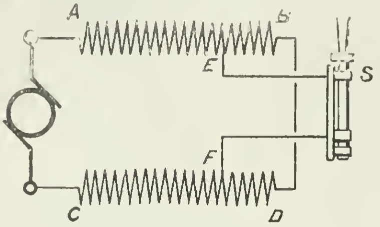

Fig. 2.—A Voltage Raising Device.

For normal running the switch is kept closed, thus only the portions A E and C F of the coils are effective; for the gassing charge, then, the switch is opened, and the additional turns E B and F D are brought into use to get the higher voltage.

A New Switch Plug.

Messrs. Albert Lee & Co., Ltd., 8 and 9, New Zealand Avenue, E.C. 1, have sent us for inspection a 10-amp. wall socket and two-pin plug insulated with a fire-proof material known as "Fiprallee." From exhaustive mechanical and electrical tests carried out at the National Physical Laboratory it would appear that, in many respects, the material is superior to porcelain; it is non-hygroscopic, acid-proof, and of high dielectric value. The wall socket and plug are of very solid construction, and all metal parts are effectively protected. The pins fit into bushes screwed into the terminals, which are moulded in the material, making a very safe contact. The construction of these plugs and sockets is such that they can carry 25 A without any risk.

LEGAL.

Claim for Lighting Set.

At Bishop's Stortford County Court, Mr. Philip H. Bedser sued Mr. Ernest E. Smith, proprietor of the local kinema, for the balance due for the supply and erection of a twin-cylinder lighting set—£76 19s. 2d. A counter-claim for £100 for expenses incurred in putting the engine in order was entered by the defendant.

It was stated by Mr. Smith's counsel that in 1918 his client contemplated substituting electric for gas lighting in his hall, and Mr. Bedser, after negotiations, offered to supply an engine in first-class running order, with a generator and battery, at a cost of £580. The set was installed, and from the beginning had been a source of trouble owing to frequent breakdowns. The engine was defective, and after numerous repairs it broke down altogether. Mr. Bedser denied that the engine was defective, stating that he left it working satisfactorily. He admitted that the engine possibly could go wrong without this being due to incompetence in management.

The case was adjourned finally until March 11th.

Breach of Apprenticeship Deed.

At Gloucester County Court on February 28th, Lionel Cadogan Mitchell, electrical engineer, claimed £10 damages from Samuel Johnson and his son, Henry Johnson, for an alleged breach of agreement relating to the apprenticeship of the younger defendant.

Plaintiff stated that this defendant left his employ five months before the expiration of the term of apprenticeship, and commenced work elsewhere. In addition to the claim, plaintiff sought an injunction to restrain Henry Johnson from committing a breach of the deed by being engaged with any other person in business as an electrical engineer within the City of Gloucester or a radius of six miles from the city, for five years after the expiration of the terms of the deed. The younger defendant, in his evidence, said that he became apprenticed to plaintiff when 16½ years of age. He was called up for the Army, and joined the Royal Engineers. Upon his demobilisation, witness said, he did not agree to continue his apprenticeship, as he considered himself worth a journeyman's rate. Defendants' counsel argued that the agreement was cancelled by virtue of the younger defendant's military service. Upon the other hand, counsel for plaintiff claimed that the deed was not cancelled thereby.

His Honour Judge Alan Macpherson held that plaintiff had failed on both claims; he decided that the agreement was brought to a conclusion by Henry Johnson's joining the Army, and in the absence of a definite agreement to revive it the deed was dead. The restrictions regarding employment after apprenticeship were held by the judge to be contrary to public policy. Judgment, with costs, was entered for defendants.

Pretoria and Municipal Employés.

A serious position was created in consequence of the judgment in the case of the Transvaal Property & Investment Co. *v.* the Pretoria Municipality. The applicants, the owners and lessees of certain premises, requested the installation of electric light. It appeared that during the construction of the premises a dispute arose between the company and the Joint Board of Master Builders and the Builders' Industrial Union, and as a result the work on the premises was "blacklisted." The municipal employés would do no work there in the way of inspection or connection until the disputes had been settled. In the opinion of the manager of the electric supply department, the employment of persons other than municipal employés would cause a strike, with the result that all the electrical services of the Council, including tramways and lighting, would be stopped.

Mr. Justice Mason, in the course of his judgment, said the obligation on the municipality arose under the statute, and the rights of the inhabitants were governed by the statutory provision and legal constitution of the Municipal Corporation. The duty of the Court was to enforce the legal right of the individual against everyone, however powerful or highly placed, and it had no discretion to refuse such an application as the present one for the enforcement of a plain legal right because difficulties might arise in the carrying out of its judgment. The Court was entitled to rely on citizens, whether in the service of the municipality or not, fulfilling their declared and positive legal obligations. There would, therefore, be an order directing the respondent to connect or cause to be connected the electric light from the municipal supply to the applicants' premises within ten days, and thereafter to supply, subject to such charges and upon such conditions as had been lawfully fixed and subject to the installation being in accordance with the requirements. The municipality must pay the costs of the application.—*Cape Times.*

A Western Ireland Electricity Company.

An application was made in the High Court of Ireland, before Mr. Justice Powell, by the Ballinrobe Electric & Woollen Company for power to enlarge its sphere of operations. The company, it was explained by counsel, was formed to supply electric light to towns in Co. Mayo, and by special resolutions the shareholders now desired to engage in the manufacture of woollens and textiles.

His Lordship said he would reserve his decision until an affidavit had been filed showing whether any creditors objected.

Thefts of Electricity.

On March 7th, the Clacton U.D.C. prosecuted Charles R. Small, an engineer, for having diverted electricity from a meter circuit. The clerk to the Council stated that defendant's house was supplied with electricity through two separate meters, one for lighting and the other for heating. Upon an examination of the meters it was found that although the lighting meter appeared to be in order the heating meter had been tampered with. The connecting wires had been stripped and crossed, thus short-circuiting the meter installation. Defendant admitted twisting the wires, but stated that he did not do it wilfully, but through ignorance. It was said that the loss sustained by the electricity department was probably under £2. After deliberation the magistrates fined defendant £5.

Another case of this nature was brought before the Stipendiary Magistrate at Stoke-on-Trent on March 11th. The Corporation prosecuted Alfred Phillips, of Hanley, for fraudulently preventing an electricity meter from registering the quantity of electricity supplied by the Corporation; abstracting electricity "the property of the Corporation"; and causing to be laid certain wires or conductors to communicate with the Corporation's mains without the consent of the Corporation. The defendant's mother was also summoned on these three charges, but the case against her was dismissed on payment of court costs. Defendant pleaded guilty to all the charges. The Corporation's counsel stated that upon examining the defendant's premises, an inspector of mains found that wires had been taken from between the point of entry and the meter. A lamp had been connected to these wires. The ordinary lighting energy was being registered by the meter. Upon a second visit the inspector found that the lamp and its accessories had been removed, and a motor had taken its place. Defendant then denied knowledge of this, but it was evident that the defendant had guilty knowledge, as the connections made called for at least a reasonable knowledge of electrical matters. Defendant's counsel said his client desired to be frank. He was not an electrician, but when he found insufficient lighting in the cellar he decided to fix another lamp. He did this, but was not aware that the electricity being used was not passing through the meter. Later he found this circumstance out, but continued to run the light, and he had also connected a motor for a little time.

The magistrate regarded the case as a serious one, and imposed a fine of £10 and costs, making a total of £16 2s.

Keen v. Slocock.

In the Mayor's and City of London Court last week, before Mr. Registrar Wild, a claim was made by Herbert Edward Keen, trading as H. E. Keen, electrical engineer, Great Smith Street, Westminster, against Mr. H. L. Slocock, solicitor, Old Broad Street, E.C., for £5 for the hire of a motor lorry on May 26th. According to the plaintiff's case the defendant required certain electrical fittings to be conveyed to a cottage at Marlow that he was fitting up with electricity, and it was arranged that the material should be sent by road by motor lorry. Accordingly a Studebaker motor lorry was hired at a price of £5, and the goods were conveyed to Marlow. The installation at the cottage had been carried out by the plaintiff, and there had been some compromise as to the price paid for the work, but the hire of the motor lorry was not included, and had not been paid. Mrs. Keen was called, and proved the arrangement being made for the hire of the lorry to convey the electrical material to Marlow, and that the amount for the hire was still due. The defendant said that the plaintiff had undertaken to carry out the electrical installation in question in fourteen days provided the material was delivered at the place at once. The railway people could not deliver, and as it was essential to have the material there at once he consented to the lorry taking it down. Had the electrical work been done in fourteen days he would have paid for the hire, but the work took seven weeks. The installation too was faulty, and the matter had been referred to a firm of contractors, the whole matter as he understood being then settled. Now the question of the lorry had been brought up. The Registrar said the question of faulty installation had nothing to do with the present claim. If the defendant thought he had any grounds for complaint in respect of it he should have raised a counter-claim. There had been an agreement to pay £5 for particular work which had been done. There was no counter-claim, and the plaintiff was entitled to judgment, which was entered accordingly with costs.

Workmen's Compensation Case.

A case under the Workmen's Compensation Act was heard at Marylebone County Court, on Monday, before Judge Sir Walworth H. Roberts, when John Childs, an electrical wireman, claimed compensation against Mr. Ford, a turf accountant, of Notting Hill, for injuries received on November 8th last.

The evidence of applicant was that he was engaged to do some electric wiring in a house at 23, Pembridge Square, and on the date in question, while at his work on a step ladder testing and repairing electric wires, the ladder slipped, and he fell, fracturing his left arm and dislocating his shoulder. Applicant was 60 years of age, and had been employed by the respondent at 1s. 9d. per hour, being subject to an hour's notice. He worked from eight o'clock in the morning till five in the evening, and one o'clock on Saturdays, his weekly earnings being £3 18s. 6d. Applicant only claimed 35s. for the period of his incapacity, as he had been working with the respondent only for about 15 days when the accident occurred. A man named Skimmings had been employed under him, but to reduce expenses his employer dispensed with Skimmings's services and engaged a lad in his place. During the previous twelve months applicant had been receiving an average weekly wage of £4.

The Judge said that no answer to the claim having been filed a *prima facie* case had been made out. He found in favour of the applicant, allowing him £1 per week, with 75 per cent. (additional war allowance), altogether 35s. per week.

Quain v. Spink.—Correction.

We regret to find that an error occurred in the report of this case appearing in the Electrical Review for March 4th. The defendant Spink had not entered a counter-claim for the balance of £15 wages, and judgment was not given for him for that amount. Our reporter based his inaccurate reference to this point on a statement appearing in defendant's affidavit filed in court.

Freemasonry.—The secretary of the Kelvin Lodge wishes to remind the members that owing to the Easter Holidays the next regular meeting will be held on Thursday, March 31st, and not on Friday, March 25th (Good Friday).

The Albert Medal.—At a meeting of the Council of the Royal Society of Arts, held on Monday, the Chairman, Mr. Alan A. Campbell Swinton, F.R.S., presented the Albert Medal of the Society to Prof. A. A. Michelson, For. Mem. R.S., awarded to him in 1920 for his optical inventions which have rendered possible the reproduction of accurate metric standards and have provided the means of carrying out measurements with a minute precision hitherto unobtainable.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR FEBRUARY, 1921.

A fall occurred during February in the values of goods under the three heads—exports, imports, and re-exports. This may have been due, in part, to the decline in certain prices, although, perhaps, this is of too recent occurrence to have made its effect felt yet. The reduction in the export figure amounted to £223,703, or 12 per cent.; imports fell by over 20 per cent.; and re-exports were reduced in value to the extent of 15 per cent. In the case of the exports the reduction was evenly distributed among the separate items, but there were big falls in the value of imported electrical machinery and goods (unenumerated). Increases occurred in the export of submarine cables, telegraph and telephone instruments, and glow lamps, in the import of insulated wire, glow lamps, and meters, and in the re-export of glow lamps and carbons.

Values of Electrical Exports and Imports for February, 1921.

	Exports.	Imports.	Re-exports.
Electrical goods and apparatus (unenumerated)	£220,244	£92,904	£15,629
Insulated wire	319,195	13,874	—
Glow lamps	45,775	21,653	8,329
Arc lamps and parts	2,421	4,432	20
Batteries	73,950	11,859	31
Meters	30,953	26,696	4,080
Carbons	12,151	10,319	917
Electrical machinery:—			
Railway and tramway motors ...	12,919	—	—
Other motors and generators ...	235,633	—	—
Electrical machinery (unenumerated)	143,974	64,062	3,187
Switchboards (not telegraph or telephone)	9,506	952	40
Telegraph and telephone cable and material:—			
Telegraph and telephone wire and cable (not submarine)	152,151	9,669	114
Submarine telegraph and telephone cable	106,752	—	—
Telegraph and telephone instruments and apparatus	150,703	25,877	882
Totals... ...	£1,516,327	£281,297	£33,229

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Wiring in Ferro-concrete Factories.

The letters in your issues of February 25th and March 4th are of interest, especially the letter signed "J. K. G.," as I have had similar experience where the wires have resisted the flames although the copper sheathing showed signs of being heated to nearly melting point. For years past I have used Stannos wires buried in concrete buildings, and have yet to learn of a failure.

In 1912 I buried several lengths of Stannos wire in various kinds of cements and plasters, on both d.c. and a.c. circuits, and after three years I cut away the cement and carefully examined the sheathing with a magnifying glass, and in no case was there any sign of destruction. The only alteration observable was in some cases a slight discoloration of the outer tinned surface, but in the case of the wire covered by Portland cement, even this was absent, and the surface came out as clean as on the day on which it was put in.

Before 1912 and since I have laid wires in concrete, ordinary plaster, special plasters, and various floor compositions, and, as before stated, with complete success. There are a number of buildings constructed which will not permit ordinary steel tubes beneath the plaster without cutting into the base; this applies more particularly to those buildings where patent hard-surface plaster is used, very often not exceeding a quarter of an inch in thickness, and I know of no system better suited for such a building than the Stannos wire. It would be interesting to know of other contractors' experience in this matter, as the attempt to use steel conduits in buildings of this character not only brings about mechanical and costly difficulties, but in very many cases leads to condensation troubles, which are entirely absent when sheathed wires are used.

Having used Stannos wire continuously since 1909 for wiring many thousands of lights on the ordinary 2-wire system, and also with the outer sheathing as the return negative, and having done this without trouble of any kind, I have no hesitation in saying that it possesses more advantages than any of the other known methods in use at the present time.

I attribute this to the resisting properties of tinned copper, together with the fact that once the wire is placed in position it will be found as I have found it, the same after ten years' use, namely, free from movement of any kind.

E

Owing to the protective qualities of Portland cement, I have for many years past, when burying wires under soft plaster, had them covered with Portland cement, which acts not only as a preservative, but is practically nail-proof.

Rawlings Bros., Ltd.,
W. R. Rawlings,
Managing Director.

London.
March 11th, 1921.

Your correspondent "Inquirer" says "C.T.S. cables strike him as being rather too unprotected for general use, although, of course, ideal for some classes of work."

As an instance of "damning with faint praise" this sentence will take some beating. But can "Inquirer" give any instances of this inadequacy of protection? We will wager not! C.T.S. has reached its present state of popularity largely through its ability to protect.

We can, however, tell him of at least one ferro-concrete job of 250 houses in Weaverham, Cheshire, where C.T.S. is not considered "rather too unprotected."

We venture to suggest to you, Sirs, that when you receive letters for publication containing paragraphs airily condemning something or someone, under a *nom de plume*, you should, in fairness, do one of three things:—

1. Get proof of the writer's assertions.
2. Make him publish his name and address.
3. Submit the letter to the firm likely to be affected, to enable them to answer the libellous statements on the same page as the letter containing them.

St. Helens Cable & Rubber Co., Ltd.,
J. H. C. Brooking.

Warrington.
March 14th, 1921.

Domestic Supply from 500-volt Generators.

Replying to "Inquirer," I would point out that his problem has been solved by Dettmar in the way mentioned by him, *i.e.*, fixing another pair of auxiliary brushes between the existing brushes. As this brush will short-circuit two segments whenever it bridges the insulation between them, it is necessary that the coil thus short-circuited should be moving in a weak field. Dettmar arranged this by leaving a gap in the middle of the pole.

With "Inquirer's" present machines the above would not be practicable, and therefore if he has not a battery it will be necessary to use the static balancer system.

At least two rings will be required on the revolving part; and a connection must be made to two points in the winding or two segments.

A choking coil must be connected to the two rings. For 120 volts a 24 per cent. tap would be taken. For 150 volts a 30 per cent. tap would be made. For 250 volts the wire would be taken from the middle point of the choking coil.

These static balancers are sold by firms in this country.

If the out-of-balance current for the 120-volt tap was limited to 50 amps., the output of the balancer would be 6 kW. To get a rough idea of the cost it would be necessary to know the r.p.m. of the generators, the number of poles, and the lower pressure and the maximum out-of-balance current.

There will be a magnetising current in the choke of frequency r.p.m. × number of poles/120 cycles per second.

The size of a static balancer is about one-half the size of a transformer of the same volt-amp. capacity.

If "Inquirer" cares to get in touch with me directly, I shall be pleased to give him further information. I send my name and address herewith.

T. W. R.

March 14th, 1921.

In reply to "Inquirer" (March 4th) as to the practicability of obtaining a reduced pressure for domestic purposes by fitting another set of brushes between the existing brushes, this is extremely impracticable, in fact, impossible. Certainly there is a point between the existing brushes where this desired low pressure would evidence itself on a voltmeter, but it cannot be utilised owing to the fact that the pressure between adjacent commutator segments at this point would be very considerable, and as these sections would be short-circuited as they came under the brushes, enormous local currents would be set up, resulting in terrific sparking and flashing over, with the almost certain destruction of the insulation of the machine.

So far as I can judge, the only disadvantage of conversion to the 3-wire system at 250 volts between outers and neutral is the expense involved in reconstruction of the generating plant and rewiring for domestic supply.

The alternative to conversion to the 3-wire system would be the installation of a motor-generator, the motor being wound for 500 volts, and the generator to give the desired low pressure for domestic work.

This method, of course, would not be nearly so expensive as the entire reconstruction of the system to a 3-wire supply.

K.

March 7th, 1921.

Lead-covered Wiring and Payment According to Ability.

In your current issue, it is interesting to read communications from two readers, "Bourgeois" and "Regular Reader"; the former inquires, the latter replies. Quite a coincidence.

To "Bourgeois," I would say that, given a lead-covered V.I.R. cable or wire of C.M.A. quality, with the standardised accessories, bonding clamps, earthing clips, &c., used in connection therewith, he has, so far as the goods are concerned, all that can be desired; in fact, properly installed under proper supervision, the system bids fair to rank as the ideal system for electrical installations for lighting.

I, for one, can positively assert that it is not the particular system of wiring which makes for an efficient installation, passing all tests required by the supply authority, that is, examination of the work first, then an insulation test, to earth and between, wattage of the circuits, and the nature of the "earth," but rather is it the quality of the labour handling the goods. This latter factor in installation work has become a positive danger, and is a source of considerable anxiety to any installation engineer upon whom the full responsibility falls for scamped work under floors, in roofs, and, in fact, anywhere where the "handywork" of the "handyman electrician" is doomed to be concealed from view.

When you consider the extent to which the once specialised trade of "electric wiring" has drifted into the hands of plumbers, ironmongers, decorators, &c., all self-styled electrical and sanitary engineers, all ready at a push to enlist in their services men whose knowledge of the trade, in training and experience, is limited to the screwing of a pipe and tugging wires through, the majority shielded and protected against "payment on merit," or, as "Regular Reader" advocates, on ability, by their unions, is it to be wondered at that inquiries stop at inquiries, and that a tender has not been received from "So and So" for such and such a contract?

I fear, Sir, in common with others whose ambition is to revive the trade with a sound job with a sound guarantee, the remedy of registration with the E.C.A. would be of little avail; would not the registration of the "man" be better? Is it not a trained man's due to enjoy the confidence of, and be paid better by, his employer, than some of the imitations who at the present time contaminate the industry, and yet are considered to be on the same footing and receive the same rate, simply because?—well, I'll leave the rest for a more able explanation.

I do not know, but I am very much inclined to think, that your "Regular Reader" would support the contention: "Survival of the Fittest," and I wish him every success, and conclude,

Engineer Contractor.

March 14th, 1921.

[Our correspondent appears implicitly to support the policy of registration of contractors by his remarks about "self-styled electrical and sanitary engineers"; we agree that the wireman also should give proofs of his competence, but ought not that qualification to be guaranteed by his trade union? We may add that "Survival of the Fittest" by no means necessarily connotes the survival of the best.—Eds. Elec. Rev.]

Payment According to Ability.

Your correspondent, "A Regular Reader," seems to have left out of his consideration altogether the human side, also the fact that quality counts as well as quantity. I should like to ask him what is to become of the man (possibly married and a father) who fails to pass the work test? I well remember once failing to pass a test, but I was put on a course of instruction, and came second out of forty-two in the final exam., and highest aggregate for thirteen exams., proving from my own experience that the man who fails to pass a test is not necessarily a failure. Therefore I contend that before any concern institutes a system of work tests, it should be prepared to instruct those who fail, with a view to a second and possibly a third chance of passing. The suggestion that one-third of the average engineering factory's employés (fitters and turners) are not worth their keep, and further, that the other two-thirds adjust their output to the level of the lowest, is absurd. Everyone admits that there are wasters, but one-third is a gross exaggeration, and if all adjusted their output to the same level it would be impossible for anyone to pick out the waster or to show that there were wasters at all. Though it may sometimes be so, it is not an invariable rule that the man with fifteen years' experience besides his apprenticeship is worth more than the man just out of his time. At thirty-six a man has lost some of the youthful vigour and enthusiasm he possessed at twenty-one. Further, he is not so responsive to new ideas. The young man nearly always has the advantage in technical knowledge. I once desired a simple explanation of "power factor." The explanations given in various books I got hold of being rather beyond me at that time, I asked my workmates. The older ones seemed to have no idea; the younger ones had ideas more or less vague, but were unable to express them, and finally I got my explanation from a fellow apprentice, a lad of eighteen. I will give a little of my experience, to compare with your correspondent's. I have met these two to one men. I am a wireman, and on one well-remembered occasion worked alongside of another man who wired 41 lights to my

22, precisely identical jobs. The result was that I got the sack, the contractor telling me he had no use for drawing-room wiremen, which I took as a compliment. I never regretted it, and I never lost by it. I take a pride in my work, and contend that it is bad generally to sacrifice quality to quantity. Later I worked alongside of the same man for another contractor, but this time he got the sack for scamped work and making a mess of some two-way wiring. Who was the better man then? He was the elder. As to the causes of low production, these are many and complex. Fear of unemployment is one, lack of direct interest in the undertaking is another, uncongenial and unhealthy surroundings is another, monotonous repetition work is another. The fact that employers do not always take advantage of new and improved machinery is another, and so we might go on. For some the masters are to blame, for some the men.

In conclusion, I would say to "A Regular Reader" that fifteen years' extra experience on a particular job very often makes a man a more experienced dodger.

Another Regular Reader.

March 14th, 1921.

Electric Radiators.

Some time ago a discussion took place in the Electrical Review regarding the efficiency of radiators. It was then contended that radiators which allowed air to pass freely through were less efficient than radiators arranged so that air could not pass through. The first type gives off its heat as hot air, which promptly goes to the ceiling, whereas the second type gives radiant heat, which warms the room more effectively.

For some time past I have tried a radiator, for office heating, in which the heating coils are held in horizontal grooves, so that no air can circulate through them. My experience is that a 2-kW radiator of this type is more efficient, for actual heating purposes, than a 3-kW one in which the wires are arranged so that the air circulates through them freely.

These facts are slowly becoming known amongst radiator makers, but there are still large numbers of the bad and inefficient type being sold. These do a great deal to bring electrical radiators into disrepute.

To get the best results out of radiators the wires should be run at a bright red heat. Apparently this can be managed satisfactorily with modern high quality resistance wires.

Radiator.

March 10th, 1921.

Mains Records.

I desire to obtain information regarding up-to-date methods of keeping mains records, and wish to know whether any of your readers could put me on the track of obtaining it. I am chiefly interested in the upkeep of records for overhead transmission, h.t. and l.t. networks, where numerous extensions and alterations are constantly being carried out. Any information on the subject would be much appreciated.

Colonial Inquirer.

March 14th, 1921.

Gas-heated Appliances.

I venture to draw your attention to the large number of electrical manufacturers in this country who continue to use gas-heated appliances in the manufacture of electrical parts. Strange to say, even small articles like soldering irons are in the majority of cases gas-heated.

I suggest that this is a field where that very useful body, the E.D.A., will find wide scope. Extremely useful missionary work might be done, even among its own members.

X.

March 8th, 1921.

BUSINESS NOTES.

Bankruptcy Proceedings.—David Suchostawer, 1, First Avenue, Acton, Middlesex, engineer.—The adjourned public examination of this debtor was held recently at Brentford. It was reported that the debtor was a Russian subject who came to England in 1907. He commenced business, and stated that he had invented a machine which would transform the propulsion powers of motor-cars. Debtor alleged that he had assigned a certain patent to a company. This patent was a device to collect the mechanical and electrical power and get them to act simultaneously. Debtor stated that he had spent about £500 on machinery and experiments. The examination was adjourned to be closed.

John William Gladwin, electrical engineer, 81, Burcet Road, and 1a, Measbrook Park Road, Sheffield.—The following are creditors herein :—

Ashton, T. A., Ltd.	£12	Hattersley & Davidson	£32
British Insulated and Helsby Cables, Ltd.	29	Honsley, George	22
Carron Co.	11	Mechanical and Electrical Engineering Co.	48
Crammer & Cheshire	17	Oliver Typewriter Co., Ltd.	50
Derbyshire, Alfred	50	Pashley, Arthur	106
Drake & Gorham	36	Pass, Benjamin	20
Gladwin, Annie	48	Siemens Bros. & Co., Ltd.	16
Hall, Bernard	150	Sheffield Electric Supply Dept.	12
Hallamshire Electric Co., Ltd.	78	Smith & Sons	16

Albert Edward Dickinson, trading as the Crown Electrical Co., 157, Hnnslet Road, Leeds. Electrical engineer and contractor.—The public examination of this debtor was held on March 8th, at the County Court House, Albion Place, Leeds. The statement of affairs showed liabilities £514, against assets estimated to realise £79, leaving a deficiency of £435. Debtor attributed his position to want of capital and bad trade. He stated that when his petition was filed, the sheriff was in possession under an execution for £39. Debtor commenced business in partnership with another in April, 1919. He possessed stock worth £30, while his partner found about £285. The business was not a success, and in May, 1920, the partner went out of the business, debtor agreeing to repay the amount of his capital when he was able to do so, but none of it had been repaid. He had kept books of account, but it was stated that they were not properly entered up. He became aware of his position in May, 1920. The examination was closed.

Albert Lord, electrical contractor, 33, Westgate, Burnley.—This public examination took place at Burnley on March 10th. The liabilities were £977, and assets £52. The cause of failure alleged by debtor was "heavy household expenses." Debtor said he did not think the profits on the business were ever equal to his household expenses. He commenced without capital, and did small jobs at first, but later took a £565 contract, from which he allotted £250 to a Manchester firm for materials. He lost money on that work. That was one of the reasons for his insolvency. He denied selling off his stock quickly just prior to filing his petition. The examination was closed.

Private Meeting.—A. Jay & Co., electrical engineers, 48, Fenchurch Street, London, E.C.—A meeting of the creditors of the above was held recently, at the offices of Messrs. Poppleton, Appleby & Hawkins, 4, Charterhouse Square, E.C., when a statement of affairs was presented which showed liabilities of £736 due to trade creditors. The assets were estimated to produce £605, less £70 for preferential claims, leaving net assets of £535, or a deficiency of £201.

Mr. C. Poppleton reported that the debtor commenced business in Fenchurch Street in May of last year, with a capital of £800, which represented his savings. He expended £200 in fitting and decorating the shop. The shop takings had only averaged some £46 a month, while the rent had been £35 a month, but through having premises in Fenchurch Street a quantity of repair work had been obtained, and the turnover had been in the neighbourhood of £1,000. Since the commencement, £217 had been spent in wages. The deficiency in the statement of affairs was practically accounted for by the writing down of the assets, and the present position was attributed to the money expended in establishing the business. It was pointed out that since the commencement the takings had always been progressive.

After discussing the position the creditors decided that a deed of assignment should be executed, with Mr. E. H. Hawkins as trustee, and that the debtor should be allowed to carry on the business and a committee was appointed, consisting of representatives of the Ediswan Electric Co., the International Electric Co., and the Ever-Ready Co.

The following are creditors :—

Watshams	£15	Falk, Stadelmann & Co.	£43
Welco, Ltd	12	Siemens Bros., Ltd.	52
Edison & Swan & Co.	210	Wardle Engineering Co., Ltd.	13
International Electric Co., Ltd.	38	Asnew Lamp Co.	19
Helium Lamp Co.	13	British Thomson-Houston Co., Ltd.	130
Evered & Co., Ltd.	13	Ever-Ready Co., Ltd.	40
Metropolitan-Vickers, Ltd.	50		

Dissolution of Partnership.—Lucasse Electric Co., electrical engineers, 31a, Stoney Stanton Road, Coventry.—Mr. A. Eccleston, Mr. N. H. Copson, and Mr. C. W. Fairfaxhave dissolved partnership. Debts will be attended to by Mr. C. W. Fairfax, who will continue the business in his own name at 44, Sackville Street, Coventry.

Trade Announcements.—Messrs. W. D. Clough, Ltd., have recently opened premises at 185, Fordnenk Street, Bridgeton, Glasgow, equipped with plant for the business of automobile, electrical and mechanical engineers; electrical repair, re-winding, contracting and wiring work will be undertaken, and trade literature is wanted.

Mr. J. S. Dyas, of 68, Dawson Street, Dublin, has been appointed representative in Ireland for Messrs. H. W. Smith & Co. (1920), Ltd.

As from March 21st the registered address of the Twiss Electric Transmission, Ltd., will be 39, Victoria Street, Westminster, S.W. 1, larger offices having become necessary owing to increased business.

The London office of the Hart Manufacturing Co. is now under the management of Mr. T. C. Meale, who has been with the company for the past 13 years.

Electrical Utilities, Ltd., are vacating their Victoria Street offices, and all communications should be addressed to the works at 1-3, Shelgate Road, Battersea Rise, S.W. 11.

Mr. E. Mitchell (hand-made ornamental switchplates, &c.), has removed to larger premises at 412a, Great Hoiton Road, Bradford.

The Esperanto Lamp Co. (managing director, Mr. F. L. Strawson) has been formed to carry on the lamp business of the London Factors and Agents, Ltd. The office address will be 38 and 39, Parliament Street, London, S.W. 1. The general business of the London Factors and Agents, Ltd., is unaffected by the change.

Company Liquidations. — Stols Electrophone Co. (1914), Ltd.—A petition for the winding up has been presented to the High Court by Messrs. T. B. Browne, Ltd., of 163, Queen Victoria Street, E.C., and will be heard in London on March 22nd.

Simplex Construction Co., Ltd.—A petition for the winding up of this company has been presented by Mr. J. Murray, of 11, Suffolk Street, Pall Mall, S.W., and will be heard by the High Court on March 22nd.

Electrical Industries, Ltd.—The first meetings of the creditors and shareholders were held at the Carey Street Offices of the Board of Trade on March 9th, when Mr. Warley, Official Receiver, reported that after satisfying the preferential creditors and debenture-holder, there would only be a very small margin for distribution among the unsecured creditors. A resolution was passed for the liquidation to be left in the hands of the Official Receiver.

Catalogues and Lists.—Ironclad Switchgear Co., Ltd., Monton Lane, Eccles, Lancashire.—An illustrated and priced booklet of various types of ironclad switch and fuse gear.

Messrs. Baker & Hyman, 11 and 13, Portland Crescent, Leeds.—Four illustrated and priced leaflets dealing respectively with an automatic scissors-type arc lamp, circular rheostats, scissors-type miniature arc-lamp outfit, and standard-type rheostats.

The Walsall Hardware Manufacturing Co., Ltd., Ablewell Street, Walsall.—"The Grip"—a little magazine dealing with points in connection with grip conduits and fittings.

Messrs. R. B. Hand & Co., Ltd., 63, High Holborn, W.C.1.—A well-illustrated and detailed catalogue of portable electric machinery (flexible shaft drives) manufactured by the R. G. Haskins Co., of Chicago, for which Messrs. Hand are sole agents in the British Isles.

The British Thomson-Houston Co., Ltd., Mazda House, 77, Upper Thames Street, E.C. 4.—Price-list No. 10,550—B (Section I), giving illustrated descriptions of applications of "Eye-Rest" indirect lighting.

Messrs. H. C. Slingsby, 142, 144, and 146, Old Street, E.C.—List No. 149, illustrating trucks, ladders, barrows, &c., and giving full details.

Messrs. Thompson & Co., 48, Watling Street, E.C. 4.—Prospectus No. 283 of the Société Genevoise d'Instruments de Physique, illustrating and describing "Rex" single-phase meters.

The Falkirk Iron Co, Ltd., Falkirk.—A leaflet, illustrated in colour, describing the "Falco" electric iron; priced.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Leaflet No. X 2,389, illustrating and describing "Witton-M.L." circuit-breakers of various types. Fully priced and detailed.

Messrs. E. P. Allam & Co., 107 — 109, Gray's Inn Road, London, W.C. 1.—March stock-list of electric motors for sale or hire.

Messrs. Vickers-Petters, Ltd., Ipswich Works, Ipswich.—A well-illustrated catalogue (50 pp.) of Vickers-Petters semi-Diesel crude-oil stationary and marine engines, with numerous views of actual installations and illustrations of erecting shops, &c. Full details of the engines are given, and a description of a new electric starting device.

Messrs. Babcock & Wilcox, Ltd., Oriel House, Farringdon Street, E.C. 4.—"Liquid Fuel Burning for Marine and Land Boilers," an interesting brochure profusely illustrated by views of oil-firing installations. The advantages of the system are set forth as well as full descriptions of applications of the plant to various types of boilers. Also a list of the principal ports at which fuel oil may be obtained.

Electrical Trade in South Africa.—According to the *British and South African Export Gazette*, the installation of electric tramways is under consideration in many centres in South Africa, and the work might be considerably hastened by the enterprising effort and advice of local firms holding agencies for British manufacturers of the plant required. Complete electric lighting plants, with a capacity ranging from 20 to 1,000 lamps, are being actively pushed with satisfactory results in all the East African markets. They include both British and American types.

Proposed British Fair at Bukarest.—The Rumanian Press Bureau publishes the following statement:—"The British Government has notified the Rumanian Government of its desire to hold a fair on a large scale at Bukarest, at which goods from Great Britain and the British Dominions would be exhibited, the object being to supply Rumania and the other States in the south of Europe with such goods. Negotiations on the subject between the two Governments will begin shortly."—*Reuter's Trade Service* (Bukarest).

Social Events.—About 120 members of the staff of the Osram-G.E.C. Lamp Works assembled at the Café Royal on the 11th inst., under the chairmanship of Mr. C. Wilson, managing director, the occasion being the revival of the annual staff dinner, and a very enjoyable evening was spent. The speeches were commendably brief and to the point; following the loyal toast, which was proposed by the chairman, Mr. W. F. Franks proposed "The Firm," and, in the absence of Mr. H. Hirst, Mr. White replied. The chairman also replied, remarking that during the war everyone had become slack, but in the last year or so much improvement had been made; in future they would all have to work harder than they had ever worked in their lives before; if they relaxed their efforts they might go under, but he was sure that if every man did his best, they would have nothing to fear. Their aim was to find out what other people were doing, and then try to go one point better; the newly inaugurated research department had already done excellent work, but it was still young, and had a future before it. When it had had time to get into proper working stride it would prove of immense value to the whole of the G.E.C. undertakings. The rest of the evening was devoted to a programme of music and song (excellently arranged by Mr. F. Cole), Mr. Dion Lane's contributions being particularly appreciated. During the interval Mr. J. F. Jessop, in a few well-chosen words, proposed "The Chairman," the toast being drunk with musical honours, and after completing the musical programme, the company dispersed after having spent a most enjoyable evening.

The fourth social evening of the Ediswan Bristol Staff and their friends was held at the company's showrooms on the 2nd inst.

The annual staff dinner of Messrs. J. H. Holmes & Co., Newcastle-on-Tyne, was held on Wednesday evening, 9th inst., when a large gathering of the staff and branch office managers and agents from various offices in the United Kingdom were present. Mr. G. McCluskey, outside superintendent engineer, presided, and the following partners were present:—Messrs. Alfred Holmes, Ellwood Holmes, Stephen Holmes, and Oliver Holmes. The toast of the firm was proposed by Mr. T. Carter, chief engineer, and the amicable relations between the staff and the firm were emphasised. Mr. Alfred Holmes, the senior partner, when responding, said that he fully appreciated the loyalty of the staff and their efforts to make the business a success. A toast to the branch offices and agents was given by Mr. Stephen Holmes, and this was replied to by Mr. F. W. Varney, manager of the London branch. Mr. J. G. Adamson was responsible for the entertainment programme.

Wages Dispute at Liverpool.—Trouble is developing between the Electrical Trades Union and the Post Office authorities over the work of re-wiring the Liverpool General Post Office. The Union contends that its members should receive the district rate of 2s. 3d. per hour, but it is understood that the Post Office claims that this work should come under the schedule of rates paid by the Post Office Engineering Union.

Book Notices.—"Hydro-Electric Survey of India: Second Report on the Water-Power Resources of India." By F. E. Bull and J. W. Meares. Pp. 123; 17 figs. + plates. Calcutta: Superintendent, Government Printing Office. Price Rs. 1—6; or from Messrs. Constable & Co., London, or other agents for Indian Government publications.—This Report is referred to in our leading columns to-day.

"The *Transactions* of the South African Institute of Electrical Engineers." Vol. XII, Part 1. January, 1921. 22 pp. Price 2s.—This issue includes a report of the 12th annual general meeting, and gives a statement of income and expenditure for 1920 and the balance-sheet; also discussions on two papers:—"Notes on Small Suction Gas Plants," and "Power Requirements of Rolling Mills."

Combines of Japanese Electrical Companies.—Tokio will in future be a field of keen competition among several companies for the supply of electric power and lighting. In addition to the fairly numerous existing companies the Keihin Electric Power Co., the Kanto Water Power Electric Co. and the Gumma Electric Power Co. are now being organised. The combined supplying capacity of these, and the companies already in existence will soon far exceed the demand for the entire city and neighbourhood, and the question of regulating supply and demand is being considered by the respective companies as a matter of grave importance. It is probable that some companies will eventually combine in order to avoid competition. The Tokio Electric Light Co. which amalgamated with the Nippon Electric Light Co. some time ago, recenty amalgamated with the Tone Water Power Electric Co. The company is about to amalgamate with the Tone Electric Power Co., the negotiations for the combine having now been concluded. By this combine the Tokio Electric Light Co. will possess the supplying power of the two companies. In addition, the Tokio Electric Light Co. being a large shareholder in the Shinetsu Electric Power Co. controls a large supply of electricity from this source. The Shinetsu Electric Power Co. has recently amalgamated with the Nakatsugawa Water Power Co. which will shortly begin its power house operations, consequently the supplying capacity of the Shinetsu Co. is expected to increase considerably in the near future. In these circumstances the Tokio Electric Light Co. possesses a paramount position in the supply of electricity in Tokio and the neighbourhood.

A combine of companies in Kyushu is being planned, but details are as yet unavailable. It is conjectured that the Kyushu Hydro-Electric Co. (capital 35,000,000 yen), the Kyushu Electric Light Co. (capital 18,000,000 yen), and the Kyushee Electric Tramway Co. (capital 16,000 yen), will be amalgamated, and that ultimately the smaller concerns will be merged into the combination.—*Reuter's Trade Service* (Tokio).

Copper and Lead Prices.—Messrs. F. Smith & Co. report March 15th:—Copper (electrolytic) bars, £71, 20s. decrease; ditto sheets, no change; ditto wire rods, £87. £1 decrease: ditto h.c. wire, 11½d., ⅛d. decrease.

Messrs. James & Shakespeare report March 16th:—Copper bars (best selected) sheets and rod, £114, 40s. decrease; English pig lead, £20 10s., 20s. increase on last week's quotation,

The Scottish Electricians' Strike.—A statement issued by the Electrical Contractors' Association with reference to the dispute with the employés respecting wages, explains that at a conference the employers intimated that, on account of the state of trade, they found it necessary to stand fast to their notice regarding a reduction of wages, as their experience was that the public considered the cost of installation work too high, and consequently work could not be obtained at the existing rates to afford employment to the large majority of men in the trade. Shop notices for the reduction of wages to 2s. per hour for the first full pay in March were posted. The Union requested a further conference on the matter, and this conference was held on 4th inst., when no agreement was come to.

The Perth branch of the Electrical Trades Union has announced that it is prepared to supply direct labour to undertake all branches of electrical work, including armature winding. Estimates are given free. Those requiring such labour have been asked to apply to the Strike Secretary.

Kinematograph Electricians. — Representatives of the Electrical Trades Union and members of the Devon and Cornwall Branch of the Cinema Exhibitors' Association recently met in conference at Plymouth to open negotiations with regard to "a card" for kinema operators. The question of wages was one of the outstanding subjects discussed, a claim being made by the Union for £5 5s. a week for operators in "Class A" houses. The exhibitors opposed on the ground that it was in excess of the ordinary Union rate for electricians in the district—namely, 2s. 1d. an hour, which for a week of 48 hours made a wage of £5.

It was proposed with reference to "Class B" houses that chief operators should have £4 10s. a week, and that the assistant should be a non-technical assistant.

A discussion arose regarding the qualifications of operators and the training of apprentices. Mr. W. J. Corse, a kinema proprietor, and the head of an important electrical business in Plymouth and elsewhere, pointed out that many of the operators were not electricians. He worked for practically all the exhibitors in the district, and he had seen some of the best machines put into houses "mucked up" by inefficient operators within a week. Mr. F. J. Martin, for the Electrical Trades Union, retorted that exhibitors could not expect efficient men unless they paid first-class wages. Mr. Corse replied that as they paid at the rate of 2s. 1d. an hour, which was first-class wages for the district, they were entitled to expect first-class work.

Mr. Mont Gilpin (Chairman of the Exhibitors) said he was in favour of Union wages and Unions; but, on the other hand, he insisted that if they paid the Union rates for men, they must have efficiency. Very often it happened that men who became assistant operators started with no training except such as they got in the kinemas. As soon as these assistants turned the handle and threw a picture on the screen—no matter the quality of the picture—they immediately claimed to be first-class operators.

It was ultimately decided that "apprentice operator" should be substituted for "non-technical assistant." It had been proposed that the non-technical assistant should be paid 35s. a week, but under the new agreement the apprentices are to be paid on a scale commencing at 15s., and rising by 5s. each six months for three years.

Earlier Posting of Commercial Correspondence.—Representations have recently been made to the London Chamber of Commerce both by the Controller of the London Postal Service and by the Union of Post Office Workers with regard to the extra pressure and risk of delay in the transmission of postal matter caused by the accumulation of correspondence in business houses for posting late in the day. The president and chairman of the London Chamber has issued a communication to members suggesting after having made independent inquiry into all the circumstances, so far as practicable, endeavours should be made :—

(1) To post letters as soon as they are ready at intervals during the day.

(2) To arrange for the posting of as much matter as possible at lunch time each day.

(3) To post, especially, printed matter, statements, invoices, &c. (*i.e.*, matter coming within the ½d. rate), before 3 p.m., wherever possible.

(4) To dispatch other bulk matter (*e.g.*, imitation typewritten circulars) in the same way.

(5) To reserve for the late afternoon and evening collections only those letters which cannot be posted earlier.

(6) To avail themselves more largely of the facilities afforded by private posting boxes under arrangement with the postal authorities.

Union of Manufacturers of Electrical Material in Spain.—A union of manufacturers of electrical material has been formed, with headquarters at Barcelona, for the purpose of defending the interests and furthering the development of the industry in Spain. The name of the union is Agrupacion de Constructores de Materiél Eléctrico de Espano, and the President of the Council is Don J. de Guilléo Garcia.—*Reuter's Trade Service* (Madrid).

The Leipzig Fair.—The commercial prosperity of Germany was strikingly shown at the Leipzig Fair. The display of machinery, textiles, porcelain, and other products of German manufacture gave magnificent results. The first day's sales surpassed all expectations. There were 90,000 buyers, among them thousands of foreigners, including 500 from the Balkans, 8,000 from Czecho-Slovakia, and 300 from the United States and England.—*Daily Mail.*

French Lamp Combination.—It is stated that the Compagnie Thomson-Houston and the Compagnie Générale d'Electricité have decided to transfer their various lamp factories to a new French company which is to be formed with the co-operation of the General Electric Co., of New York. The two former companies will possess a large interest in the new undertaking.

Compulsory Trade Unionism.—Fulham Borough Council Electricity and Lighting Committee recommends that all employés under the full control of the Committee be required to be members of a recognised Trade Union, and that it be a condition of employment that a person not already a member of a Trade Union at the time of engagement in or about the Fulham electricity works shall join a recognised Trade Union within a fortnight of such engagement.

Foreign Trade.—February Figures.—The following are the values of imports and exports of electrical goods and machinery in February :—

	February, 1921. £	*Inc. or dec.* £	2 months, 1920. *Inc. or dec.* £
Imports.			
Electrical goods, &c.	217,235	+ 118,529	+ 283,303
Machinery	1,256,862	− 126,567	− 80,628
Electrical machinery	64,062	− 25,258	− 23,258
Exports.			
Electrical goods, &c.	1,123,801	+ 494,554	+1,099,058
Machinery	6,397,929	+3,654,692	+7,981,591
Electrical machinery	392,526	+ 259,800	+ 531,006
Re-exports.			
Electrical goods, &c.	30,042	+ 22,166	+ 41,062
Machinery	94,703	− 9,572	+ 42,838
Electrical machinery	3,187	+ 1,265	+ 7,945

Subsidy v. Unemployment Dole.—A novel proposal is made with a view to restoring the Welsh steel trade, and enabling it to regain foreign markets. Mr. Llewellyn Carter, general secretary of the South Wales section of the National Federation of Blast Furnacemen, has sent a letter to all the Welsh employers urging that steps be immediately taken to obtain Government aid for the iron and steel industry in the task of recapturing lost trade. He proposes that the Government be asked to enable the employers to accept any orders going by providing the difference between the cost of production and the international selling price, this form of temporary subsidy to displace the unemployment dole to the men. Subsidies do not represent the best form of encouraging trade, but as an alternative to unemployment pay they are worth discussion.—*Machinery Market.*

Demand for Machinery in China.—Electrical engineering in China, which since the Armistice has shown signs of considerable development, is at present experiencing a spell of stagnation, says the *North China Daily News*, owing to the recent drops in exchange. While the cost of machinery is about 225 per cent. above pre-war figures, it is only recently that the purchaser in China has suffered from this advance, but to-day, with exchange as low as it is, prices show an increase of something like 100 per cent. in taels. The result is that schemes which were in contemplation, and which would have meant large orders for the electrical engineering works of Great Britain and America, show a very strong tendency to remain in abeyance. There is little doubt that but for the drop in exchange, many of these schemes would have reached a concrete stage. In the case of a great many Chinese undertakings the plant is in urgent need of extension, and not only had these extension schemes been approved, but inquiry for the necessary machinery was afoot. At the same time, projects for entirely new undertakings had been formulated and the capital promised. At the more favourable rates of exchange this capital was perfectly adequate for the acquisition of the required plant, but to-day it is no longer so. As a consequence, many promising schemes appear to have been dropped, even though in some cases the machinery is urgently needed. It is impossible to say what will be the policy of these concerns. Up-country correspondents from time to time have had occasion to comment, for instance, upon the bad quality of electric light supplies by local companies, and while this is, doubtless, largely due to inefficient management and the indifferent care given to machinery, a certain amount is to be debited to overloading. It is to be feared that some such policy may be continued in the meantime, in view of the high cost of plant, but it is none the less certain that this will be only a temporary expedient, and that sooner or later a great number of Chinese concerns must come into the market for machinery. Just now it is impossible to say how long they can hold off, but apparently a first essential to their coming in will be a realisation of the fact that their undertakings will have to be capitalised on a more generous scale than they had previously prepared for.

One feature of engineering which promises to play a prominent part in the future is the suction gas plant. A question which has agitated the Chinese mind considerably is the relative cheapness of coal and of oil as fuel. And here the fact that coal is to be obtained locally, which means that its price is not subject to the vagaries of exchange, is a point which has received a good deal of attention on the part of the Chinese. In the circumstances, the presence of anthracite seems likely to operate in favour of the suction gas plant, the installation of which has already taken place in some cases on a comparatively large scale.—*Reuter's Trade Service* (Shanghai).

Faraday House Testing Laboratories.—During the 32 years of its existence the services of Faraday House (the Electrical Standardising, Testing, and Training Institution, Ltd., 66, Southampton Row, W.C. 1) as a testing institution have been utilised by many more engineers and others than it is convenient to recall. The scope of the work embraces everything that is supplied by the electrical and associated industries, and anyone can ascertain rapidly, for a reasonable fee, whether the machinery, apparatus, or materials he uses are fulfilling their requisite functions. Moreover, the testing department is kept separate from the other branch of the Institution's work; a special staff is engaged, and as the Institution does not engage in trade, it will be appreciated that it occupies a perfectly independent position. Faraday House undertakes, *inter alia*, electrical, mechanical, chemical, photometric, &c., tests; mathematical calculations and investigations are also made in connection with electrical machinery and apparatus, and the laboratories are frequently requested to make tests upon samples by manufacturers or their customers. A wide range of instruments may be hired, or a private workshop rented; advice and assistance is given to inventors, and arrangements can be made for the exhibition of their apparatus or models. Investigations into, and reports upon, inventions and electrical appliances are made, and the laboratories are connected with the public electricity supply mains, from which a constant supply of both d.c. and a.c. at high and low pressures is available; a special set has been installed to supply either single, two, or three-phase energy with a wide range of frequency.

Electrical Goods in South Africa.—In its issue for February 19th, the *South African Mining and Engineering Journal* stated that dealers reported a livelier state of things, and expected within a month to be very busy. Everybody seemed to be much more cheerful, and a more hopeful feeling was existent as to the future. As a result of the elections and the settlement of the labour unrest, many more orders were coming in from the country and other parts of the Union than had been the case for a long while. Prices remained unaltered. Materials were coming in freely, and all lines were well stocked. "Altogether, one gathered the impression that there was now more spirit, more go, in the electrical wares business than has been noticed for some months past."

Exhibition at Gothenburg.—An exhibition is being arranged in Gothenburg, to take place in 1923, in which many arts and industries will find a place. The main object of the exhibition is to illustrate the development of Swedish industry during the past 300 years. Iron and steel products will play a large part in the show.

For Sale.—Glasgow Corporation Tramways Department has for disposal 20 G.E. 52-type 25-h.p. traction motors, and 18 B 13 controllers, with various spares. By direction of the Disposal Board, Messrs. A. T. & E. A. Crow will offer by auction on April 7th, at Lemington-on-Tyne, machinery, tools, electric plant, motors, &c. The Lancashire and Yorkshire Railway Co. have for sale one Yates & Thom compound-vertical engine direct coupled to a 750-kW Dick-Kerr generator, complete with condensing plant, &c. For particulars, see our advertisement pages to-day.

Halifax Corporation Electricity Department invites offers for two Babcock and Wilcox water-tube boilers.

Beckenham Urban District Council Electricity Department has for sale one 120-kW Belliss-Fowler single-phase alternator and exciter.

LIGHTING AND POWER NOTES.

Aberystwyth.—Sale of Undertaking.—The Town Council has agreed, subject to the satisfaction of the Electricity Commissioners as to the position, financially and otherwise, of British Properties, Ltd., to the assignment to this company of the undertaking of the Chiswick Electricity Supply Corporation, Ltd.

Barnes.—Progress of Extensions.—Contracts to the value of £56,069 have been placed by the Urban District Council. The engine room and switch room are nearly completed, and it is hoped to commence the erection of the new generators shortly. The boiler and economiser foundations have been completed, and the boiler makers will soon commence erection. Practically the whole of the coal storage and handling plant has been delivered.

Barrow. — Mains Extensions, &c.— At the Town Council meeting on March 7th, considerable mains extensions were approved. The recommendation to share a cost of £500 as expenses of the joint committee of the proposed Furness, South Cumberland, and Lancaster area electricity committees was approved, the amount being divided between the different authorities in proportion to their rateable values and populations. The meeting approved the recommendation of the General Purposes Committee that the Council retain its membership of the Incorporated Municipal Electrical Association, but decline to be governed by the Association with regard to the salaries of the staff. Approval was also given to the setting up of a works joint committee as soon as possible for the electricity works undertaking, and the town clerk and the borough electrical engineer are to prepare and submit a draft constitution of this committee. With regard to electricity works extensions, the committee reported that the engineer had written to Messrs. Vickers with reference to their power house at Barrow Island, and had not proceeded with the Backbarrow scheme.

Bexley.—Revision of Terms Refused.—The Urban District Council has been endeavouring to obtain a revision of the agreement under which electricity is supplied in bulk to the Foots Cray Electric Supply Co., but the latter has replied that it cannot agree to the Council's proposals, and asks for terms under which the Council would be prepared to supply it in bulk up to 1935. The engineer advises the Council not to enter into such an agreement, and the entire matter has been referred to the clerk for advice. At present the supply to the Foots Cray Co. is maintained at a loss.

Blackpool.—New Supplies.— The electricity department has sufficient service work to keep it busy for three months ahead, and it has been decided not to accept, for the present, applications for supply which involve extensions of mains, or where a supply of gas is already available.

Bo'ness. — Bulk Supply. — To meet the growing demands upon the electricity works, the Town Council has arranged for a bulk supply to be obtained under agreement with the Scottish Central Supply Co., subject to the approval of the Electricity Commissioners, who are to be asked to sanction an expenditure of £20,000 for converting plant.

Bradford.—Direct Labour Decision.—At a City Council meeting it was decided that the work of wiring the Corporation houses being erected by direct labour should be carried out by properly authorised wiring contractors and not by direct labour. Mr. Longley said the 50 electrical wiring contractors in Bradford worked in very harmonious relationship with the electricity department, and there was an honourable agreement that, provided they did not form a ring to keep up prices, the department would not enter into competition with them in trade. He suggested also that the Corporation could not wire houses at the prices at which contractors in the trade could do it. He mentioned that the necessity for this motion arose out of the behaviour of direct-labour, general workmen at the Bradford Moor housing site who threatened to strike when a private firm, by contract, sent its men to do wiring. The Trade Union leaders had had to intervene to prevent a strike. Alderman Barber, secretary of the Trades and Labour Council, protested against what he termed the spirit of the resolution, and said it gave preference to certain sections of the community.

Brandon. — Street Lighting. —The Urban District Council has received a communication from the County of Durham Electrical Power Distribution Co. stating that, as so many contingencies might arise which would have to be provided for, it would be an extremely difficult matter to quote a definite price for converting the present system of street lighting to electric lighting. It was of opinion, however, that the work could be carried out at a cost of between £2,000 to £3,000.

Burton-on-Trent. — New Plant.— After considering the purchase of a second-hand 2,000-kW set, or alternatively a new 5,000-kW set, the Electricity Committee has decided to recommend the latter. This will involve alterations to the station and switch house. The total cost is estimated at £50,930.

Continental. — Spain. — The King has received a deputation which presented to him in the name of the Instituto de Ingenieros Civiles and the first Congress Nacional de Ingeneria, a project for the construction of a national system of distribution of electrical energy prepared by the most eminent technical experts in Spain. It is proposed to contruct a great system covering the whole of the country, the total length of the lines being some 6,500 km. The direction of the lines would be determined by the principal rivers, the great railway lines, in order to facilitate their eventual electrification, and the most important power producing and consuming centres. In this system would be incorporated power derived from water falls and central stations, and the latter could use *in situ* the coal of inferior quality so abundant in the country. Every consumer will be able to find power up to 50,000 kW within a distance of 80 km. The cost of the scheme is reckoned at about 200 million pesetas, which is not a high figure if it is borne in mind that power would be available at practically any point in the country at a price less, perhaps, than five centimos per kWh.—*Reuter's Trade Service* (Madrid).

France.—M. Millerand, President of the Republic, has made his first official journey through France in connection with the great scheme of harnessing the Rhône. He was accompanied by experts from the departments through which the Rhône flows, and the gigantic project was explained to him by means of plans. Speaking at Lyons on March 13th, he expressed the hope that the scheme would contribute in a striking manner to the renaissance of France. This is a tremendous work, and includes the harnessing of the Rhône from the Swiss frontier to the sea, and, when completed, and electrical power is distributed, navigation developed, and huge tracts of land irrigated, it is prophesied that France will have a national equipment which will compensate her for her economic disasters in the war. It is computed that her waterfalls will be able to develop 9,000,000 h.p., the basin of the Rhône alone furnishing 1,700,000, of which 800,000 can be utilised. The undertaking is divided into six sections, and the work, which will begin in 1924, will last six years at most. The cost is put at 2,200,000,000 fr. (about £88,000,000 at normal exchange). Seventeen power stations are planned, and the energy they will produce will be equivalent to that obtained from 6,000,000 tons of coal. From the agricultural point of view over 400,000 acres of land will be put under cultivation, irrigated,-and cleaned, and by the system of harnessing the river it will be possible to begin intensive navigation on the upper reaches, and between Lyons and Arles, thus creating a wide waterway which, with the Rhine, will connect the Mediterranean and the North Sea. Financial experts have pointed out that the annual expenses will exceed by several million francs the receipts, but, on the other hand, it is argued that the indirect advantage to the communes and to the State will make up for the deficit. The State, the towns interested, and certain companies which have obtained concessions will subscribe to the scheme, the State guaranteeing the interest on the money, and eventually participating in the profits. The Swiss Government has given its approval to the project.—*Daily Telegraph.*

Italy.—The plans have been prepared for the development of the waterfalls on the Upper Avisio and the Noce, in the Trentino, which will benefit Malé and the whole of the Valle del Sole. The water gathered by special plant installed at Peio and Cogolo will be impounded in a large reservoir constructed at Pian di Palu, and that drawn by a special plant situated at Pelizzano and at Malé will be stored in a second great reservoir at Pelizzano and Mezzana. Whole fields, meadows, and woods will be displaced to make room for these two storage lakes. An idea of the extent of the works may be obtained from the fact that the Pian di Palu reservoir will have a volume of 38,000,000 cb. metres and an area of 900,000 square metres. It is estimated that the scheme will yield from 150,000 to 180,000 h.p. of electrical energy.

Czecho-Slovakia.—A Bill introduced into the Parliament of the Czechoslovak Republic proposing to tax hydro-electric undertakings has called forth the liveliest opposition from owners of these undertakings. Public meetings have been held, and a memorial has been forwarded to the Government. The introduction of such a tax, the memorialists declare, is most harmful, particularly at a time when, owing to the coal famine, the development of the country's water resources is most urgently required in the interest of national welfare. The amount of the proposed tax cannot be justified, and its effect will be injurious to the many struggling industries of the country. Should the tax be persisted in, the memorial asks for a drastic revision of its amount of incidence by an official Commission to be appointed for the purpose. The Government's proposal was a flat rate of 10 heller per h.p., and the memorialists submit the following modifications :—(1) Total remission of the tax in the case of saw and paper mills, &c., where its imposition would mean the stoppage of such undertakings ; (2) a tax of $\frac{1}{2}$ heller on undertakings with extraordinarily high foundation and working costs ; (3) a tax of $\frac{3}{4}$ for undertakings with more than normal building and working costs ; (4) a tax of 1 heller per h.p. on undertakings with normal building and working costs. Certain other stipulations are also put forward.—*Trva.*

Dundalk.—Loan. — The manager of the electricity department reported to his Committee that a further loan of £2,000 would be required to meet the liabilities due in respect of new cable and services, a new cooling tower, &c. The Urban Council approved of the recommendation.

East Africa.—Dar-es-Salaam.—Progress is being made with Dar-es-Salaam's electric lighting scheme, which includes the completion of a large new power station and the relaying of the main supply lines with necessary feeders and network boxes to facilitate testing and maintenance.—*British and South African Export Gazette.*

Electricity District. — North-East Midlands.—The Electricity Commissioners give notice that they have further extended the time within which objections and representations in connection with the above-named district may be made from the last day of this month to June 30th, 1921.

Falmouth.—Bulk Supply Negotiations.—The Town Council has decided not to transfer its electric lighting powers to Messrs. Herd & Smith, Ltd. The Council is negotiating with the Cornwall Electric Power Co. for a bulk supply.

India.—Extensions at Pondicherry.—H.M. Consul at Pondicherry (Captain H. G. Tranchell) has informed the Department of Overseas Trade that the sum of 65,000 rupees has been voted by the Conseil Général of that place for repairs and new machinery in the municipal electricity works. H.M. Consul states that probably most of the equipment will be obtained from Madras or Bombay.

Japan.—Semi-Official Scheme Deferred.—It is stated that the Government has decided to give up for the present the proposal to organise a semi-official electric power company in view of the antagonism shown to the scheme, and the possible financial difficulties involved. The railway authorities, however, will go on with their electrification programme, which has been already drawn up, and will build a power station on the Shinano River at a cost of 500,000,000 yen.—*Reuter's Trade Service* (Tokio).

Kingstone.—Erection of Poles Banned.—The Urban District Council has declined to allow Mr. J. H. Langston to erect electric light standards in the town, as the scheme of the Hereford Town Council already has been supported. The Council has asked Hereford when the scheme is to be carried out.

Lancaster.—Proposed Supply to Morecambe.—At a meeting of the Lancaster Town Council it was reported that Morecambe Corporation had intimated that, as both authorities desired to extend their electricity undertakings, the Commissioners had suggested a conference of the two bodies, with a view to arranging a scheme for the extension of one of the works to enable both boroughs, and possibly neighbouring townships, to be supplied therefrom. Morecambe offered to take a supply of 400,000 units per annum from any such extension of the Lancaster works. The meeting approved the appointment of a Sub-Committee of the Electricity Committee to meet the Morecambe representatives.

Lincoln. — Proposed Price Increase. — The Town Council has applied for permission to increase the price of electricity from 8d. to 1s. per unit, and the quarterly minimum payment from 13s. 4d. for 20 units to 15s. for 15.

Malvern.—Proposed Electricity Supply.—The Gas and Electricity Committee is arranging an interview with the Shropshire, Worcestershire, and Staffordshire Power Co. to discuss the question of terms under which the company would be prepared to supply the Malvern district.

Paisley. — Supply Negotiations Ended. — Messrs. J. & P. Coats, Ltd., have decided to extend their own electricity generating station at Ferguslie Thread Mills rather than purchase a supply from an outside source. The decision brings to a close protracted negotiations between the firm and several local electricity supply authorities, including Paisley Corporation.

Plymouth.—Loan Sanctioned.—At a meeting of the Electricity Committee, the town clerk reported that the Electricity Commissioners had sanctioned the borrowing of the sum of £20,000 for a period of 20 years for the purposes of a new converter, switchboard, switchgear, &c.

Newcastle.—Reduced Lighting.—In an endeavour to reduce costs the Lighting Committee has decided to reduce the city lighting by 40 per cent.

Rotherham. — Proposed Lease of Station.—At a meeting of the Electricity Committee the town clerk submitted a letter from the Yorkshire Electric Power Co. asking whether the Corporation would be prepared to lease its new power station to the company, subject to a provision ensuring the Corporation a supply for customers in its area. The Committee recommended that the application be not entertained.

Runcorn.—United Alkali Co.'s Power Station.—The new power station of the United Alkali Co., at Runcorn, is a fine modern building designed to house four 5,000-kW sets, two of which are already installed. The Metropolitan-Vickers Co. supplied the h.p. switchgear of the cellular type with duplicate bus-bars for controlling the main generators and feeders. Eight of the 12 Babcock & Wilcox water-tube boilers are in commission, each being designed to produce 25,000 lb. of steam per hour at a pressure of 220 lb. per sq. in.

Sheffield.—Proposed Price Reduction.—Owing to the realisation of a substantial profit upon the undertaking, the general manager of the electricity department recommends that the increase of 150 per cent. upon all supplies at the price of 2d. per unit and under, put into force as from last September, shall be reduced to 125 per cent. as from the December meter readings.

Stafford.—Loan.—At the monthly meeting of the Town Council, the Finance Committee reported that the borrowing of a further £33,800 had been sanctioned, in respect of the Council's application for £78,000 for the extension of the electricity works.

Steyning.— Special Order.— The Steyning Electric Light Co., Ltd., is applying to the Electricity Commissioners for a special order authorising the company to generate and supply electricity within the parishes of Steyning, Bramber and Beeding.

Sunderland.—Price Increase Deferred.—The Town Council has declined to sanction an increase in the tariff of the low-pressure network, as proposed by the Electricity Committee. The matter was referred back to the Committee with an instruction to circulate a detailed financial statement in support of the increases. The chairman of the Committee stated that during the past few months they had spent about £23,000 in connection with the low pressure supply, and a further £17,000 would be spent in the course of the next two years for necessary upkeep. Wages had recently gone up by £1,800, and the Committee felt that the consumer should pay for what he used rather than that the ratepayers should subsidise the supply.

Taunton.—Loan.—The Town Council has applied for a loan of £1,000 for meters, principally for 200 new houses being built.

Walsall.—Large Mains Extension.—The Electric Supply Committee proposes to make an extension of mains to Messrs. Harrison's No. 3 pit at Wyrley, at a cost of £14,250.

Whitehaven.—Loan.—The Town Council has applied for a loan of £1,420 for the purpose of supplying electricity to Kells, where there are 180 prospective consumers.

Worcester.—Electric Light for Houses.—At a recent meeting the City Council had before it the question of lighting 150 houses, being built under the housing scheme. It was moved that the laying of electricity mains should be suspended and gas lighting should be installed. An amendment that the houses should be lighted electrically was carried after some discussion.

York.—COUNTY COUNCIL AND PROPOSED STATION.—The Agricultural Committee of the West Riding County Council reports that it has considered the proposals of the York Corporation to erect a power station at Linton Lock, and is advised that the proposals as they now stand would be detrimental to the interests of draining agricultural land and this view has been placed before the Corporation with a view to such proposals being modified to safeguard the interests of the agricultural community.

TRAMWAY AND RAILWAY NOTES.

Australia.—PROPOSED TOOWOOMBA TRAMWAYS.—The second report of the consulting engineer on the proposed system of tramways for Toowoomba was on practically the same lines as the previous one, with the addition of a recommendation that a transmission line be constructed from Ipswich to Toowoomba to carry electric power from Brisbane, in preference to the establishment of the Council's own power house, as the cost of power secured from Brisbane would be considerably less. The cost of the tramway is estimated at £147,184, and the transmission line, substations and apparatus at £73,827, making a total of £221,011.—*Tenders.*

Barrow.—INQUIRY.—At the Town Hall, on March 10th, Mr. J. C. Dawes, O.B.E., one of the inspectors of the Ministry of Health, held an inquiry into the application of the Town Council to borrow the sum of £6,650 for the purchase of four electric vehicles for use in connection with the disposal of house refuse. Evidence was given as to the financial position of the borough, and it was pointed out that two motor vehicles were at present in use, in addition to 12 horses and carts, for the removal of house refuse. It was proposed to have the four electric motor wagons, to dispense with 10 horses and carts, the cost per ton being about 1s. 1d. less. The Corporation possessed a garage sufficiently large to accommodate the additional motor wagons, but would have to install further electric charging apparatus, which, with the adaptation of the building, was estimated to cost £810, which was included in the amount required. There was no opposition, and the inquiry was concluded.

LOSS ON TRAMWAYS.—At the Town Council meeting on March 7th, the chairman of the Electric Tramways Committee moved the adoption of the minutes showing that the estimated loss on the undertaking for the 15 months ending March 31st next, during which time the Corporation had been the owners, was £15,680, which was equal to a rate of 9d. in the £. In a long statement the chairman took the Council back to the time when the Corporation entered into negotiation with the British Electric Traction Co., pointing out that the system was electrified in 1904, and provision was made for the purchase on clearly defined lines at the end of 7, 14, or 21 years. The matter was considered at the end of the first seven years, and, after receiving reports from the Corporation officers, no action was taken. At the beginning of 1919 an agitation arose amongst a certain number of the inhabitants of the town, and they pressed the Corporation to acquire the undertaking. The reports of the officers inspecting the system recommended the Corporation to take advantage of its powers, and purchase, as they considered the capital cost to the Corporation would be much less than it would be under the provisions of the agreement at the end of 21 years. This advice the Council followed, and the undertaking was purchased as from January 1st, 1920, for the sum of £96,250.

The Committee regretted having had to increase the fares, and now having to make this heavy demand upon the ratepayers, but it felt it was the only satisfactory course to follow. The alternative would be to carry the deficit forward in the hope of making it good in future years, but in view of the uncertainty with regard to tramway finance, it considered these initial losses should be dealt with now.

Bradford.—ONE-MAN CARS.—Though the Ministry of Transport recently rejected the Bradford Corporation's application for power to build a number of additional double-deck railless cars to replace the existing railed service on three routes—the idea being to economise by avoiding the relaying of the lines—sanction has been secured to the reconstruction of the city's railless car service, so that the cars can be run by one man per car. This, of course, will effect a great saving, and it is hoped that it will make the railless cars a paying concern. Hitherto they have been worked at a loss because they are not big enough to carry the number of passengers necessary to enable them to pay whilst requiring two men. The railless system, advantageous as it is in many ways, lost £8,000 last year. The work of reconstruction is to be commenced immediately. The new design will be such that passengers will enter and leave by the front platform, paying their fares to the driver.

BELGIAN CONTRACT.—On the adoption of the Tramways Committee's minutes, at a recent meeting of the City Council, the chairman of the Committee, in reply to questions, agreed that a tender had been accepted from a Belgian firm for acid steel tramway tires, but the firm had written subsequently saying they had made a mistake, and their quotation had been for basic steel. The contract had not been re-let to the Belgian firm, and would not be until the matter came before the Committee and the Council. It may be remembered that there was a good deal of controversy locally over this letting of a contract to a foreign competitor of British firms which tendered, and whose quotations were considerably higher.

Brampton (Cumberland).—SURVEY FOR TRAMWAY ROUTE.—The Cockermouth Electric Power Co. has commenced a survey of the route from Cockermouth to Southwaite, Wreay, Wetheral, and Brampton, in connection with a proposed electric tramway, and with a view to supplying electricity to Brampton and the villages *en route.*

Burnley.—SPECIAL RATE.—The Finance Committee, on March 10th, decided to levy a special rate of 5d. in the £ for the Corporation tramways, which last year showed a loss of £12,000.

Huddersfield.—TRAMWAY DEVELOPMENTS.—Substantial development schemes in local constructional work are in contemplation by the Tramways Committee. When the new depôt at Longroyd Bridge is completed, it is intended to build tramcars locally.

L. and Y. Railway.—PROJECTED ELECTRIFICATION.—The reconstruction and electrification of the whole of the line on the Lancashire and Yorkshire system between Southport and Ormskirk is under consideration. This information was given by Mr. Edgely, when reporting to the Lathom and Burscough Urban District Council, on the result of a deputation to Mr. Ashton Davies, passenger superintendent of the L. & Y. Railway, asking for certain improvements. When the proposed scheme has been carried out, it will mean that there will be a complete circuit of electric railway from Liverpool along the coast line through Formby, returning *via* Blowick, Burscough and Ormskirk, where it will link with the present electrified line from Liverpool to Ormskirk.

Leeds.—NEW TRAMWAY.—The new tramway and road-widening scheme for Roundhay Road, under which it is intended to build a special tramway road separate from ordinary traffic, is estimated to cost £26,650, and will provide a great deal of work for the unemployed. In favour of the scheme it has been argued that the cost of relaying the tramway rails on the existing road would be £28,000, so that the Committee claims it will save £2,000, provide work for the unemployed, and secure a very important roadway and traffic improvement.

London.—CONDUCTOR'S POWER TO ARREST.—It was stated in a case at Old Street Police Court on March 12th that a tramcar conductor had power under the Tramways Act to arrest a passenger. In the case in question it was suggested that the conductor was not arresting but merely detaining a drunk and disorderly passenger until he could call a constable. The Magistrate said the section of the Act referred to seemed to cover power of arrest.—*Morning Post.*

Paisley.—PROPOSED SALE OF SYSTEM.—The Glasgow Tramways Committee has received a letter from the Paisley District Tramways Co. intimating the latter's readiness to negotiate for the sale of the tramways to the Glasgow Corporation.

Portmadoc.—LIGHT RAILWAY APPROVED.—At a meeting of the Portmadoc Urban District Council it was stated that the construction of the proposed light railway from Carnarvon to Portmadoc, *via* Beddgelert, had been approved by the Government.

Sunderland.—RESULT OF THROUGH RUNNING.—At a recent meeting of the Town Council the chairman of the Tramways Committee (Ald. G. New) presented a report on the experience gained so far in the new system of through running by the District Co.'s cars over the Corporation route from Grangetown to the centre of the town. He stated that if through running was continued it would result in a loss to the Corporation on the Grangetown route of £4,000 per annum. The Council decided that consideration of the matter should be adjourned pending the issue of a detailed statement to the members.

Wolverhampton.—PROPOSED FARE INCREASE.—The Corporation has decided to apply for permission to raise the fares on its tramway system, owing to the losses which have occurred under the present rates. The application requires the substitution of a maximum of 1½d. per mile for the existing maximum of 1d. per mile.

TELEGRAPH AND TELEPHONE NOTES.

A New Automatic Telephone.—The L.M. Ericsson Telephone Co., of Stockholm, has held a demonstration of a new automatic telephone exchange on the Hultman-Ericsson system, which has been perfected after experiments extending over seven or eight years. By the new system, operators are entirely eliminated, and every subscriber, by a simple manipulation, can obtain connection with any number desired. Large orders for installations of the new exchange are being obtained from abroad; among others, one has been obtained from Rotterdam for an exchange to serve 5,000 subscribers.—*Reuter's Trade Service* (Stockholm).

Bulgaria.—PRESS TELEGRAMS.—After March 15th, Press telegrams will be accepted between the hours of 6 p.m. and 9 a.m. for transmission between the United Kingdom and Bulgaria at the rate of 2½d. per word, with a minimum charge of 10d. per telegram, says *The Times.*

India.—Cable Rates.—Cable rates from India to Europe will be increased, as from April 1st, from 1s. 6d. to 1s. 8d. per word, says *The Times*.

Telephone Service.—Select Committee.—On the 9th inst. Col. Gibbs, one of the Government Whips, placed on the order paper of the House of Commons a motion for the appointment of the Select Committee to inquire into the organisation and administration of the telephone service and the method of making charges; the Committee to have power to appoint from outside its own body such persons as it may think fit for the purpose of obtaining special expert or scientific information or advice upon the subject matter of its order of reference. The following is a list of the members proposed for appointment to the Committee:—Mr. Evelyn Cecil, chairman, Major Evan Hayward, Mr. John Hodge, Mr. Gerald Hohler, Mr. J. Stanley Holmes, Gen. Sir Archibald Hunter, Sir Evan Jones, Mr. Robert Lynn, Mr. W. Lane-Mitchell, Capt. A. H. Moreing, Mr. W. G. Perring, Mr. Alexander Richardson, Mr. A. K. Rodger, Mr. W. S. Royce, and Mr. A. E. Waterson. The Committee met for the first time on Tuesday, and the inquiry is to be conducted in public.

Night Service for Motorists.—The Automobile Association has installed over 50 sentry boxes along the main roads of the country, in which are fitted telephones for the use of members. During the past 18 months members have been provided with special keys, enabling them to open the boxes and use the telephones at night time, after the A.A. road patrol in charge has gone off duty. To enable members more easily to locate these telephones after dark, the Association, says the *Manchester Guardian*, has for some months past experimented with systems of illumination. The first roadside telephone box to be illuminated is that situated on the Epsom Road, near Ashstead. The Association has decided similarly to illuminate the telephone signs attached to all the roadside telephone boxes, except where the boxes are well indicated by public lighting services.

New Exchange.—Following the inauguration of the new Langham exchange, as reported in our last issue, subscribers on the old National system connected to the Redhill exchange were on the 12th inst. transferred to an exchange with up-to-date magneto equipment. The change, says *The Times*, is in pursuance of the policy of reconstruction being carried on in almost all the outer London exchanges, many of which are being practically rebuilt and improved by the addition of new lines.

Trans-Atlantic Cable Purchase.—Speaking on a vote for £2,672,500 for salaries and expenses of the Post Office, including telegraphs and telephones, in the House of Commons on March 14th, Mr. Pike Pease (the Assistant Postmaster-General), said the Government had purchased from the Direct United States Cable Co., at a cost of £570,000, a trans-Atlantic cable, for the purpose of coping with additional Imperial traffic, and to provide an alternative line in case of interruption of the Imperial cable owned by the Government. The purchase price included a stock of cable and cable stations at Ballinskelligs, Harbour Grace (Newfoundland), and Rye Beach (United States). To lay a new cable would have cost about £1,000,000. The cable was transferred to the Post Office on November 4th last. Laid originally in 1874-5, one-half of it had since been replaced by new cable. The total length was 3,197 miles.—*Daily Telegraph*.

Turkey.—Wireless Telegraphy.—It is reported that the Société Radio-Télégraphique Parisienne is negotiating with the Imperial Ottoman Bank with a view to the establishment of a wireless post on the bank premises. The same company has offered to buy the building now used as a police station at Galata Sari in the centre of Pera, which belongs to the Ministry of Finance.—*Reuter's Trade Service* (Constantinople).

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—April 27th. Victorian Railway Commissioners, Spencer Street. Caustic soda primary cells, complete (Contract No. 33,914).*

May 2nd. Victorian Railway Commissioners. Twelve miles of ·015 sq. in. two-core, lead-sheathed, wire-armoured, 2,200-V cable.*

June 22nd. Victorian Railways. One electric lifting magnet (capacity ½ ton), one 440-V motor generator.

June 29th. Supply of 1-ton platform type industrial storage battery trucks, also battery charging equipment.—*Reuter's Trade Service* (Melbourne).

Brisbane.—March 30th. P.M.G.'s Department. Switchboard apparatus and parts.*

Morwell Power Scheme. The Electricity Commissioners of Victoria have made certain alterations, alternatives with additions, to the specifications which will necessitate tenderers cabling any consequent amendments of their tenders before March 31st. See our advertisement pages to-day for further particulars.

Bedford.—March 31st. Electricity Department. Electricity meters, h.p. and l.p. cables, for 12 months. (See this issue.)

Belfast.—April 25th. Electricity Department. E.h.p. and l.p. switchgear. (See this issue.)

Belgium.—March 23rd and April 6th. The Société Nationale des Chemins de Fer Vicinaux, 14, Rue de la Science, Brussels. Laying of the underground armoured cables required in connection with the supply of electricity to the Brussels-Haecht line and the lines in the Louvain section. Particulars can be obtained for 3 francs from the Services Electriques, 48, Rue Montoyer, Brussels.

Belgrade.—May 1st. The Serb, Croat, and Slovene Ministry of Public Works. Erection of a power-station, main conductors and transforming stations in connection with an electrical scheme at Kostolac for the supply of energy to Belgrade, Semlin, &c.*

Dundee.—March 26th. Tramway Department. Twelve months' stores, including insulated wire, lamps, switches, and overhead equipment. The Manager.

East Ham.—April 2nd. Electricity Department. L.p. paper-insulated, lead-covered, armoured concentric cable, with necessary joint boxes, &c.; also two c.i. lighting feeder pillars. (See this issue.)

France.—April 5th. The French State Railway authorities, 43, Rue de Rome, Paris. Supply of four 8-ton electric travelling cranes for the new railway workshops at Sotteville-Quatre-Mares, Rens. Particulars may be obtained from the Services Electriques (1st Division) at the above address.

Halifax.—March 23rd. The Board of Guardians. Electrical fittings required during the six months ending September 30th next. Mr. A. T. Longbottom, Clerk, Union Offices, Carlton Street, Halifax.

Liverpool.—March 19th. Electrical supplies for West Derby Union. Mr. H. P. Cleaver, Union Clerk, Union Offices, Brougham Place, Liverpool.

London.—H.M. Office of Works. April 12th. Supply of electrical labour-in-daywork in the Leeds district. (See this issue.)

Manchester.—April 7th. Electricity Committee. High-pressure steam and water valves; high-pressure steam and water pipes, steam receivers, &c.; weighbridges and automatic coal-weighing machines; electric and hand-operated cranes. (March 11th.)

March 21st. L. & Y. Rly. Co. Six months' supplies of stores, including signal, telegraph and electric fittings, and signal, telegraph and electric light wires. Specification from Mr. Sharp, Stores Department, Osborne Street, Manchester.

Perth.—March 21st. Electricity Department. One 1,000-kW, d.c., geared turbo-generator, with condensing plant. (March 4th.)

Runcorn.—March 19th. Castner-Kellner Alkali Co., Ltd. Construction of light railway and sidings to connect its works with the L. & N.W. Rly. Co.'s Runcorn Dock branch. Lt.-Col. H. F. Stephens, engineer to the company, 23, Salford Terrace, Tonbridge, Kent.

South Africa.—Pretoria.—May 10th. Municipality. Switchgear. Tenders, marked "Electric Light and Power Department, 1920 Extensions, Contract No. 5," to Deputy Town Clerk, Municipal Offices, Pretoria, on May 10th. Deposit, five guineas. Further particulars may be obtained from the general manager of the Electric Light and Power Department, or from the consulting engineer, Mr. G. M. Clark, 40-42, Meischkel's Buildings, Johannesburg.

Johannesburg.—March 30th. Municipal Council. Forty 50-h.p., 500 to 600-V tramcar motors. Tenders to Town Clerk, Municipal Offices, Johannesburg.*

Uruguay.—Monte Video.—March 29th. State Power House. Single and three-phase meters.*

Wimbledon.—March 29th. Electricity Department. Annual contracts for cables and conduits, joint boxes and jointing materials, transformers, meters, &c., lubricating oils. (March 11th.)

Worksop.—April 6th. Electricity Committee. E.h.p. and l.p. cables; e.h.p. and l.p. switchgear; transformers; 500-kW rotary or motor converter. (March 11th.)

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Belgium.—Ten firms submitted tenders on March 1st to the municipal authorities of Antwerp for the supply and erection of an electrically-operated pump for the No. 7 dry dock at the Lefebvre basin. The lowest offer, 21,645 fr., was that of the Société de Construction Electrique de Belgique, of Brussels.

London.—L.C.C.—Highways Committee. Accepted.

10,000 track insulators.

Bullers, Ltd. (accepted)	£637 10	per 1,000
Park Royal Engineering Works, Ltd.	687 10	,,
,, ,, ,, ,, ,, alternative ..	675 0	,,
R. A. Bradshaw & Son	825 0	,,

HAMMERSMITH.—Electricity Committee :—

Air-cooler for use in connection with the 10,000-kW turbo-alternator, £1,175.—C. A. Parsons & Co., Ltd. (recommended).
Boiler feed-pump, £293.—G. & J. Weir, Ltd. (accepted).
2,000 yd. ·05 sq. in. and 500 yd. ·2 sq. in. l.p. cable, £834.—Hackbridge Cable Co., Ltd. (recommended).

Sheffield.—The Corporation has placed an order with the Leeds Steel Works for 1,000 tons of rails for the tramways at £24 per ton.

Sunderland.—Corporation.

House service cable.—Enfield Ediswan Cable Works, Ltd.
Section pillars.—Henley's Telegraph Works, Ltd.
E h p. switchgear.—Ferguson, Pailin & Co., Ltd.
E.h.p. joint boxes.—W. G. Farrow.

Tramways Department :—

Radial truck, £90.—J. G. Brill Co.

Weymouth.—Town Council.

Worthington-Simpson, Ltd.—Air and force pumps for turbine, £794.
A. Curtis.—Electric welding repairs to boiler, £88.

Wolverhampton.—Electricity Committee.

E.h.p. and l.p. cables for 12 months.—Callender's Cable and Construction Co., Ltd.
Repairs to transformer, £228.—British Electric Transformer Co., Ltd.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, March 18th. At the Institution, Storey's Gate, S.W. At 6 p.m. Paper on "Contact Pressures and Stresses," by Prof. E. G. Coker, F.R.S., Mr. K. C. Chakko and Mr. M. S. Ahmed.

Royal Institution of Great Britain.—Saturday, March 19th. At Albemarle Street, W. At 3 p.m. Lecture on " "Electricity and Matter," by Sir E. Rutherford, F.R.S. (Lecture III.) ;

Royal Society of Arts.—Monday, March 21st. At John Street, Adelphi, W.C. At 8 p.m. Cantor Lecture : "X-Rays and their Industrial Applications," by Major G. W. C. Kaye.

Faraday Society.—Tuesday, March 22nd. At Burlington House, Piccadilly W. At 8 p.m. Ordinary meeting.

Institution of Electrical Engineers.—

Liverpool Sub-Centre.—Monday, March 21st. At the University, Liverpool. At 7 p.m. Paper on "Electric Driving in the Paper Mill on Heat-economy Lines," by Mr. A. B. Mallinson.

North-Western Centre. — Tuesday, March 22nd. At the Engineers' Club. At 7 p.m. Paper on "The Long-Distance Telephone System of the United Kingdom," by Sir William Noble.

South-Midland Centre (Students' Section).—Tuesday, March 22nd. At the University, Birmingham. At 7.30 p.m. Paper on "Prime Movers in Small Power Stations," by Mr. H. E. D. Carter.

Institution of Engineers and Shipbuilders in Scotland. — Tuesday, March 22nd. At 39, Elmbank Crescent, Glasgow. At 7.30 p.m. Paper on "The Dalmarnock Power Station," by Mr. R. B. Mitchell.

Institute of Railway Signal Engineers (Incorp.).—Wednesday, March 23rd. At the Midland Grand Hotel, St. Pancras, N.W. At 6 p.m. Paper on "Fundamental Calculations of A.C Track Circuits," by Mr. D. C. Gall.

Manchester Wireless Society. — Thursday, March 24th. At the Manchester College of Technology, Sackville Street. At 7.30 p.m. Lecture on "Direction Finding," by Mr. J. Hollingworth.

Edinburgh Electrical Society.—Friday, March 25th. At the Philosophical Institute. At 8 p.m. Paper on "Automatic Telephones," by Mr. W. Leithead.

Manchester Association of Engineers. — Saturday, March 26th. At the Memorial Hall, Albert Square. At 7 p.m. Annual general meeting. Paper on "Fire Extinguishment by Mechanical and Other Means, including Sprinkler Installations," by Mr. J. T. Clarke.

NOTES.

Electrolytic Calcium.—At the annual general meeting of the Institute of Metals, on March 9th, a paper was read by Mr. P. H. Brace, of East Pittsburg, U.S.A., in which he gave a brief historical survey of the development of the metallurgy of calcium and described a type of apparatus developed by him for the manufacture of the metal, which is obtained by the electrolysis of fused calcium chloride. The electrolyte is first melted by means of an alternating current ; when a small pool has been formed, direct current is switched on, and as the metal deposits on the cathode, the latter is slowly withdrawn from the bath. Further deposition takes place on this calcium, which itself is withdrawn at such a speed that a continuous rod of the metal is formed. A summary of the more important uses of calcium, including the preparation of certain aluminium alloys, is given in the paper.

Directional Wireless at Sea.—Marconi's Wireless Telegraph Co., Ltd., has brought to our notice the case of the crew of the British steamship *Fanad Head* which was recently instrumental in rescuing the personnel of the Norwegian steamer *Ontaneda* in the North Atlantic, off Newfoundland, when all hands would have been lost but for the use of the new wireless direction-finding apparatus. A heavy gale had left the *Ontaneda* drifting helplessly with broken-down engines, and a list of 50° in a heavy sea. Her captain sent out "S O S" signals for help, but in the thick weather he could get no observations of sun or stars, and had to estimate his position by dead reckoning. His calculations proved to be 90 miles out. Whilst several vessels which went to his assistance were steaming about near the position given without finding a trace of the *Ontaneda*, the *Fanad Head*, by means of her Marconi direction-finder, discovered the true position of the doomed vessel. She was nearer to the *Fanad Head* than to the ships which had originally steamed to her assistance, and Captain Finlay proceeded to the spot where he calculated the *Ontaneda* to be. The wireless direction proved to be the correct one, and the distressed sailors were rescued just in time.

Safety First !—According to the N.E.L.A. *Bulletin*, the Safety Committee of the Northern States Power Co. of Minneapolis is waging a vigorous campaign in the interests of safety. The Committee is not only bringing the attention of the employés to the dangers which exist in their work, but is also drawing attention to risks encountered while going to and from work and ways of guarding against them. Bulletins are issued each month to drive the safety message home to the employés. One of these gives the following :—

FAMOUS LAST WORDS.

"I wonder if it's alive ? I'll touch it and see."

"Listen ! That's the train whistle. Step on it and we'll try to get across."

"They say these things can't explode. I'm safe lighting this match."

"I wonder whether this rope will hold my weight ?"

"I don't need rubber gloves to pull this dead wire out."

Problems of Unemployment.—In the *Journal* of the Royal Society of Arts for March 11th a paper on this subject, which was read before the Society on February 8th, by Mr. E. C. de Segundo, A.M Inst.C.E., is printed.

The author points out that the problem of unemployment has descended to us from the remotest antiquity, and is of world-wide interest ; every country is vitally in need of commodities which it cannot produce, yet unemployment threatens to increase throughout the whole world, except in Germany. Capital and Labour are in themselves inert (though necessary) factors in the production of wealth ; the vitalising factor is directive ability, which is a form of capital owned by every intelligent being. Present-day unemployment is due to the rise of prices of commodities beyond the purchasing power of consumers, and increase of production will not, of itself, reduce our unemployment—the commodities produced must be offered at a price that will compete with that at which other producers offer them. The author condemns the continuance of the E.P.D. after the war as a disastrous error on the part of the Government, which led to economic instability and withdrawal of credit from industry.

Labour also is to blame for lack of foresight, and the discouragement of efficiency. Incidentally, the author points out that "a tax of 6s. in the £ on *earned* income is virtually the equivalent of *two days' forced labour per week*." Key industries should be permanently protected from foreign competition, and research should be encouraged. With regard to the reform of social conditions, while Socialism is a beautiful ideal, it has always failed in practice ; the only thing that will prevent social disintegration is the more rigid observance of the moral law, which should be inculcated by a rational system of education. Both workers and employers have failed to appreciate the situation, and the remedy for their failure lies in their getting to know one another better. Every worker, in whatever class, should first qualify as a citizen ; he should be rewarded in proportion to the services he renders, and the scale of remuneration should be based upon the character, as well as the extent, of his services ; these conditions fulfilled, the industrial army is analogous to the military army, and should be maintained during slack periods by some form of insurance ; but this industrial army should be confined to *British* working men. The Trade Unions should insist upon the maintenance of a proper standard of efficiency, ability, and moral character as a condition precedent to membership. To cope with the perils of the day, we should disperse the atmosphere of mistrust between employer and employed ; condemn the abuse of confidence in trade ; enforce the law against perjury ; and foster the dissemination of sound, healthy moral principle.

In the discussion, the chairman (Mr. G. J. Wardle) pointed out that the author's proposed "industrial army" constituted a revolution in industry—a revolution which the Labour Party had proposed in the "Right to Work" Bill.

Mr. John Baker denied that Labour had abused its power with regard to wages during the war ; prices went up, and wages followed prices.

Prof. J. A. Todd ascribed the trade slump to the beginning of the fall in prices a year ago, which caused consumers to hold back for a further fall. The "industrial army" system opened the door to obvious abuses. Mutual knowledge between employer and employed would go far towards producing a friendly settlement.

Educational.—Prof. J. A. Fleming, M.A., D.Sc., F.R.S., is to deliver a course of six lectures, commencing on April 27th, on "Wireless Telegraphy and Telephony by Continuous Waves." The lectures are to be given at University College, London, and the course is open to both members and non-members of the University. The fee is two guineas, and tickets can be obtained from Dr. W. W. Seton, University College, Gower Street, W.C. 1.

New Electrical Caulking Apparatus.—M. Gunnar Nord, the Stockholm shipbuilder, has invented a new electrical apparatus for caulking ships and houses, which carries out the work entirely automatically and in a tenth or fifteenth part of the time required to perform the same operation by manual labour. The invention is being exploited by the Stockholm lawyer, M. Herman Sundins.—*Reuter's Trade Service* (Stockholm).

Water Power in Italy.—Under the auspices of the University of London, a series of six advanced lectures is being delivered by Prof. Luigi Luiggi, D.Sc., M.Inst.C.E. (Professor of Hydraulic Construction in the University of Rome), upon "Recent Engineering Works in Italy." On March 11th the lecture was devoted to a description of hydro-electric construction. Prof. Luiggi said that prior to the war the aim of Italian hydro-electric engineers was to secure large volumes of water rather than high heads. During and since the war, however, the necessity for economising in materials led to the adoption of higher pressures and the use of smaller pipes and turbines. To-day, heads of 2,500 ft. were of common occurrence, and there were many installations in which a head of 3,000 ft. was in use. Hydro-electric plants, in the face of low interest obtained from Government bonds, &c., were considered a good and sound investment yielding 6 or 7 per cent. regularly. Hydro-electric power was an absolute necessity to the economic life of Italy, owing to the price of coal being from 15 to 20 times the pre-war rate. Most coal-using works, blast furnaces, &c., had been forced to shut down, and this led to the reaping of a rich harvest by users of electric furnaces. The lecturer gave numerous details regarding the rainfall and other factors in various districts of Italy, and described the construction of canals, dams, and pipe lines, illustrating his remarks with a large number of excellent lantern slides. Apart from their efficiency, these works conform to the canons of architecture; as the speaker said, when millions of lire have been spent upon construction, the engineers feel that the expenditure of another half-a-million lire, to secure a certain amount of beauty, is not waste.

The lectures, which are being held at the Institution of Civil Engineers, conclude to-day.

The Proposed Engineers' Club for London.—Since the meeting of the Provisional Committee on February 10th, the Executive Committee which was then appointed has been considering the questions of rules and membership, housing and finance, with a view to placing concrete proposals before a general meeting of the supporters of the scheme, which will be convened when the Committee's report is ready. In the meantime there is no slackening in the interest manifested in the subject by prospective members; the number of applications received by Mr. Edmund L. Hill, hon. secretary (39, St. James's Street, S.W.1), has long passed the thousand mark. It is very desirable, for the guidance of the Committee, that everyone who contemplates joining the Club should signify his intention as soon as possible. A provisional application form has been printed, and is being widely distributed; we suggest that those who intend to become members should each obtain a supply of these from the hon. secretary, with a view to securing the adhesion of their engineering friends to the scheme.

Hydro-Electrotechnics in France.—The city of Toulouse has signed an agreement with the University to place at the disposal of the latter the falls of the Baulève on the Garonne; a large area of land near the Castle has also been placed at the disposition of the University for the purpose of setting up a hydraulic industrial laboratory. The building will be erected so as to serve as a permanent exhibition or museum of hydraulic technics. This institution will have a beneficial influence throughout this region of France. The Electrotechnical Institute of Toulouse has made an agreement with the Société Hydrotechnique de France, whereby the work of carrying out tests of the hydro-electric stations in the Pyrenees and the region of the Massif Central will be done by the Institute. The Minister of Public Works has also committed to the same Institute the execution of important hydraulic researches. These commissions render indispensable the erection of a laboratory with available hydraulic energy and a considerable quantity of water. The Toulouse Hydroelectric Institute was founded in 1907 and has at its head Prof. Carmichel.

Water-Power in the United States.—A proposed plan to develop about 500,000 kW in water-power on the Delaware River, at a total cost estimated at $200,000,000, has been announced by Mr. Paul T. Brady, of the Westinghouse Electric and Manufacturing Co. Active work will be commenced as soon as authorisation is received from the Federal Water Power Commission. The plan calls for the construction of four dams, with an average head of 80 ft. The total power capacity of these dams is estimated at about 500,000 kW at normal high water. In addition a steam-power plant with a capacity of 100,000 kW will be erected somewhere in New Jersey in order to supplement the hydro-electric plants during seasons of low water. If present plans are carried out, the steam-power plant and two of the hydro plants will be in operation by January 1st, 1923.

Applications for permission to use water power filed with the Federal Power Commission at the end of January numbered 168, totalling 16 million h.p., of which 2½ millions were in conflict, leaving a net total of 13½ millions. The power involved is about 27 per cent. of the estimated maximum potential water power of the country and 57 per cent. of the minimum. By far the largest project is that of the Southern California Edison Co. in the Grand Canyon of the Colorado River, in three stages, aggregating 3½ million h.p.

Electricity as Scapegoat.—A correspondent of the *Electrical World* protests against the common practice of attributing fires which occur in buildings in which electricity is installed, to "crossed wires." The writer states that he knows of a case where this reason was assigned to an outbreak of fire when the affected building was not wired at all. There is also a tendency to ascribe fires in this country to electricity, when the cause is not apparent. The practice is grossly unfair.

New Copenhagen Atomic Research Institute.—On March 3rd a new section of the Danish University was opened, under the title of the Atomic State Institute, for the study of atoms as distinct from the study of experimental physics, now being carried on at the Technological Academy. Prof. Niels Bohr, Principal of the Institute, explained that ways would be opened for entirely new research and, pressing an electric button, he disclosed an arrangement by which the colours of the spectrum were projected from a platinum wire through plates of glass. It was, he said, by means of these colours that the secret of atoms was being studied. The Rector of the University spoke of the Institute as a model organisation in international science.—*Birmingham Post.*

Hydro-Electric Works in Bavaria.—The conclusion has now been reached by the Government of Bavaria that it will be impossible to bring to a conclusion the proposed Bayernwerk—one of the State works for the supply of electricity in Bavaria—without also having recourse to private capital. It is estimated that the expenditure on this hydro-electric works would amount to 500,000,000 marks under existing circumstances, which sum it would be impossible for the State to raise. As a consequence, a Bill is about to be laid before the Bavarian Diet to authorise the conversion of the Bayernwerk into a joint stock company, with a share capital of 100,000,000 marks, which will be fully subscribed by the State, while the amount of 400,000,000 marks is to be issued in the form of a loan to be guaranteed by the State. The loan is to be raised on the same terms as the loan issued for the Walchensee works and the middle Isar, and the hope is entertained in Government circles that the emission will find a favourable market, provided that the company is formed as quickly as possible.

Service Notes.—As a temporary measure, until sufficient submarine detector ratings have been trained, says *The Times*, the Admiralty announces that wireless ratings may be employed on hydrophone duties in submarines "as a special case." The ratings selected will be given a short course of hydrophone instruction at Portland, and may receive the allowance of 3d. a day as detectors, second class, while actually employed in submarines as qualified listeners.

The Supplementary Admiralty Orders for March, issued on the 12th inst., show that a revised scheme for the Royal Naval Reserve and the Royal Naval Volunteer Reserve has been approved. The latter, says *The Times*, will be composed of seamen, signalmen, wireless telegraphists, engine-room, electrical, and ordnance artificers, motor mechanics, artisans, writers, and victualling ratings. Enrolment in the R.N.V.R. will be for four years, and during that period every rating will do 42 days' training, including 14 days at sea. Pay, when called out or during training, will be that of the corresponding ratings in the R.N., and marriage allowance will be made. Certain bounties for out-of-pocket expenses will also be allowed.

Electric Supply Cricket League.—We are asked to announce that it is hoped to start matches in connection with the Electric Supply Cricket League during the forthcoming season. The League is confined to electricity supply undertakings within 10 miles of Charing Cross. Full particulars regarding membership, &c., can be obtained from Mr. A. W. Seabright, the hon. secretary, at 19, Cadogan Gardens, S.W.

The League had to suspend its activities during the war, but it is hoped that there will be an accession of clubs to the League this season.

Appointments Vacant.—Relief charge engineer and junior charge engineers, for the Newport Corporation Electricity Department; permanent way foreman, for the Colombo Electric Tramways and Lighting Co.; shift engineer, for the Doncaster Borough Electricity Department; charge and shift engineer, for the Borough of Trent Electricity Department. See our advertisement pages to-day.

INSTITUTION NOTES.

Institution of Electrical Engineers.—SUMMER MEETING.—We have already announced that a summer meeting of the Institution will be held at the Scottish Centre (at the invitation of the Committee of that Centre, of which Mr. J. E. Sayers is chairman), from June 7th to 10th, and we are now able to outline the provisional programme. On Tuesday, June 7th, a visit will be paid in the morning to the Corporation generating station at Dalmarnock, preceded by a paper by Mr. R. B. Mitchell, describing the station. In the afternoon visits will be paid to the shipyard of Messrs. John Brown & Co., Ltd., Clydebank, to the Clydes Mill power station of the Clyde Valley Electric Power Co., and to other works; there will also be an excursion by road to some of the Glasgow Corporation's reservoirs. In the evening a public function will be held at Glasgow. On Wednesday morning, June 8th, a paper will be read at Glasgow University, by Prof. Magnus Maclean, on "The Hydro-Electric Resources of the Scottish Highlands." During the first part of the afternoon the works of Messrs. Babcock & Wilcox, Ltd., at Renfrew, will be visited, after which, by the invitation of the firm, an excursion by steamer on the Firth of Clyde will occupy the rest of the afternoon and evening. The last two days of the meeting will be devoted to a West Highland excursion; on Thursday, June 9th, a start will be made from Glasgow, at mid-day, for Fort William, where the night will be spent, and next morning, Friday, June 10th, members will proceed by steamer to Kinlochleven, where the British Aluminium Co.'s hydro-electric installation will be inspected. A return by steamer during the afternoon to Oban will conclude the meeting.

Ladies are cordially invited to take part in the meeting, and application for tickets should be made to the Secretary of the Institution, 1, Albemarle Street, W. 1, not later than March 28th.

Magnetic Susceptibility of Low Order.—Prof. E. Wilson delivered the last of his lectures (see p. 246 of our February 25th issue) on the above subject to the members of the Institution on the 10th inst.

III. *Practical Applications.* — At the present time so far as actual bulk is concerned magnetite is of the first importance, but magnetic separation has found applications in other directions. In 1914, in Northern Norway, about 2,200,000 tons of ore were dealt with, yielding 900,000 tons of concentrates. At Mineville, New York State, U.S.A., about 1,200,000 tons of ore were dealt with in 1916, and in 1917 in Sweden 2,500,000 tons of ore, yielding 1,100,000 tons of concentrates. were recorded. Of course, these figures do not refer to such important applications as the separation of wolfram from tinstone ores, or the separation of monazite for use in the gas mantle industry.

The lecturer exhibited tables giving the susceptibility values of minerals to be separated, together with those which are important and most likely to be met with.

The susceptibility of even low-grade magnetite, which may be of the order 0·1, is still so high as to overwhelm that of any other rocks. It is largely associated with apatite, which has a small negative susceptibility and which gives rise to trouble, not from a magnetic standpoint, but because it takes the form of an impalpable powder and adheres to the magnetite most tenaciously. Its removal has to be specially dealt with by washing or by air-blast, as the case may be. In the separation of wolfram ore from tinstone there is none too large a margin in favour of the wolfram ore. A great field is open for treatment.

The deposit in which monazite is found contains amongst other minerals ilminite and zircon. This is a case of double separation, the ilminite being extracted by a weak field, and the monazite by a strong field, the zircon going forward as a non-magnetic mineral. Great care must be taken, if grinding of the ore has to be resorted to, that the zircon, which is very hard, is not rendered magnetic by minute traces of iron.

In the separation of spathic ore from zinc-blende or copper pyrites, there is a fair margin in favour of the former, and there is scope for treatment.

The separation of franklinite from zinc-blende was one of the early problems solved by Wetherill Specular ore when occurring with magnetite, as in the Norwegian schists, involves a double separation, the magnetite being first removed by a weak field, and the hematite by an intense field.

A great deal of ingenuity has been spent upon the construction of the machinery used in magnetic separation. In the case of magnetite, the preliminary rough dry process (Wenström or Gröndal) is followed by either a dry or wet fine separation. The Edison separator is an example of the dry process, and that of Gröndal is extensively used in wet separation. In the case of feebly magnetic materials, *e.g.*, monazite, the double separators of Wetherill, the Rapid Magnetting Machine Co., or Humbolt, are available.

Wireless Section.—At a meeting of this Section of the Institution on March 16th, a paper by Mr. G. Stead, M.A., on the "Effect of Electron Emission on the Temperature of the Filament and Anode of a Thermionic Valve," which was communicated by Prof. Sir J. J. Thomson, described experiments which were carried out in the Cavendish Laboratory in May, 1918, and which were undertaken on behalf of the Wireless Telegraphy Department of H.M. Signal School, Portsmouth. The paper, which was published with the consent of the Admiralty, explained that the temperature at any point on a tungsten filament which was emitting electrons was altered by the passage of the emission current through the filament, and also on account of the latent heat of evaporation of the electrons. An account was given of some direct measurements, made with an optical pyrometer, of the distribution of temperature along an emitting filament under various conditions, and it was found that when the negative end of the anode battery was connected to the negative end of the filament battery the distribution of temperature along the filament became increasingly unsymmetrical as the emission current increased, the negative limb being hotter than the positive limb at a given distance from the lead. In the particular filament employed in the experiments it was estimated that the total electron current from the filament increased by 35 per cent. when the emission amounted to 11 per cent. of the current from the filament battery. An account was also given of some measurements of the temperature of an anode which was undergoing electron bombardment, showing the relation between the anode temperature and the number of watts dissipated by the anode per sq. cm. of surface.

At the same meeting Dr. W. H. Eccles, vice president, and Miss W. A. Leyshon, B.Sc., presented a paper dealing with "Some Thermionic Tube Circuits for Relaying and Measuring," the first part of which was concerned with some methods of measuring the voltage factor of a triode, and with circuits arranged for voltage amplification in which the full value of the voltage factor could be utilised. In the ordinary method of using a triode as a voltage amplifier, a high resistance was included in the anode circuit, and the variations in the p.d. across the resistance resulting from variations in the grid potential were utilised. The authors showed that a diode could replace the resistance or impedance in a voltage amplifier, with a resulting increase in the sensitiveness of of the latter. The second part of the paper dealt with some methods of detecting very light contact between two conductors; and the third part described triode circuits in which very small movements of a conductor could be made evident. It was pointed out that the experiments recorded in the second and third parts of the paper might form the basis of relays which could be actuated by extremely feeble currents or slight movements of conductors; the possibilities of the apparatus were many, and it might add appreciably to the ever-growing variety of uses to which the thermionic valve might be put.

Barrow and District Association of Engineers.—At a meeting of the Association on March 11th, Mr. T. A. Sedgwick, A.M.I.E.E., read a paper on "Electric Furnaces." He said that the war was responsible for an enormous increase in the number and tonnage of electric furnaces in each of the countries affected. Previous to 1914, the greater part of the alloys were imported, and when those supplies were interrupted, the steel manufacturers were compelled to take up their production. At the time of the armistice, their yearly output of alloys exceeded 10,000 tons, an output which met the whole country's requirements. It could be said that the number of furnaces installed in this country was not less than 150 with an aggregate capacity of 120,000 kVA.

Edinburgh Electrical Society.—At the Apprentices' Night, held on March 11th, competitive papers were read by Messrs. Bee, Clunie, and Mercer, the respective subjects being "Measuring Instruments," "Small Motors," and "Country-House Lighting." The papers were much appreciated, and the decision as to prize will be announced later. At the next meeting of the Society, to be held on March 25th, Mr. Leithead will give a lantern lecture on "Automatic Telephones."

Chelmsford Engineering Society.—On March 3rd, Mr. L. D. Hill read a paper on "Direction and Position-Finding by Wireless." The author dealt with the history and principles of direction finding in detail, the lecture being fully illustrated by numerous lantern slides and a film showing a demonstration of position-finding from three land stations during an aeroplane flight from London to Brussels. Reference was made to the very important part played in the war by British direction-finding, which far surpassed the efforts of enemy countries.

Institution of Railway Signal Engineers (Inc.).—The next meeting will be held at the Midland Grand Hotel, St. Pancras, on March 23rd, when a paper by Mr. D. C. Gall, entitled "Fundamental Calculations of a.c. Track Circuits" will be read and discussed.

Manchester Wireless Society.—At a meeting, on February 23rd, Mr. P. G. Thomason, late of the Royal Naval Reserve, lectured on "Aerials." After explaining the purposes of an aerial, and describing the early designs of Hertz and those of Sir Oliver Lodge, and the long vertical wire of Marconi, the lecturer enumerated the types of aerial in use to-day. The directional effect of aerials was explained, and the types of aerials in use at the big wireless stations, such as Clifden, Poldhu, and Carnarvon, were described in that connection.

Royal Artillery Institution.—Mr. H. F. Trewman, chief instructor in the electrical branch of the Ordnance College, lectured, by the aid of diagrams and lantern slides, on "Wireless Telephony," at the above-named Institution, at Woolwich, on March 8th.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the **Electrical Review** *posted as to their movements.*

Fulham Borough Council Electricity and Lighting Committee recommends that the basic salary of Mr. N. A. Chesterfield, chief clerk in the electricity department, be increased as from April 21st from £230 to £275 per annum, which, with the cost of living adjustments under the scale of the National Joint Board, will temporarily increase his total remuneration to £476 per annum.

Mr. F. G. Nesbitt has been appointed by Carron Company as its representative for London and the Southern Counties for its electric cooking and heating department, in succession to Mr. C. McKinlay, who has left its service.

Mr. W. J. Green, for 11 years manager at Weston-super-Mare for the Bristol Tramways Co., who is leaving, has been presented by the clerical staff with a silver-mounted umbrella, and by the traffic staff with a silver inkstand.

Messrs. William C. Yuille & Co., Ltd., of Glasgow, electric fittings suppliers, have appointed Mr. A. Munro (of the Edison Swan Electric Co., Ltd.) as manager. He will combine with the appointment the duties of the late Mr. H. D. Anderson, director.

We are informed that Mr. Walter Rutherford has resigned from the board and management of the English Electric Co., Ltd. Mr. P. J. Pybus, joint managing director, has been appointed managing director.

Obituary.—Mr. J. Cameron.—The death has taken place, at the age of 72 years, of Mr. John Cameron, of Bispham, near Blackpool, who, until the Blackpool Corporation took over the undertaking last year, was manager and secretary of the Blackpool and Fleetwood Tramroad Co.

Mr. W. E. Dalgleish.—The many friends in the North of England of Mr. W. E. Dalgleish will regret to hear of his death on March 10th. He was employed for many years by the Metropolitan-Vickers Electrical Co., Ltd., and during the past eight years as one of the engineers on the erection staff attached to its Newcastle on-Tyne district office.

NEW COMPANIES REGISTERED.

Macqueen's Standardised Aluminium Alloys, Ltd. (173,553).—Private company. Registered March 7th. Capital, £100 in £1 shares. To acquire the manufacturing, utilising, exploiting, and selling rights in the United Kingdom or elsewhere of a process of standardising the alloys of aluminium invented by L. E. Macqueen, and known as "Macqueen's Standardised Aluminium Alloys." The first directors are: L. E. Macqueen, 6, Arthur Street, W.C. 2, consulting metallurgist and analyst (permanent managing director); L. A. Macqueen, 43 Munster Square, Regent Park, N.W. 1, electrician. Registered office: 267, High Holborn, W C. 1.

Waterloo Tool Co., Ltd. (173,558).—Private company. Registered March 7th. Capital, £2,000 in £1 shares. To carry on the business of manufacturers of and dealers in tools and cutlery, electrical and mechanical engineers, electricians, &c. The subscribers (each with one share) are: F. V. Lippold, 11, The Grove, Wandsworth, S.W., electrical engineer; W. A. S. Oxborow, 18-20, Temple Chambers, E.C., accountant. F. V. Lippold signs as "director." Registered office: 21 and 23, York Road, Lambeth, S.E.

C. F. Elwell, Ltd. (173,566).—Private company. Registered March 8th. Capital, £50,000 in £1 shares (40,000 "A" ordinary and 10,000 "B" ordinary). To adopt agreements with C. F. Elwell; to carry on the business referred to therein; to acquire the benefit of and turn to account inventions relating to radio telegraphy, telephony, and other means of intercommunication, and apparatus, instruments, and appliances connected therewith, &c. The subscribers (each with one "A" ordinary share) are: B. L. H. Diddams, 117, Fortress Road, N.W. 5, clerk; A. E. Fournier, 24, Gosberton Road, S.W. 12, clerk. The directors are to number not less than two nor more than six. The Radio Communication Co., Ltd., and C. F. Elwell (or his representatives) may, so long as they respectively hold £5,000 shares, nominate two directors each. The first directors are: J. H. Scrutton and E. Benyon (deemed to represent the said company) and C. F. Elwell and E. E. Mittell (deemed to represent the said C. F. Elwell). Registered office: 12, Craven House, Kingsway, W.C. 2.

R. G. Co., Ltd. (173,555).—Private company. Registered March 7th. Capital, £125 in 6d. shares. To acquire and deal in patents and inventions relating to electrical and mechanical engineering, &c., and to acquire the exclusive British, Colonial, and foreign patent rights in an invention relating to reversing gears, for which provisional patent No. 29,636 of 1920 has been granted to F. Newton and Newton Brothers (Derby), Ltd. The permanent directors are: C. A. Newton, Park Lane House, Littleover, Derby; F. Newton, 9, Keddleston Road, Derby; R. Newton, 36, Ashbourne Road, Derby; H. Newton, Mile Ash House, Duffield Road, Derby; H. B. Roy, Darley Dene, Belper Road, Derby. Secretary: C. A. Newton. Registered office: 21, Market Place, Derby.

Marler & Co., Ltd. (173,489).—Private company. Registered March 3rd. Capital, £7,000 in £1 shares. To carry on the business of electrical, mechanical, and heating engineers and contractors, &c. The permanent directors are: W. S. Marler, Guyon, St. Julian's Avenue, Newport, Mon.; G. J. Fisher (chairman), Briarlea, Penygarn, Pontypool; C. D. Esnouf, Brookale, Pensisely Road, Llandaff; R. Fisher, Trouville, New Inn, Pontypool Road; R. Moore, Newport, Mon. Solicitor: H. Saunders, Pontypool.

Wye Lighting, Heating & Power Co., Ltd. (173,525).—Registered March 4th. Capital, £5,000 in £1 shares. To carry on the business indicated by the title. Minimum cash subscription £7. The first directors are: J. P. Sharples, 6, Upper Bridge Street, Wye, Kent; J. Long, 15, Church Street, Wye, Kent; S. D. F. Harwood, "La Quinta," Wye, Kent. The two first-named are permanent. Qualification £100. Secretary: F. Flower. Registered office: 7, Bank Street, Ashford, Kent.

Fogdens Electric Co., Ltd. (173,508).—Private company. Registered March 4th. Capital, £2,000 in £1 shares. To carry on the business of electricians, electrical, mechanical, sanitary, gas and water engineers, ironmongers, manufacturers of and dealers in automobiles, motor cars and bodies, &c. The first directors are: Mrs. Bertha Fogden (governing director), Prestatyn, The Cliffs, Southend; Miss Blanche Fogden, Prestatyn, The Cliffs, Southend. A. F. Wilson, Wynchmore, Crowstone Road South, Westcliff. Registered office: 23, The Broadway, Leigh-on-Sea.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Church Stretton Electric Supply Co., Ltd.—Charge on certain land and buildings at Crossways, Church Stretton, and Church Stretton Electric Lighting Order, 1916, rights, powers and privileges, &c., dated January 29th, 1921, to secure £1,550. Holder: Church Stretton Developments, Ltd.

Ebonestos Insulators, Ltd.—Satisfaction in full on January 31st, 1921, of mortgage dated June 30th, 1920, securing company's balance at bankers.

Marston Billington, Ltd.—Debenture dated February 19th, 1921, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: F. G. W. Pearson, Highlands, Farnham Common, Bucks.

Electrical Contracts & Maintenance Co., Ltd. (101,757).—Return dated December 31st, 1920. Capital, £3,000 in £1 shares. All shares taken up. £1,331 paid. £1,669 considered as paid. Mortgages and charges, nil.

Dartmoor Electric Supply Co., Ltd.—Issue on February 17th, 1921, of £1,050 debentures, part of a series already registered.

Colne Valley Electric Supply Co., Ltd.—Satisfaction in full on February 12th, 1921, of debenture dated December 2nd, 1915, securing all moneys due or to become due.

Northampton Electric Light & Power Co., Ltd.—Issue on February 12th of £1,000 and on February 23rd, 1921, of £2,200 second debenture stock, parts of a series already registered.

Tredelect Dynamos, Ltd.—First and second mortgage debentures dated February 22nd, 1921, to secure all moneys not exceeding £4,000 each, which the mortgagees may pay under their guarantee to company's bankers, charged on premises in Water Lane, Richmond, and the company's undertaking and property, present and future, including uncalled capital. Holders: Sir Herbert H. Bartlett, 56, Victoria Street, Westminster; F. A. Minter, Old Trees, Parkside, Wimbledon; and others.

C. H. Hare & Son, Ltd. (110,911).—Return dated December 31st, 1920. Capital, £16,000 in £1 shares (8,000 preference and 8,000 ordinary). All shares taken up. £8,502 paid. £7,498 considered as paid. Mortgages and charges, nil.

Henry Bisseker, Ltd.—Particulars of £6,300 second debentures authorised January 27th, 1921, whole amount issued, charged on the company's undertaking and property, present and future, including uncalled capital.

Leatherhead & District Electricity Co., Ltd.—Particulars of £10.000 debentures authorised February 7th, 1921, present issue £9,150. charged on company's property, present and future, including uncalled capital, subject to prior first mortgage debentures.

CITY NOTES.

W. T. Henley's Telegraph Works Co., Ltd. The accounts for 1920 show a profit of £240,003. Deducting £46,975 for directors' and auditors' fees, debenture interest, and depreciation, and adding £141,633 brought forward, the total is £334,661. Income tax requires £45,524; reserve £18,432; loss on realisation of Government loans and trustee securities £35,681, less reserve, £5,607, plus £7,560 transferred to reserve against Government loans and trustee securities still held, making £13,166; preference dividend £9,000; interim dividend on the ordinary shares £20,000; pension funds £5,000; final dividend on the ordinary shares of 2s. per share, less tax, making 3s. for the year, requires £40,000; to be carried forward £183,538. Provision has been made in the accounts in respect of the liability for excess profits duty and corporation tax to the end of the year 1920. Henley's Tyre & Rubber Co., Ltd., has had a successful year's trading, and the progress of the company has necessitated an increase in the capital employed from £140,000 to £200,000 The Tyre Co., following the practice of the parent company of purchasing against requirements only, has been fortunate in not holding any considerable stocks of rubber, and has consequently been able to take full advantage of the fall in prices. Since the close of the year, an issue of £250,000 ordinary share capital at 24s. per share has been made. The applications considerably exceeded the amount offered. In allotting the shares preference was given to applications from the existing ordinary and preference shareholders and debenture stockholders, all of whom received allotment in full.

Newcastle and District Electric Lighting Co., Ltd. At the annual meeting, held in Newcastle on the 11th inst., Lieut.-Col. F. R. Simpson, who presided, said that in view of the uncertainty of the outlook they had placed £16,000 to the general reserve. During the year capital expenditure had reached £23,065, necessary to meet the large increase in the demand for energy. A further £16,000 had been allowed for depreciation, making the amount written off up to date £105,500. Wages, salaries, coal, &c., showed an increase of £14,959, coal being the principal item. As to wages, rates of pay were nearly 170 per cent. above pre-war level. The total gross receipts for electrical energy supplied showed an increase of £36,937, or 33 per cent. over 1919, which was mainly due to a large increase in new consumers and extensions to existing installations. The net profit for the year was £11,104, making, with the amount brought forward from the previous year, an available balance of £24,367. During the year a petition was lodged against the Newcastle Corporation Bill, which contained clauses conferring upon the Corporation powers to supply electrical energy to consumers near its tramways, and which would have affected the rights of the company. As a result of the petition the clauses referred to were deleted. It was resolved that a dividend at the rate of 5 per cent., less income tax, be paid for the year.

Para Electric Railways and Lighting Co., Ltd. At the meeting held last week, Mr. Follett Holt said that the situation in Para was adversely affected by the sudden and serious fall in the exchange value of the Brazilian milreis from the high figure of 18d. to little more than half that figure. The important bearing thereof on their revenue had caused them to be very conservative in the allocation of their funds, and in the recommendation to reduce the dividend from 8 per cent. to 6 per cent. for 1920. The local gross receipts were slightly less than the year before, chiefly owing to certain concessions made both for public and private lighting in connection with the debt settlement; during the latter part of the year traffic returns were less satisfactory, due to the state of the rubber market. The general condition of the rubber market, chiefly governed, of course, by the Eastern plantation rubber, was critical, and there was little doubt that the year 1921 would put the commercial endurance of Para and its hinterland to a severe test. The outlook in respect of the company's local earnings was not encouraging, and operating and other expenditure had to be carefully watched.

County of London Electric Supply Co., Ltd. Capital expenditure during 1920 £293,821. Revenue for 1920, after deducting expenses, &c., £244,253, plus £19,188 brought forward. Debenture interest, less tax, £53,751; written off preliminary expenses £8,972; to reserve for depreciation, renewals, &c., £50,000; to general reserve £62,500; 6 per cent. on preference shares, less tax; 8 per cent. for the year, less tax, on the ordinary; carried forward £18,595. The death is recorded of Mr. F. E. Savory, one of the original directors of the company. Sir Ernest Hiley resigned from the directorate in August last, and Sir Guy Granet in December, due to increasing pressure upon their time. Lord Gainford and Lieut.-Col. Sir Frederick Hall have been appointed to the board. The deputy chairman, Sir Harry Renwick, has been appointed chairman and managing director. In order to comply with the requirements of the new Electricity (Supply) Act, 1919, application was made early last year to the Electricity Commissioners for their consent to the company proceeding with the erection of its proposed generating station at Barking, powers for which were obtained in 1913. The Commissioners decided to defer this matter until after March 31st, 1921, by which date schemes have been invited by them covering the constitution of a Joint Electricity Authority for the London and Home Counties Electricity District. An extraordinary general meeting has been convened at the conclusion of the ordinary general meeting for the purpose of considering, and, if thought fit, approving a Bill introduced by the company for the purpose of facilitating the erection of the proposed generating station at Barking, in the event of the consent of the Electricity Commissioners being obtained. The applications received during the past year amounted to the equivalent of 5,678 kW, making the total at December 31st last 87,902 kW. Consumers have increased from 31,390 to 34,764. As to the associated companies, the South London Electric Supply Corporation, Ltd., has declared a final dividend on the ordinary shares at the rate of 9 per cent. per annum, making 7 per cent. for the year. The Bournemouth & Poole Electricity Supply Co., Ltd., has declared a final dividend on the ordinary shares at the rate of 9 per cent. per annum, making 7 per cent. for the year. The business of the Coatbridge and Airdrie Electric Supply Co., Ltd., continues to progress. Units generated and purchased, 66,926,800; total sold, 49,553,223 (increase 7,065,551); used on works, 6,098,029; used in transmission and distribution, 11,275,548. Meeting held March 15th.

Allmaenna Svenska Elektriska A.B.

The report of the Allmaenna Svenska Elektriska A.B., of Vasteras, states that the directors experienced great difficulties in planning the company's activity during 1920. In the first half of the year manufacturing did not correspond by a long way to the great demand for the company's products, while the new orders coming to hand at the end of the year, particularly from the Scandinavian markets, showed a large reduction. The present stock of orders was certainly satisfactory, but the company would be unable to avoid having to manufacture for stock to a large extent. The results of the year's activity were prejudicially affected by two strike months at the beginning of the year and by prices falling heavily. The directors were adopting strong measures to reduce the stocks and the working expenses.

The department for electrical installations was satisfactorily occupied, although in this branch also the orders seemed to be decreasing. The sale departments in Sweden had been reorganised in order to bring down the high working expenses which were occasioned by the late period of high prosperity, and in connection with this matter the sale of installation materials had to the greatest possible extent been concentrated at the company's central warehouse in Stockholm. Satisfactory results were being shown by the export trade, and the new markets to the westward were constantly being increased. A new subsidiary company was started in Belgium at the change of the year with a share capital of 500,000 kr. During the year negotiations were opened with the Soviet Government regarding a concession to carry on business in Russia, and the discussions were still proceeding.

The activity at the ironworks departments was still further diminished on account of the inconsiderable demand. Mining operations were suspended during the year after sufficient ore for treatment in the near future had been mined. The production of pig iron was being continued to a reduced extent; the new sheet rolling mill at Surahammar had been brought into operation, and was supplying transformer sheets of high quality for the company's needs. At the end of the year the number of persons employed at the company's own offices and works was 6,963, as compared with 7,220 at the close of 1919.

After having made provision for depreciation, interest charges on loans, and for taxation, the accounts show net profits of 4,018,000 kr., as contrasted with 8,019,000 kr. in 1919 and 7,718,000 kr. in 1918. As mentioned in a previous issue, the dividend is at the rate of 6 per cent., as compared with 12 per cent. in 1919, leaving 337,000 kr. to be carried forward. The share capital now amounts to 108,500,000 kr., as against 84,050,000 kr. in 1918. In addition the company's own loans amount to 10,000,000 kr., while the debt to the banks increased from 378,000 kr. in 1919 to 5,849,000 kr. last year.

Telegraph Construction & Maintenance Co., Ltd.

Presiding at the annual meeting, on March 10th, the Earl of Selborne, K.G., said that on the debtor side of the balance sheet the debts owing by the company and reserves for insurance and contingencies had increased by no less than £436,843, as compared with the previous year, and stood at the large figure of £1,882,550. On the asset side the item of stocks of stores, materials, &c., showed a corresponding increase of £832,122, and stood at £1,551,978. On the one side the figures were due to the company having received large sums as instalments on account of contracts in course of being carried out, and on the other to the unusually heavy stocks of materials and cable forming part of those unfinished contracts. The profit and loss account showed a net profit, after providing for income tax, excess profits duty, and corporation tax, of £110,187, which was about £14,000 less than last year. It must be remembered that a year ago the prices of materials were on the upward grade, whereas now they were rapidly falling, and it was very difficult to maintain prices on a falling market. As instances he might mention that iron wire had fallen about £20 a ton, steel nearly £30 a ton, copper wire about £50, and jute yarn about £60 a ton. Those reductions had mostly taken place in the last few months of the year. The responsibility and anxiety of the management of such a business as theirs during a year like 1920 had been very great, and they had reason to be very grateful for the skill which had been shown. Before the close of the year they purchased the ex-German cable steamer *Stephan* from the Ministry of Shipping. They realised that the present was not a favourable time to buy a steamer, but they had certain contracts for which she was required, and there was no other course open to them. As showing the unprofitable nature of shipowning at the present time, he might give them the receipts and expenses of their three steamers last year. The *Colonia* brought in receipts amounting to £181,859, and her expenses were £182,626, a loss of £1,067. The *Stephan* brought in £166,904, against expenses amounting to £168,167, an excess of expenditure over receipts of £1,263. In the case of the *Telcone* the receipts were £49,794 and the expenses £45,940, a profit of £3,854. Those figures showed that in a year in which their ships had been fully employed, they had been unable even to earn their depreciation. It was obvious that operating expenses must come down or their ships would have to join the ranks of the unemployed; they could not continue to contemplate a loss on every voyage they undertook. He hoped sincerely that this year they would get back to an economic basis in that regard. Out of the £110,187 profit for the year they proposed to pay the shareholders in dividends a total of £89,640; to add £20,000 to the reserve fund, and to increase the carry forward by £547. Before arriving at that profit they had had to provide for income tax, excess profits duty, corporation tax, and rates and taxes of their works, an amount of over £130,000, which was very much more than the shareholders received in dividends, and during the year they had paid over half a million sterling in wages and salaries. In that connection he would like to draw their attention to the great drag on industry caused by the rising rates. At their two works, owing to the rise in the assessments and the great increase in the rates, they would this year have to pay about £19,000 in that way, as compared with £2,600 in 1900. When they took everything into consideration the results of the past year were satisfactory. The country was passing through a time of most extraordinary difficulty. There was no royal road out of the economic position in which they found themselves. They could only emerge by rigid economy and by a lessening of taxation. What the world wanted was peace—an assurance of peace by the settlement of disputes among nations, and the consequent resumption of international trade. That alone would bring them a new era of prosperity.

Metropolitan Electric Supply Co., Ltd.

At the annual ordinary general meeting held on March 8th, Mr. A. W. Tait, C.B.E. (chairman), said that the increase in revenue for the year was satisfactory as the two previous years showed a slight decrease. The output rose from 25,127,000 to 27,798,000 units. The removal of restrictions had had a beneficial effect upon the lighting load, and the number of new consumers connected represented an addition of 3,374 kW. The present trade depression necessarily had an adverse effect upon the sale of power, but the company was really well situated as there had been considerable industrial development in its western area of supply, leading to a number of new connections. It was hoped that the new plant at Willesden would be available before the end of the year; this should enable the company to effect considerable economies in generation and distribution. It was necessary to raise £500,000 in order to carry out the programme of the company. Negotiations already had been opened in this direction, and it was thought that the investment would prove an attractive one, having regard to the sound position of the undertaking. The chairman thought that the next directors' report would be very satisfactory, as the peak of high prices had been passed. The report and accounts were adopted.

Charing Cross, West End and City Electricity Supply Co., Ltd.

The ordinary annual meeting of the shareholders was held on March 10th. Mr. Wm. F. Fladgate, M.V.O. (chairman), who presided, said that the output had reached 14½ millions of units in the West End and over 20 millions in the City. Referring to the borrowing of £250,000 on 6½ per cent. secured notes, the chairman said that it had been the practice of the company to depend on advances from its bankers, but owing to the contemplated large expenditure it was thought wiser to raise the necessary funds by the issue of the notes. A large part of this amount (£160,000) had been spent upon works at Bow, but until December last the improvements were not benefiting the company, although it was hoped to realise a marked decrease in costs later in the present year. The speaker hoped that from £100,000 to £150,000 would suffice for the capital expenditure this year, but this would depend upon the cost of labour and materials. The directors were asking for increased borrowing powers to the extent of £250,000 for each undertaking—City and West End. These powers were required, as the limit of the present powers had almost been reached. The chairman spoke at some length upon the proposed Greater London electricity supply scheme. He stated that the supply companies had produced a scheme, in which the L.C.C. participated, and the engineering proposals had been found satisfactory to both parties. For various reasons the preparation of a joint financial scheme was considered undesirable, and separate schemes had been formulated. The report and accounts were adopted, and the resolution empowering the board to borrow £500,000 was passed unanimously.

Newcastle-upon-Tyne Electric Supply Co., Ltd. During the year 1920 the connections increased by 25,203 h.p. to 341,940 h.p. The profit was £392,643, against £248,194. After deducting £30,000 for plant renewals and improvements reserve, and adding £9,598 brought forward, there is available £372,242, against £259,621. Debenture and loan interest require £57,914 and reserve for special depreciation and contingencies other than the equalisation of dividends £25,000; dividends on the 7 per cent. cumulative preference shares and the 5 per cent. preference shares are paid, subject to income tax, and the total distribution on the ordinary shares is 8 per cent. for the year, subject to tax. There is to be carried forward £13,091. The expenditure on plant renewals and improvements during the year amounted to £44,911, which has been charged against reserve for plant renewals and improvements account. The unsettled conditions in trade, and the continued high labour costs have again adversely affected the trading for the year. The additional capital expenditure for the year has amounted to £475,459, and represents the completion of the remaining extensions at Carville and further extensions at Dunston power stations, and additions to the company's distribution system generally. The extensions at Carville power station were completed during the year, and the new plant is now in commission. Negotiations with the North Eastern Railway Co. are proceeding in connection with the electrification of a portion of that company's main line. The directors have been approached with the object of obtaining a contribution to the funds of the University Colleges of Newcastle-upon-Tyne, and recommend to the shareholders that an amount of £1,000 be sanctioned, payable over two years.

Meeting: March 22nd.

Oxford Electric Co., Ltd. Speaking at the annual meeting, Sir Henry Mance said that 1920 was the first normal year they had had since the commencement of the war. The coal strike, and the extension of summer time to October were detrimental, but, notwithstanding this, their output had increased by 26 per cent. The great advance in the rates of wages and the cost of coal and other commodities had necessitated their applying for an increase in the statutory charge; this had been granted, and was now in operation. With regard to legislation, it would be a long while before any material change could be made in the distribution of electric power throughout Oxfordshire or the neighbouring counties. According to the *Times* report, Sir Henry said that the further measure which would be under the consideration of Parliament this session appeared to be an enabling Bill giving lending and borrowing powers to various authorities, but he did not expect much assistance in the future in that direction. What they really wanted was willingness on the part of the Government to guarantee interest on any money advanced with the latter's approval for the purpose of cheapening and extending the production and distribution of electricity. If the Government would take that responsibility, which would cost them nothing, they would be rendering a real service to the industry throughout the country.

London Electric Wire Co. and Smiths, Ltd. In addressing the annual general meeting held in London last week, Sir George H. Fisher-Smith, J.P., said that the final dividend of 6¼ per cent. (making 7½ per cent. for the year) on the ordinary shares would leave £38,926 to be carried forward, or £10,512 more than in the previous year. He described 1920 as one of the most difficult years for commerce ever known. The present lack of business was due to the almost entire absence of purchasing power. There was plenty of work to be done, but there was not sufficient money to pay for it. The time had arrived when the cost of production would have to be seriously reconsidered, and capital and labour would have to work together to that end in their mutual interest if we were to retain our great manufacturing position in the world. He believed that the present financial stringency was largely due to excessive taxation. It was difficult to forecast the future, but he was under the impression that we were nearing the bottom of the reductions in the values of raw material, and if prices could be stabilised buyers both at home and abroad would have confidence in placing orders, and in consequence a revival in trade would surely take place. The electrical industry would be one of the first to revive, because a successful future would demand more and more the use of electricity. Their company was ready to meet the expansion when it came.

Mr. A. N. Smith stated that the company had managed to make a record output during the past year at its Manchester factories. The completion of the new extensions was in sight.

County of Durham Electrical Power Distribution Co.—Dividend of 12 per cent. for the year on the ordinary shares; carried forward £1,275.

Mirrlees Watson Co., Ltd.—Dividend for 1920, 10 per cent., and a bonus of 7½ per cent., both less tax.

British Insulated & Helsby Cables, Ltd.—Profit for 1920, after making provision for estimated liability for E.P.D. and corporation profits tax to date, is £340,713, plus £103,316 brought forward, making a total of £444,029. From this are deducted: directors' and debenture trustees' fees and remuneration to works committee, £9,665; interest on first debenture stock, £22,500; interest on second debenture stock, £10,000; preference dividend, £30,000. There has been put to depreciation on buildings, plant, machinery, &c., £50,000; to reserve account, £50,000; and to first mortgage debenture stock redemption account, £5,000. The interim dividend on ordinary shares absorbed £37,500, and it is proposed to pay a further dividend of 6¼ per cent. on the ordinary shares at once, and a bonus of 5 per cent. on June 30th next, making with the interim dividend already paid a total of 15 per cent. for the year, absorbing a further £112,500. There is carried forward, after making provision for estimated liability for E.P.D. and corporation profits tax, a balance of £116,864. During the past year, both the Prescot and Helsby factories were again kept busy to their full capacity. On account of failing health, Dr. E. K. Muspratt resigned his seat on the board. Mr. J. A. Smith has recently been elected a director.

Electro-Bleach & By-products, Ltd.—The profit for 1920, after deducting repairs, standing charges, depreciation, income tax, debenture interest, bonus to employés, directors' additional remuneration, and reserve for E.P.D. and corporation profits tax, is £51,643, plus £4,277 brought forward. Preference dividend 12½ per cent. for the year; ordinary dividend 25 per cent. for the year; carried forward £5,921. Sir H. Mackinder, M.P., and Mr. E. G. Cubitt, J.P., resigned their seats on the board during the year. Messrs. H. D. Butchart, E. O. Glover, and A. W. Tangye, O.B.E., have been appointed directors. Mr. F. J. Dundas and Mr. James Swinburne retired in December, 1920, but at the request of the directors have rejoined the board. Meeting: March 23rd, at Manchester.

Scarborough Electric Supply Co., Ltd.—New connections during 1920 equivalent of 16,438 lamps (30 watt), making 161,141. New consumers 449. Units supplied 1,454,377, increase 396,670. After putting £4,000 to depreciation, and paying £755 bank interest, the profit is £2,370, plus £2,339 other revenue, making the net profit £4,709, plus £6,683 brought forward. Dividend to be paid at the maximum rate allowed under the Scarborough Electricity (Temporary Increase of Charges) Order, 1918, namely, 2¼ per cent., leaving £9,142 to be carried forward. Mr. G. Alderson-Smith has retired from the chairmanship, and Mr. A. A. C. Swinton takes his place. The former remains as deputy chairman. Mr. G. L. Beeforth has retired. New directors are Messrs. R. Pawley, F. G. Holden, and Capt. W. H. L. Wordsworth.

Brompton & Kensington Electricity Supply Co., Ltd.—The revenue account for 1920 shows a credit balance of £42,903, plus £1,230 brought forward; £1,000 interest on loan to the B. & K. Accessories Co., Ltd., and £274 interest received and accrued, making a total of £45,406. After paying 7 per cent. on the cumulative preference shares, £369 is written off investments, £9,655 is put to depreciation, £10,000 to reserve, 12 per cent. for the year is paid on the ordinary, £1,000 is put to directors' additional remuneration, and £1,776 is carried forward. The number of customers increased from 7,389 to 7,896; lamps connected (35 watt) from 433,152 to 472,936; gross receipts from £74,045 to £102,372; expenditure from £44,683 to £59,469; net receipts from £29,362 to £42,903; average price per unit obtained, from 4.61d. to 5.303d. Meeting: March 17th.

Cambridge Electric Supply Co., Ltd.—Mr. R. F. Scott, presiding at the annual meeting, said that the net profit was £900 more than in 1919, and £2,000 more than 1918. They had hardly recovered their pre-war position. They were paying 46s. for coal, against 18s. 3d. or less a few years ago, and the coal now was not quite so satisfactory. The business was still expanding, and must do so. They would have to provide new machinery, and probably before the end of the year would have to raise £10,000 new capital.

Globe Telegraph & Trust Co., Ltd.—Quarterly interim dividend of 5s. per share on the old and new ordinary shares, free of tax; further 4s. 8d. per share, being interest at the rate of 10 per cent., free of tax, in respect of the instalments paid on the new ordinary shares.

Western Telegraph Co., Ltd.—Second quarterly interim dividend of 5s. per share, free of income tax, to holders of old shares Nos. 1 to 207,930 inclusive, being at the rate of 10 per cent. per annum. The dividend of 4s. per share, free of income tax, on the new shares, in accordance with the terms of the issue is also announced.

Direct Spanish Telegraph Co., Ltd.—Dividends of 10 per cent. per annum, less tax, on the preference shares, and 6 per cent., free of tax (making 10 per cent. for the year) on the ordinary.

Stock Exchange Notice.—Application has been made to the Committee to appoint a special settling day in the following:—

Midland Electric Corporation for Power Distribution.—280,000 ordinary shares of £1 each, fully paid, Nos. 1 to 280,000.

Hastings & District Tramways Co., Ltd.—After paying 7½ per cent. on the preference shares and putting £3,000 to depreciation, £1,000 is to be carried forward.

South Staffordshire Tramways Co.—After paying 1 per cent. on the preference shares, £668 is to be carried forward.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets have got into a much better state of mind. Members admit that they are puzzled to account for the change of front that has occurred in markets. The obvious explanation is that there is more buying than selling. The forced realisations apparently have ceased. Prices had to get down to levels at which they were tempting, but for the last 2½ months Stock Exchange men have been complaining that nobody had any money except for purely gilt-edged stocks. Nor can it be said that the present movement has any substantial backing of purchases behind it. It is almost as much sentimental as real, but the fact remains that the market outlook is more healthy, and this possibly has led to the greater hopefulness which has arisen in regard to trade and industry generally. There is every hope of the Bank Rate coming down before the Budget is opened, and the Spring of the seasons is reflected in that of the markets.

At the meeting of the London Electric Wire Company the other day, Sir G. H. Fisher-Smith expressed his belief that the electrical industry would be one of the first to revive. His impression is that we are near the bottom of the reduction in the values of raw material, and if (a big "if") prices could be stabilised, buyers both at home and abroad would have confidence in placing orders, and in consequence a revival in trade would surely take place. This may be taken as a very fair sample of the optimism which has sprung up in regard to trade. It certainly has its effect upon industrial shares. Edisons have recovered from 8s. 9d. to 10s., and, although the other manufacturing issues are still under a cloud, it is no longer so difficult to sell them as it was even a fortnight ago. The report of the W. T. Henley's Company makes a capital showing. The company repeats its 15 per cent. dividend paid for the last three years, and carries forward the substantial amount of £183,000, which is an increase of £42,000 over that of last year. It may be recalled that the present 15 per cent. dividend is equal to 30 per cent. on the capital as it stood before the latter was doubled in 1918. The report mentions that the holding in Henley's Tire and Rubber Company is now £200,000, an increase of £60,000 as compared with a year ago.

City of London Electric ordinary have gone back to 24s. 6d., but on the other hand, County ordinary are better at 7¾, and the preference hold their rise at 8¼. We have heard two or three inquiries lately as to whether the County Company is likely to follow the example of the City of London, and split its shares into the more easily negotiable denomination of £1. Charing Cross and Metropolitan ordinary shares are both ex dividend, showing no particular change allowing for the deductions, which, however, have the effect of making the yields on the shares still more attractive than they were before. Westminsters continue a shade under £5. The Newcastle-on-Tyne report is a good one, but the ordinary shares remain at 15s. 6d.

It may be of interest to remark, incidentally, that last week the electricians employed by one of the big London boroughs presented what amounted to an ultimatum to the Borough Council, stating that any re-adjustment of wages must be considered only on a basic line of 150 per cent. increase over the wages paid just before the war broke out. In other words, the pre-war wage was multiplied by 2½ to arrive at a starting point from which fresh adjustment of wages would alone be considered.

The rises in Home Railway stocks are mostly confined to those in the steam division, where material improvements have occurred this month. Some of the stocks are 10 points higher than they were at the beginning of March. With them have advanced the prior-charge issues, and the pre-ordinary stocks of the Metropolitan, the District, and the Central London companies have kept pace. Metropolitan 3½ per cent. "A" debenture stock has recovered to 55½ and the 3½ per cent. "B" debenture to 53. District prior-lien debenture at 58 and the 6 per cent. debenture stock at 54 are both better. The three issues of Metropolitan 3½ per cent. preferences have hardened to 43, while the 5 per cent. preference has risen to 61. There is a fair amount of cover-margin for the debenture stocks of all the electric companies. The London Electric, the District, and the Central London securities have an additional protection in a Common Fund agreement with three of the Underground Railways and the London General Omnibus Company, which secures the prior-charges of all, before the ordinary stocks of any receive their allotted share of the pooled receipts. The ordinary stocks of the electric companies are steady, without any particular feature declaring itself. Metropolitan is ½ up and Underground Electric £10 shares ⅛ higher, the latter movement replacing the loss of last week.

The feature amongst cable issues is the manner in which Marconi's have spurted. Towards the end of last week a buying movement developed which has lifted the price 3/16 to 38s. 9d., from which it reacted to 1 7/8. Apparently there is something of a bear account in the market, for the volume of buying has been comparatively small. Marconi Marines have risen in sympathy to 25s. 9d. Radio Corporation Common are better at 8s. 3d., the preferred remaining about 10s. 9d. The cable group itself is very quiet. Anglo-American deferred eased off to 16, and United River Plate Telephones at 6⅜ are ⅛ lower. Stock Exchange members regard with curious interest a dozen or more of huge drums outside the Shorter's Court entrance to the markets. The drums bear Callender's lettering, and are said to be awaiting practical use in the direction of further telephonic facilities for the Stock Exchange.

Babcock & Wilcox have risen to 2⅜, an improvement of 5s., the whole of the iron and steel market being decidedly better on the impression, mentioned above, that trade has reached its lowest curve, and that from now onwards the course of industry should expand. Armaments are better for the same reason, there being quite material rises in Vickers and certain others of this class. On the other hand, British Aluminium ordinary are weak at 15s. 9d., British Insulated have dropped to 30s., and English Electrics to 11s. 9d. Metropolitan-Vickers preference, despite the rise in Vickers shares, gave way to 1⅜. General Electrics are harder at 1⅛, and Siemens improved to 20s. 6d. Telegraph Constructions at 20½ are ex the recently paid dividend. Prices in the rubber share market are better, more in sympathy with other markets than for any intrinsic reason. Indeed, the price of rubber has dropped below 1s. per lb.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1919.	Dividend 1920.	Price March 16, 1921.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary..	12	12	6⅛	—	£9 16 0
Charing Cross Ordinary	7	8	8¾xd	—	10 13 4
do. do. do. 4½ Pref. ..	4½	4½	2⅞	—	8 8 8
Chelsea..	4	6	8⅛	—	9 10 6
City of London	13	11	24/6	—6d.	11 8 8
do. do. 6 per cent. Pref. ..	6	6	17/6	—	8 17 2
County of London	8	8	7¾	+ ⅛	10 6 6
do. do. 6 per cent. Pref.	6	6	8¼	—	7 5 6
Kensington Ordinary	7	9	4	—	11 5 0
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref...	8	6	2⅜xd	—	10 18 2
Metropolitan..	6	7	2⅞xd	—	12 8 6
do. 4½ per cent. Pref. ..	4½	4½	2 3/16	—	8 15 8
St. James' and Pall Mall	12	12	8	—	10 0 0
South London	6	—	2⅝	—	9 2 10
South Metropolitan Pref... ..	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	4⅞	—	10 5 2
Telegraphs and Telephones.					
	1918	1919			
Anglo-Am. Tel. Pref.	6	6	80½	—	7 9 8
do. Def.	33/6	1½	16	— ⅛	9 7 6
Chile Telephone	8	6	5½	— ⅛	*5 8 8
Cuba Sub. Ord.	7	7	6¼	—	*10 15 4
Eastern Extension	10	10	16⅞	—	6 8 0
Eastern Tel. Ord.	8	10	160½	—	6 4 7
Globe Tel. and T. Ord.	8	10	15⅝xd	—	6 8 0
do. do. Pref.	6	6	⅞xd	+ ⅛	6 18 4
Great Northern Tel.	22	22	20½	—	10 14 8
Indo-European	13	10	80	—	6 6 8
Marconi	25	25	1⅞	+ ⅛	—
Oriental Telephone Ord.	10	12	2 3/16	—	*5 9 7
United R. Plate Tel.	8	8	6⅜	— ⅛	*6 10 8
West India and Panama	1/3	Nil	3/16	—	Nil
Western Telegraph..	8	10	16	—	*8 5 0
Home Rails.					
	1919	1920			
Central London Ord. Assented ..	4	4	43½	—	9 4 0
Metropolitan	1½	1½	21	+ ½	7 2 10
do. District	Nil	Nil	13½	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅛	+ ⅛	Nil
do. do. "A" ..	Nil	Nil	5/-	—	Nil
do. do. Income ..	4	2	65½	—	2 19 8
Foreign Trams, &c.					
	1918	1919			
Anglo-Arg. Trams, First Pref. ..	Nil	5½	2⅝	—	10 9 6
do. do. 2nd Pref. ..	Nil	Nil	8⅛	—	Nil
do. do. 6 % Deb. ..	6	6	69½	– 1	8 8 0
Brazil Tractions	Nil	Nil	37	+ ½	Nil
British Columbia Elec. Rly. Pfce.	5	5	56	—	8 18 6
do. do. Preferred	2½	5	54½	+ 1	*8 14 0
do. do. Deferred	Nil	8	51½	+ 1	*11 17 6
do. do. Deb. ..	4½	4½	55½	– 1	7 11 8
Mexico Trams 5 per cent. Bonds..	Nil	Nil	39	—	Nil
do. 6 per cent. Bonds..	Nil	Nil	23½	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	18	—	Nil
do. 1st Bonds.. ..	Nil	Nil	61	– 1½	Nil
Manufacturing Companies.					
Babcock & Wilcox	16	15	2⅜	+ ¼	*6 6 4
British Aluminium Ord.	10	10	15/9	— 1/16	12 11 0
British Insulated Ord.	12½	15	1½	— ⅛	10 0 0
Callenders	25	15	1⅜	—	10 18 2
" 6½ Pref.	6½	6½	17/6	—	7 8 7
Castner-Kellner	20	17	2⅞	—	7 12 9
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	10	10/-	— 1/16	—
do. do. 5 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	15/9	—	12 14 0
English Electric	—	8	11/-	—1/6	14 11 0
Do. Pref.	—	6	13/6	—	8 17 10
Gen. Elec. Pref.	6½	6½	18/6	—	7 2 5
do. Ord.	10	10	1⅛	+ 3/32	*8 17 0
Henley	26	15	1⅜	—	10 18 2
do. 4½ Pref..	4½	4½	8¼	—	6 18 6
India-Rubber..	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	1⅜	—	9 17 0
Siemens Ord...	10	10	20/6	—	*9 16 2
Telegraph Con.	20	20	20½xd	—	*5 18 3

* Dividends paid free of Income Tax.

THE INFLUENCE OF TRANSFORMER CONNECTIONS ON THIRD HARMONIC VOLTAGES & CURRENTS.

By S. AUSTEN STIGANT, A.M.I.E.E., M.Am.I.E.E.

(*Continued from page* 302.)

Table II is a summary of the conditions obtaining with different connections of double wound transformers for three-phase service. It has already been seen under the heading of "origin" that third harmonics must occur in either the magnetising current or the voltage of each phase, and it should now be borne in mind that as a power transformer is connected across the supply voltage and not in series with the line the magnetising current will wherever possible take the shape required by the particular connections and condition of service. In consequence of this, where it is not possible for the third harmonic component of the magnetising current to circulate in the primary it will be transferred to the secondary by magnetic induction if the secondary connection is such as to allow circulation of the third harmonic to take place.

When both primary and secondary connections are such as to allow the circulation of the third harmonic component of the magnetising current the component will split up and circulate round each winding in inverse proportion to the impedance of the two windings.

This is the case whether the closed circuit is formed due to the inherent properties of the connection chosen, such as with the delta connection, or due to the conditions of service, such as the star connection with a fourth wire either to the generator neutral on the primary side or to the load on the secondary side.

Table II — Statement on the Influence of Three-phase Transformer Connections on Third Harmonics.

Third harmonics in double-wound, single-phase, core and shell-type transformers and in three-phase, shell-type transformers for three-phase service. Sine wave of applied voltage.

No.	Connections.	Primary				Flux	Secondary			
		Currents		Voltages.			Currents.		Voltages	
		No Load	Line	Line	Phase		No Load	Line	Line	Phase
1	Star IN./Star IN.	Sine	Sine	Sine	Contains 3rd. H. P	Contains 3rd H. F.T.	—	Sine	Sine	Contains 3rd H P.
2	Star N to G/Star IN	*Contains 3rd H P.	*Contains 3rd H P	Sine	*Contains 3rd H P	*Contains 3rd H FT	—	Sine	Sine	*Contains 3rd H P
3	Star IN./Star 4-Wire	Sine	Sine	Sine	*Contains 3rd H P	*Contains 3rd H F.T.	*Contains 3rd H. P.	*Contains 3rd H P	Sine	*Contains 3rd H P
4	Star IN Tertiary Delta/Star IN	Sine in Star 3rd H in Delta P	Sine	Sine	Sine	Sine	—	Sine	Sine	Sine
5	Star IN./Delta	Sine	Sine	Sine	Sine	Sine	Contains 3rd H P	Sine	Sine	Sine
6	Star N to G/Delta	*Contains 3rd H P	*Contains 3rd H P	Sine	Sine	Sine	*Contains 3rd. H P	Sine	Sine	Sine
7.	Star IN/Interconnected Star IN	Sine	Sine	Sine	Contains 3rd H P	Contains 3rd H F.T.	—	Sine	Sine	Sine
8	Star IN/Interconnected Star 4-Wire	Sine	Sine	Sine	Contains 3rd H P	Contains 3rd. H F.T.	—	Sine	Sine	Sine
9.	Delta/Star IN.	Contains 3rd H P	Sine	Sine	Sine	Sine	—	Sine	Sine	Sine
10	Delta/Star 4 Wire	Contains 3rd H P	Sine	Sine	Sine	Sine	Contains 3rd H P	Contains 3rd. H P	Sine	Sine
11	Delta/Delta	Contains 3rd H P	Sine	Sine	Sine	Sine	Contains 3rd. H P.	Sine	Sine	Sine

* In all these cases the third-harmonic component is less than it otherwise would be if—(*a*) The circulating third-harmonic current flowed through a closed delta winding only, or (*b*) The neutral point was isolated.

I N means "isolated neutral." N to G means "transformer primary neutral connected to generator neutral." P means "peaked wave." F T means "flat top wave."

With reference to Table II the following remarks will make the whole question clear, and indicate the broad principles determining the existence of third harmonics in no-load currents, flux, and induced voltages.

1. *Star/Star, both Neutrals Isolated.*—As there are no fourth wires to provide a drain for the third harmonic component of the magnetising current, the flux and consequently the voltage from line to ground must contain third harmonics which appear on both primary and secondary sides. The line voltages and the line currents are not affected; the magnetising current is, of course, sine shaped.

2. *Star/Star, Primary and Generator Neutrals Connected Together, Secondary Neutral Isolated.*—The connection between the transformer primary and generator neutrals provides a drain or return circuit for the third harmonic components of the magnetising currents, so that these currents in the transformers will contain third harmonics. There will be no circulation of magnetising current on the secondary side on account of the insulated neutral point. The sine components of the no-load currents do not flow through the connection between neutrals as they are already balanced in the three phases. As the third harmonic currents must flow through the lines and generator windings then, due to this additional impedance, the currents will be less than if they simply had to circulate round, say, a closed delta secondary only. Consequently the m.m.f. per phase of the transformers is less than that required to eliminate the third harmonic voltages to neutral; that is part of the e.m.f.'s neutralising the third harmonic voltages act across the transformers and part across the lines and generator windings. Therefore a portion of the original third harmonic voltage still appears between lines and ground on both primary and secondary sides, while in addition a third harmonic component of the no-load current circulates in the primary windings and in the lines between transformer and generator.

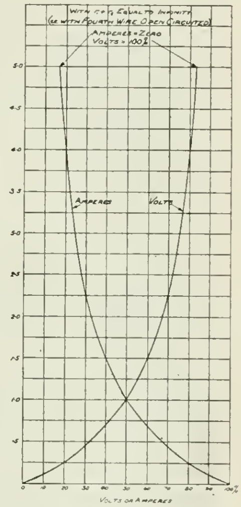

Fig. 9—Curves showing Percentage Third Harmonic Current and Voltage in Star/Star connected Banks of Single-phase Transformers with Fourth Wire on Primary Side.

Fig. 9 shows the proportion of third harmonic current and voltage components occurring with this connection with different ratios of the impedance of lines plus generator windings to transformer windings, and it is to be noted that as this ratio approaches infinity (*i.e.*, disconnected neutrals) the current approaches zero and the voltage its maximum value.

The flux wave, therefore, contains a small third harmonic component corresponding to the resultant third harmonic voltage component, which latter appears in the voltage from line to ground on both primary and secondary sides. The voltages between lines on both sides of the transformer are sine shaped. The no-load current flowing in the primary winding contains a third harmonic component smaller than that which normally occurs in accordance with the ratio of the external to internal impedance. The line current on the secondary side of the transformer remains sine shaped.

3. *Star/Star, Primary Neutral Isolated, Fourth Wire on the Secondary Side.*—In this case the fourth wire on the secondary side operates exactly in the same way for the third harmonic components of the no-load current as does the fourth wire on the primary side in case (2). The factors governing the magnitude of the third harmonic current and voltage components are the same as given under the previous heading, so that with this connection a small third harmonic occurs in the flux wave corresponding to the resultant third harmonic voltage component from line to ground which appears on both the primary and secondary sides. A third harmonic component of the no-load current circulates in the transformer secondary windings and through the line wires and neutral connection. The no-load current in the primary side is sine shaped. All other functions are sine shaped as stated in Table 1.

4. *Star, Tertiary Delta/Star, Primary and Secondary Neutrals both Isolated.*—In this case the auxiliary tertiary delta provides a closed path for circulation of the third harmonic component of the no-load current so that the current in the star primary is sine shaped, and the third harmonic current appears in the tertiary delta only. The flux is a sine wave, and so also are all the voltages and line currents.

5. *Star/Delta, Primary Neutral Isolated.*—The delta connected secondary provides a closed path, and allows circulation of the third harmonic component of the no-load current in a similar manner to the tertiary delta in case (4). On the primary side, therefore, the no-load current is sine shaped, and as the flux wave is also sine shaped, the remaining functions will have this same characteristic.

6. *Star/Delta, Primary and Generator Neutrals Connected Together.*—In this case a closed path is provided on both primary and secondary sides for the circulation of the third harmonic component of the no-load current so that this component will split up, part circulating through each winding in inverse proportion to the impedance of the two circuits. On account of the additional impedance introduced on the primary side by the lines and generator windings, the greater portion of the third harmonic component of the no-load current will circulate in the delta secondary, the remainder flowing through the primary windings, lines, and generator windings. The flux wave will be sine shaped so that the voltages on both sides will be free from third harmonics.

7. *Star/Interconnected Star, Primary and Secondary Neutrals both Isolated.*—As there is no closed circuit on either primary or secondary sides which will allow the third harmonic component of the no-load current to circulate, a third harmonic component will be contained in the flux wave which on the primary star connected side will produce a third harmonic in the voltage wave from line to ground, though not appearing in the voltage between lines. On the secondary side the voltage across the whole of the winding on each transformer if connected in series would also contain a third harmonic component, but by interconnecting the windings of the *different* transformers the third harmonic voltage components of the halves of the windings which are now in series, and electrically constitute each phase, oppose one another, and so cancel out. On the secondary side, therefore, neither third harmonic components of voltage from line to neutral nor of current exist. The secondary line voltage will also be sine shaped. It is to be noted, however, that should a connection be taken from the point where the half of the windings of one transformer is joined in series to the half of the windings of another transformer a third harmonic voltage component will be contained in the pressure from this point either to neutral or to the line. The no-load current flowing in the primary side and also the primary and secondary load currents will be sine shaped.

8. *Star/Interconnected Star, Primary Neutral Isolated, Fourth Wire on Secondary Side.*—It was shown under the previous heading that no third harmonic component of the voltage from line to neutral existed on the secondary side, and therefore the addition of a fourth wire on this side will not result in a circulation of third harmonic current component as there is no voltage component to maintain such a flow. The conditions, therefore, will be exactly the same as with the previous connection.

9. *Delta/Star, Secondary Neutral Isolated.*—The conditions with this connection are identical with those obtaining for the star/delta under sub-heading (5), with the exception that the whole of the no-load current is supplied on the primary side as the third harmonic component circulates in the delta winding. All other functions are sine shaped.

10. *Delta/Star, Fourth Wire on Secondary Side.*—From the point of view of third harmonics this case is the reverse of that outlined under sub-heading (6). A closed path is similarly provided on both primary and secondary sides for the circulation of the third harmonic component of the no-load current, so that this component will be split up, part circulating through each winding in inverse proportion to the impedance of the two circuits. In this case additional impedance is introduced on the secondary side by the fourth wire and the load, so that the greater portion of the third harmonic component of the no-load current will circulate in the delta primary, the remainder flowing through the secondary windings, lines, and load. The flux wave will be sine shaped, so that the voltages on both sides will be free from third harmonics.

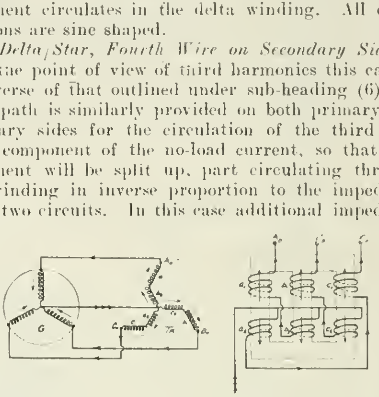

Fig. 10.—Paths of Third Harmonic Currents.

11. *Delta/Delta.*—In this case the closed delta windings on each side of the transformer offer a path of minimum impedance for the flow of the third harmonic component of the no-load current which will be split up, part circulating through each winding in inverse proportion to the impedance of the two circuits. The flux wave will be sine shaped so that the voltages on both sides will be free from third harmonics.

A note of warning should be struck against the advisability of joining together the generator and transformer primary neutrals (either *via* earth or direct by a fourth wire) *if the transformer primary is connected in the interconnected star manner.* If the neutrals are joined a third harmonic current may flow in the fourth wire resultant from third harmonic voltages in the source of supply, and due to the splitting and interconnection of the transformer primary windings, the third harmonic exciting ampere turns, and consequently the induced back e.m.f.'s in the halves of the windings on each limb of the transformer, neutralise each other, thereby providing a low impedance path (virtually a short circuit, so far as transformer reactance is concerned) for the flow of third harmonic currents. Such currents would only be limited in magnitude by the impedance of the generator winding and by the resistance of the connecting cables and transformer windings, and they would reach such large values in practice as seriously to overload the transformer and generator windings. Fig. 10 shows the paths of the third harmonic currents, and in both sketches the opposition of third harmonic exciting ampere turns in the halves of the windings on each limb of the transformer will be seen.

The final conclusions arrived at under headings (1) to (10) of the tabular statement apply strictly to single-phase transformers of both shell and core types, and to three-phase shell type transformers, as with each of these types of construction the magnetic circuit of each phase is complete in itself, and no interchange of m.m.f. and flux occurs between the phases. With three-phase core type transformers of the usual construction in which there are three limbs only, the case is somewhat different. With this type of transformer any third harmonic fluxes tending to flow would have the same instantaneous direction up or down each limb, and in order to preserve the magnetic balance of the core the third harmonic flux in each limb must find its return path outside the core through the oil (or air) and tank. Such a path is of very high reluctance, and consequently the third harmonics in the flux and induced voltage waves are very small.

[The following are the equations to curves reproduced in our last issue:—

Figs. 3 and 7A.—$i_m = 1{\cdot}16 \sin \theta - 0{\cdot}635 \sin 3\theta + 0{\cdot}365 \sin 5\theta + \ldots$

Fig. 5.—$B = 3{\cdot}36 \sin \theta + 0{\cdot}77 \sin 3\theta + 0{\cdot}19 \sin 5\theta + \ldots$

Figs. 5 and 7B.—$E = 4{\cdot}8 \cos \theta + 3{\cdot}3 \cos 3\theta + 1{\cdot}36 \cos 5\theta + \ldots$

An unfortunate error occurred in engraving the block for fig. 3, p. 301. Apparently in making the block a flaw appeared, and the engravers, in making it good, inaccurately touched in the rising part of the curve of magnetising current i_m, so that it crosses the zero axis 30 deg. ahead of the induction B. As hysteresis effects are excluded in fig. 3, the magnetising current and induction waves are in phase, and should intersect on the axis, as correctly shown in the descending portion.]

(*To be concluded.*)

A THIRD WEST RIDING (AIRE AND CALDER) ELECTRICITY SUPPLY SCHEME.

Consequent upon the provisional delimitation of the above-named district, two schemes have been submitted (one by the Leeds Corporation,* and the other by a Conference of West Riding Local Authorities†) for the improvement of the existing organisation for the supply of electricity in, and the formation of a Joint Electricity Authority for, the area. Certain representations have, however, also been made by the orkshire Electric Power Co. in connection with the district. he Power Co.'s proposals, which are signed by Mr. W. B. Voodhouse, engineer and manager to the company, point out, *ter alia*, that the proposed district is almost wholly within the area of supply granted to the company by the Yorkshire Electric Power Act, 1901, but does not include a large and important part of the company's area. The company objects to the division of its area of supply on the grounds that it will restrict the operation of the company as one undertaking, will increase working costs, and will be disadvantageous to the users of electricity. Certain districts forming a small portion of the proposed district are outside the present area of supply of the Power Co., but it would be prepared to undertake the supply of electricity if required to do so in such districts. The company's area of snpply extends into three proposed electricity districts as shown in the accompanying map, for each of which the Commissioners require schemes to be submitted.

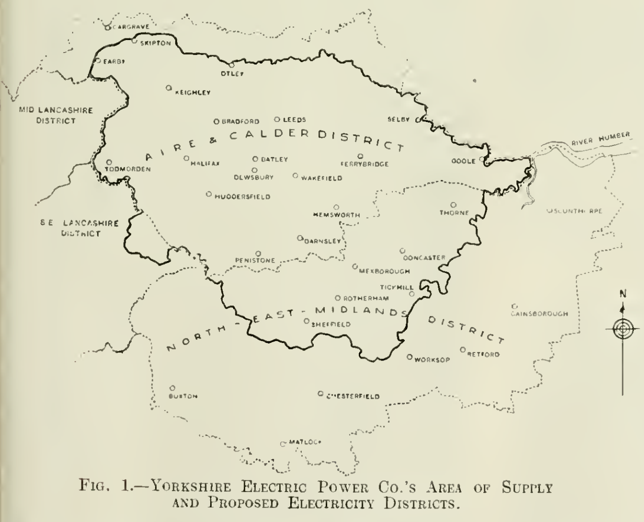

Fig. 1.—Yorkshire Electric Power Co.'s Area of Supply and Proposed Electricity Districts.

The company submits that no necessity can be shown for the establishment of a Joint Electricity Anthority in the proposed district; the company was created by Act of Parliament substantially for the purposes for which a Joint Electricity Authority would be established, and Section 12 of the Electricity (Supply) Act, 1919, recognises the special position of the Power Co. by restricting the supply of electricity by a Joint Electricity Authority in the Power Co.'s area.

It is submitted that rapid development of supply can best be maintained by the utilisation of the existing organisations. The purchase by a Joint Electricity Authority of existing undertakings would result almost certainly in an immediate increase in the cost of electricity to the consumer, and would involve either financial assistance from the State or an obligation on the ratepayers to defray losses out of the rates, which burden would largely fall on districts in which a supply of electricity from the company is now available without any risk to the ratepayers. The company has in the past found large sums of money, and is prepared to find such further capital as may be necessary; in view of the existence of the Power Co. the creation of a Joint Electricity Authority would involve uneconomical duplication aud unnecessary expense.

The delay already occasioned by the restrictions imposed prior and subseqnent to the passing of the Electricity (Supply) Act, 1919, has created a serious position of affairs such that new and extended demands for power have been delayed. The company proposed, in 1918, to construct a capital power station at Ferrybridge, and in conjunction with the Mexborough District Council, another station at Mexborough, bnt the company has not been permitted to proceed with either of these much-needed works pending the proposed inquiry (which is to be held at Leeds on April 15th next). Any further delay such as would be inseparable from the constitution of a new body would result in a serious shortage of supply, which would cause uneconomical stations to be extended; manufacturers and others who require power immediately will be forced to install their own power plant, and the economy of capital and of working expenses which would have been obtained will be lost.

In the company's area of supply there are 62 electricity undertakings, a large measure of unification has already been brought about, and the existence of an extensive system of mains makes further unification easy of attainment. Of the undertakings 24 are owned by Electrical Distribution of Yorkshire, Ltd., a company workiug in conjunction with the Power Co., and of the 62 undertakings the company is supplying or has entered into an agreement with 40. Seven of the remainder have not commenced to supply electricity, leaving 15 of the working undertakings not yet associated with the company, bnt the company is willing in all these cases to enter into agreements for supply.

The agreements which the company has made include agreements with the Corporations of Bradford, Rotherham, and Sheffield, for interchange of supply, mutual assistance and the avoidance of overlapping, and it is submitted that a continuation of development on these lines, subject to the control of the Commissioners, will produce the best results. In recent years there has been a growing spirit of co-operation, and the powers granted to the Commissioners give sufficient assurance that future developments will not be obstructed.

The rapid growth of the company's undertaking is indicated by its annual revenue as follows: 1911, £36,829; 1914, £71,304; 1917, £146,272; and 1920, £381,693.

The company's area of supply includes the Yorkshire coal field, which extends continuously from north to south across the boundary of the proposed district, and the company's extensive system of mains is available, not only for supply to collieries and all classes of users, but for taking power from those collieries which may have a surplus derived from waste heat. The company has already entered into several arrangements of this nature, and in particular the company's Barugh power station utilises as fuel a large amount of surplus coke-oven gas, and an arrangement has been entered into for a further large supply of gas fuel to this station which will result in a still larger saving of coal.

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* Elec Rev., p. 95, Jan. 21st, 1920.

† Elec. Rev., p. 324, March 11th, 1921.

In view of possible developments in the use of low-grade fuel the co-operation of the Power Co. with the colliery owners is likely to have an important effect in reducing the cost of producing electricity in the future. It is submitted that in such new developments a company undertaking will obtain the best results.

The maintenance of the company's rapid development and the provision of the further large capital sums required will depend largely on the continuance of confidence on the part of investors that, subject to the proper performance of its statutory obligations, the company's security will not be disturbed by the granting of overlapping powers to any other body. If the Commissioners are of opinion that, although the present time is inopportune for the creation of a Joint Electricity Authority, a provision for the future purchase of the company's undertaking by a Joint Electricity Authority would be desirable, the company will be prepared to consider such a condition. It is urgently necessary to proceed with the construction of a power station at Ferrybridge without further delay.

The company requests that the proposal submitted to the Corporations concerned in December, 1919, as set out below, be dealt with by the Commissioners under Section 19 of the Electricity (Supply) Act, 1919: (*a*) The Corporations of Bradford, Halifax, Huddersfield, and Leeds, and the Yorkshire Electric Power Co., to enter into an agreement for co-operative working of their generating stations, interchange of supply, and mutual assistance. (*b*) Each of the parties to retain the ownership and management of their respective generating stations, and to generate energy for their own requirements and for the purposes of the joint arrangement as required from time to time. (*c*) Provision of further generating plant from time to time to be made by agreement between the parties, or failing agreement, the Commissioners to decide which party shall provide the plant required. The party making provision of generating plant may require the other parties to enter into agreements to take supply to an amount and for a period and on terms which will justify the expenditure incurred. (*d*) The parties to supply energy to one another on terms which will encourage generation in the most economical manner.

The company requests that the restriction on the supply of electricity for lighting in districts where there are no authorised distributors, imposed by Section 48 of the Yorkshire Electric Power Act, 1901, be removed and, if considered necessary by the Commissioners, the company is prepared to assist in the formation of a joint committee representing authorised undertakers, local authorities, consumers of electricity, and other interests with the objects of: (*a*) Making recommendations as to the co-ordination of the activities of various authorised undertakers; (*b*) taking into consideration the economical and efficient supply of electricity to meet the requirements of the area and the existing provision made for that purpose; and (*c*) acting in an advisory capacity to the Electricity Commissioners and such authorised undertakers.

If so desired, powers to be granted to any local authority in the company's area to give financial assistance in any form to the company, subject in each case to the approval of the Commissioners. It may be that some or all of these proposals are beyond the powers of the Electricity Commissioners to grant, in which case the Company requests the Commissioners to support an application by the company to Parliament for the necessary powers.

THE TEMPERATURE LIMITS OF LARGE ALTERNATORS.

Discussion at Leeds.

Mr. G. A. Juhlin read his paper on the above subject, which was abstracted in our issues of February 4th and 11th, to the members of the North Midland Centre of the Institution of Electrical Engineers, at Leeds on February 8th. The chair was occupied by Mr. W. M. Selvey, Sheffield, who regretted that the chairman of the Centre (Mr. J. C. Jewell) was prevented from attending, and remarked that Mr. Juhlin was the principal electrical designer for the Metropolitan-Vickers Electrical Co., and spoke with authority.

In opening the discussion, Mr. Selvey said that if they had actually been getting at the hottest spots temperatures approaching those which Mr. Juhlin proposed to standardise, then Mr. Juhlin was absolutely justified in bringing forward a plea for facing the music. He, the speaker, remembered the first really large power station in this country and what their experiences were. In those days they were never able to catch up to their load, and he thought that, with very few exceptions, that was the state to-day and would be so for the next five years or longer. Although they hoped for wonderful things to be done under the new Electricity Act what little experience they had had of it so far did not suggest speed. The earlier experiences of electrical power were based on a load in which diversity, as they knew it to-day, had not proved its full benefit in levelling up the load; one of the items in the early specifications for turbines was a system of governing which would stand up to very wide fluctuations without appreciable change of speed, particularly applied to keeping a constant voltage on load, which was a very material thing in those early days. That resulted in turbines being fitted with very sensitive forms of governors. The only way to meet the specification was that the over-load, or the load which could be given by the turbine, should be very large compared with its normal rating, and the consequence was that their early turbines, particularly those which Messrs. Parsons were responsible for, could always give 50 or perhaps 100 per cent. overload, according to the conditions at the steam end; the generators that were driven by those machines were wound as they then thought in very generous and ample proportions. Judging by their thermometer tests their rotors and stators were remarkably cool; therefore, a machine which was intended to work at from 3,000 to 3,500 kW, because of those temperatures and because of the tremendous over-load capacity at the steam end, almost immediately got rated up, not by desire, but because the load was always growing so fast that if there was any excuse to use it for higher rating it was so used. The consequence was that those machines had no sooner been put into service than their every-day load grew from 3,500 to 5,000 kW, which did not mean that they were always definitely and entirely run at 5,000 kW, but that there were many times when there was no other alternative. Then a great change came over the scene, and it was only just beginning to come into operation to-day; that was, running machines at higher than what had been the standard speeds, and on the whole with extremely satisfactory results. The question of heat dissipation was something which was operating in a reverse direction on their economy of material; it was economical to adopt a higher speed if the heat losses of the machine were not different, and there were many reasons why they should use bigger machines running at 3,000 r.p.m. if they could have confidence in their insulation. As regarded the larger machines, Mr. Juhlin was showing them the way to an entirely inorganic mineral form of insulation, he was still proposing to use some organic binding material, but at any rate it was an improvement. If they introduced any change in one direction nature always introduced a counter-change which affected the value of what they were trying to do. A good insulator for electricity was, generally speaking, a good insulator for heat; therefore, by using a mineral or silicate form of insulation they adopted a type which tended to keep up the temperature of the metal which it enclosed, but if the insulation was not organic material and could stand high temperatures as mica did, then their old idea about temperature had no foundation. That was a very difficult mental attitude to grasp. Obviously the heat insulating property of the insulation was entirely changed, a mere temperature rise on the outer surface was no longer a criterion, and they had to reconstruct their point of view. Therefore, they must now endeavour to get at the hottest spot and make that the standard, because that was the only thing which really mattered; if everything was pretty safe there, it must be safe elsewhere, and it only remained for them to attack the problem by a new method, that was, to embed some detector right at or near the hot spot. But Mr. Selvey had still some little doubt whether it was possible to do that without interfering in some way with the general solidity of the work in the generator as a whole. One other point which was very material was the difference between 11,000 and 6,000-volt machines. That was going to be quite a big question. Mr. Juhlin said that they must be prepared to run at still higher temperatures at 11,000 volts, because with pure mica insulation they had a bigger temperature gradient. If they had more insulation they would have less room for copper; on the whole they tended to run at a higher density in that copper with higher losses. If that was so there might be a material difference of the order of from 5 to 10 per cent. in the output per lb. of fuel of 6,000 and 11,000-volt machines, and there was an enormous temptation to use 11,000 volts so long as they could.

Mr. Creedy was much interested in Mr. Juhlin's application of the Miles Walker method of calculating temperature rises. He had tried from time to time to make use of the method as described in Prof. Miles Walker's book, but no doubt owing to the causes he had mentioned, and to variations in the tightness of packing of insulation and matters of that character, he had never been able to get satisfactory results. The method seemed to him to be one by which hot spot points could be calculated, not only in turbo-alternators, but in machines of all kinds. The stresses on the rotor of a turbo-generator in the case of short circuit, he took it, were just the same as those on the stator. Were there not methods of limiting those stresses by the use of choker coils and apparatus of that kind to cut down the short-circuit current?

Mr. Spurr considered that the specifying of low temperatures could be assumed to be a method of playing for safety. Authorities would specify for higher temperatures if they felt they could rely on them. Mr. Juhlin's list of failures gave three mechanical and two electrical, but the best of his designs could be wrecked by careless assembling. Mr. Spurr had in mind large stators which were assembled on site, or handled on the railway. Although armature winders were very careful, yet they were often expected to work and make a good job under very adverse conditions. He believed that some big machines had been wound recently under conditions which made it impossible to expect anybody to work well, and if he was right in his surmise, one of those machines had failed because it was assembled under conditions under which it had no business to be, that was, exposed to weather and uncomfortable circumstances all round. In overcrowded shops things were thrown about anyhow, men were not careful enough, and it did not take very much bad handling of a coil to make it defective. He thought more help could be given to contractors working in a station towards making sound jobs. Another thing that might cause a failure was the air filter. In the United States the blast-furnace people had taken to refrigerating the air after it had passed through the filter in order to dry it; cold air was usually dry air, and he thought that before very long station engineers would have to rely on having a refrigerator plant under their charge. They would then be able to maintain the same temperature all the year round on their alternators, and they would not have machines running at a higher load in the winter and a lower load in the summer.

Mr. J. D. Bailie observed that nearly 25 years ago at a colliery not far from Leeds they had used asbestos insulation on d.c. generators of 150 kW rating at 500 volts. Those machines were still in use. Were the high temperatures referred to by Mr. Juhlin in his tests maintained continuously over the long periods of time named? If so, he thought it would have been of interest if similar experiments had been carried out, but with the current applied for twelve hours and cut off for twelve hours alternately over the whole period of the test—the object being to ascertain the effect of the alternate expansion and contraction of the conductors which would result. The object of anchoring the end windings by wide metal rings was to provide a rigid support. Would not the tendency of those rings, however, with the windings subjected to the high temperatures contemplated, be to prevent their longitudinal expansion, and so to stress the windings against the rings? A point in favour of the higher temperatures proposed, which did not appear to have been touched on so far, was that their effect would enable the diameter of the rotor to be reduced. That, in turn, would be favourable to the use of higher speeds of rotation by reducing the peripheral speed of the rotor. He believed there had been a tendency of late to run rotors at higher peripheral speeds than desirable, up to something like 450 ft. per second. Wet-air filters were not supposed to pass moisture—but did. His firm made a practice of testing the air for moisture by a method which seemed to be fairly satisfactory. His personal feeling was very much in favour of closed-circuit air coolers which were, he believed, being adopted largely. There were many machines running in the country at 11,000 volts, for example, in the stations of the Sheffield Corporation and the Yorkshire Electrical Power Co., and the difficulties had been very slight indeed. Some 15 years ago they installed two 1,500-kW turbo-alternators at 11,000 volts which were still running satisfactorily. Where the requirements were in favour of 11,000 volts, such, for example, as when the supply was for what might be termed local use, rather than for long-distance transmission when a step-up transformer would be used, there seemed to be no very sound objection to it as the generating voltage. He was entirely in agreement with Mr. Juhlin in his advocacy of the ultimate temperature rather than the rise in temperature being specified.

In replying to the discussion, Mr. G. H. Juhlin pleaded that they should not shut their eyes to the conditions under which they had been operating their machines for a number of years. The chairman had referred to the good old days when they had had machines as big as houses, and which had stood overloads. Well, there were certain reasons, and they were now altogether out of the question. The machines were not designed to stand those enormous overloads. In those days they were designing machines for close voltage regulation; that simply meant that their stators were not loaded up anything like they were to-day, and the rotors operated under totally different conditions in so far that an increase in load did not mean the enormous increase in magnetising current that it meant to-day when they overloaded a machine. When machines were being designed for 5 per cent., regulation 2.5-in. air gaps were nothing out of the common. To-day they were running machines three times the size with less than half the gap, so they got a totally different relationship between armature strength and field strength, with the consequence that the capacity was there—the machines were not designed for it, but it just happened because of the condition. They were running at much higher speeds; therefore, the windage losses were much higher, but although their total heat losses were no smaller they were distributed slightly differently. Unfortunately it was not commercially possible to produce insulation consisting of nothing but mica: they had to use a small amount of paper, but they were reducing that to the absolute minimum. They had found that by improved methods of manufacturing the mica insulation, and applying it on the coils, they could get anything from 33 to 50 per cent. more wrap in the same space, which meant that they were squeezing out binding material as much as possible, and were also eliminating any small air spaces that might be in existence. Consequently, if the insulation swelled due to slight clearance in the slot it was still as tight when it was swollen as when it was put in, so that they were approaching, he thought, very much nearer the ideal condition in insulation. He did not propose a higher limit for 11,000-volt machines; what he did want to convey was that, in measuring surface temperatures, they would have with the same surface temperature in two similar machines a much higher temperature in the 11,000 than in the 6,000-volt machine. That was the crux of the whole position. If they designed their machines with embedded temperature detectors then they put the 6,000 and 11,000-volt machines on the same basis. They were operating both of them on internal temperatures, and they knew they were not reaching higher temperatures in the one than in the other, a definite step forward. Experience had shown that rotors never suffered from short circuits, but stators on the other hand, in some cases did. Mr. Creedy's suggestion of introducing choker coils had been applied quite extensively. Reliability was the first and foremost question and always should be. If he (Mr. Juhlin), as a representative of a manufacturer, could go to anyone in the country and say: "Our machines have not broken down for five years," he thought people would flock to buy them and they would then be able to command higher prices than anyone. That was what they were striving for. They were not striving to build cheap machinery, but machinery which would do its service and do it well. Assembling machinery on site was a point which was very often lost sight of. It certainly would help manufacturers enormously if satisfactory facilities were given on sites when machines were being assembled. Winders were only human, and when they considered the enormous responsibilities that devolved upon them it was up to everyone to give proper facilities to them. His (Mr. Juhlin's) company had given up very largely the use of the wet filter; it decreased the margin of safety. At the present time they had some 20 or 30 machines going through the works with closed-circuit air coolers, which eliminated any filter altogether, and did not introduce any dust or dirt into the machine. With regard to refrigeration, he had no doubt but that they would arrive at a time when the air would be cooled down below the atmospheric conditions, but how far off that time was he would not venture to say.

THE LONDON AND HOME COUNTIES ELECTRICITY SUPPLY SCHEME.

The London County Council's scheme for the reorganisation of electricity supply in and the establishment of a Joint Electricity Authority for the above-named district has already been preliminarily outlined.[*] The scheme itself, so far as its administrative and financial arrangements are concerned, is generally similar to the other schemes which have been outlined in our pages. A committee consisting of Sir A. B. W. Kennedy and Mr. G. W. Partridge, appointed by nine of the principal electricity supply companies within the area, Mr. J. H. Rider, appointed by the L.C.C., and Mr. C. H. Wordingham, by the Conference of Local Authorities Owning Electricity Undertakings in Greater London, was formed in May, 1920, to prepare the technical part of the scheme, and has had the co-operation of Sir Philip Dawson with regard to railway electrification and power demands therefor. What follows is an abstract of the report.

The area of supply, as provisionally determined by the Commissioners, contains approximately 1,700 sq. miles, with 84 separate electrical undertakers (omitting independent electric railway and tramway systems) operating some 77 different power stations. The systems of generation comprise d.c., single-phase, two-phase, and three-phase a.c., generated and supplied to the consumers at a number of different pressures and frequencies. In certain outlying parts of the area no supplies at all are given at present. The aggregate maximum demands (excluding separate railway and tramway systems), have been as follows:—

Year.	kW.	Millions of Units.	Load Factor, per cent.
1913-14	240,700	454	21.5
1917-18	293,000	653	25.4
1919-20	320,600	608	21.6

During 1919-20 70 per cent. of the units were sold within the County of London, and the total amount of generating plant in the various power stations at midsummer, 1920, was as follows:—

	kW.
At work or available	(about) 480,000
In course of erection, on order, or sanctioned	(about) 255,000
Total	(about) 735,000

The whole of the plant which is now in course of erection, on order, or sanctioned, is of the modern turbine type, mostly of sizes varying from 5,000 to 10,000 kW. The value of this new plant is about £4,500,000. The average actual works cost of generation, excluding rents, rates, management, and capital charges, has been as follows:—

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[*] Elec. Rev., p. 169, Feb. 11th, 1921.

Year.	Works costs per unit sold.
1913-14	0.69 d.
1917-18	0.99 d.
1919-20	1.55 d.

The average fuel consumption (so far as can be ascertained) expressed as B.th.u. per kWh generated, during the last recorded year, was 38,900 B.th.u. The lowest consumption was 27,000 and the highest 92,000 B.th.u. per unit. The above average figure corresponds to a consumption per unit of about 3.7 lb. of fuel, having a thermal value of 10,500 B.th.u. per lb. Even before the war, the capital charges (including interest, sinking fund, depreciation, &c.) amounted, on the average, to no less than about 50 per cent. of the total price charged to consumers, and this percentage is likely to be still further increased.

The growth of demand within the area over the last four or five years has been at the rate of about 18,000 kW per annum, but the total demand, by the time that any capital stations can be ready, will have increased from its 1919-20 amount of 320,600 to about 470,000 kW, and by 1931, the demand may have increased to about 600,000 kW. These figures are independent of the probable railway demand, which, if it were supplied from the general system, would add, according to the estimates of the railway companies themselves, about 200,000 kW by 1931. If these figures be justified by events, the total demand ten years hence will be about 800,000 kW.

The average annual load factor has changed very little during the last ten years, in spite of the fact that the industrial load, including heating, now takes up a much greater proportion of the total power than it did ten years ago. During the last two years the maximum load has increased by 27,000 kW, while the units sold have diminished by over 45 millions. The committee made a detailed examination of what the possible diversity factor over the area of supply would be if all the principal undertakings were to be supplied from one single source. Even in this case (an impracticable one) the diversity factor would only amount to 1.07. That is to say, the sum of the maximum demands upon the various individual stations would only be 7 per cent. greater than the combined maximum demand upon a single station. Under any actual conditions, therefore, with several generating stations at work, it would not appear large enough to make any appreciable difference in cost of plant. Naturally, if tramway or railway loads (having perhaps a 40 per cent. annual load factor) were at the same time carried by the single station, its average load factor and, therefore, especially its economy in capital charges per unit, would be increased.

For the first stage of the scheme, the committee recommends that the power stations in the whole area (apart from certain outlying stations and districts which have to be dealt with separately), should be divided into groups, within each of which generation would be continued in certain power stations ("auxiliary power stations"). These stations would be linked together and would serve, for the time being, as bulk supply stations for the remaining power stations in the group, which would then cease altogether to be generating stations, and become sub-stations. The supply in bulk to the closed-down stations would be given through secondary high-pressure mains, the current being transformed to l.p. d.c. or a.c. for local distribution. The mains interconnecting the various stations of each group would work either at about 6,600 or 11,000 volts.

The second stage of supply would commence when capital stations were ready for work; these stations should supply at 33,000 volts, and should be connected to points in the area (in most cases the sites of the now existing power stations) where the e.h.p. would be stepped down to the secondary pressure, whatever that might be. When this condition had been reached, it would be possible economically to shut down more of the older power stations which had been kept at work, and to substitute for their generation the supply of stepped-down current from the capital stations.

The first stage of the scheme may possibly be completed in 1925-26, or at the earliest date at which bulk supply can be given from the capital stations; the total fuel saved at that time, over the whole area dealt with, will be at the rate of about 500,000 tons per annum, as compared with the quantity which would have been consumed with the same output had the conditions of 1919 continued.

By providing e.h.p. interconnecting mains between them the different portions of the area could be, if necessary, completely separated at times of peak load, so that the consequence of any serious failure of mains or plant would be localised as much as possible, while at times of light load the auxiliary power stations in certain portions of the area might be shut down, and the supply taken entirely from the capital stations. Further to minimise the effect of any local breakdown it is proposed that each capital station should be subdivided into two or more entirely separate sections, each complete in itself as regards boilers, generators, condensers, transformers, and switchgear These sections would be arranged so that they could be disconnected or connected as and when required.

During the second stage of the scheme two of the existing power stations which are advantageously situated for their special requirements should be practically reconstructed and enlarged, utilising the new plant which is at present going into them, and extended with further new plant. They would then serve as capital power stations. This work should be completed at any rate within about ten years from the formation of the Joint Electricity Authority. It is probable that it may be desirable and economical to transfer certain plant (in large units) from stations which it is thought on the whole ought to be closed, to others which would be continued in operation for some time.

There should be a control centre for each group of power stations, where an engineer-in-charge would be in telephonic communication with all the power and sub-stations within the area of his group, and must have complete responsibility for the distribution of the load at different hours and on different days, between any stations in the area which were at work. This is necessary especially to ensure that the highest load factor should be given to the plant which could be most economically worked, while other plant or other stations were utilised at times of peak load. A central control for the whole of the area must further be able to prescribe the method of working as between the different groups. This system of control would have to come into effect as soon as the capital stations were at work. In each group control, and especially at the central control, it is desirable that there should be visual signalling arrangements which would tell the engineer-in-charge exactly what station or plant was working at any particular moment, and how the output was apportioned.

Both the power stations and trunk mains should come under the control of the Joint Electricity Authority when it is formed, whether the systems be purchased outright, or taken over in some other way, and it has also been assumed that the local distributing powers would remain for some extended period entirely in the hands of the present undertakers. Arrangements might be made with some of the railway companies now owning power stations, or which might build power stations primarily for their own needs, to erect additional plant and to give a supply to the Joint Electricity Authority.

The most advisable pressure of supply on the e.h.p. mains from the capital stations is 33,000 volts between conductors. Wherever possible, the system of laying 3-core armoured cables direct in the ground should be adopted, except, perhaps, in some of the outlying portions of the area where overhead conductors could advantageously be used; it may be advisable to use single-conductor cables in some cases where the 25-cycle system is employed. Considering the difficulty of laying and jointing mains in the Metropolitan area, of obtaining access in case of faults, as well as the possibility or necessity (in certain cases) of using a draw-in system, it is necessary that the number of cables and the pressure between the conductors should be kept as low as is economically possible.

Energy at 33,000 volts would be transmitted from the capital stations to certain selected points in the various portions of the area, at which it would be stepped down to 6,600 or 11,000 volts, as the case might be, and paralleled with the supplies from the auxiliary power stations. Authorised distributors would receive the supply at either 6,600 or 11,000 volts in the form of 3-phase energy, and any transformation beyond that, either to 2-phase alternating, to l.p. d.c., or to l.p. a.c., for distribution purposes, would take place either at existing sub-stations or at existing power stations used afterwards as sub-stations. The energy supplied by the Joint Electricity Authority would be metered on the 6,600 or 11,000 volt side at the sub-stations. The standard frequency for the area on the north side of the river Thames should be 50 cycles per second, but on the south side of the Thames, both 50 and 25 cycles should be available, owing to the fact that, at the present time, a much greater proportion of the power and traction supply on the south side is given at 25 cycles than at 50 cycles. Interconnection between the two different frequencies, if it should be required, could be carried out by suitable frequency changers installed in sub-stations or in power stations. Such frequency changers have been in use in the London area for a considerable number of years, and are to-day being manufactured up to sizes of 5,000 kW.

During the development of the first stage of the scheme the erection of four new capital generating stations would be commenced, three on the north side of the river Thames and one on the south side. The second stage of this scheme would begin as soon as these stations were at work. Three of the sites are to the east of Blackwall Tunnel, and one is an up-river site.

The creation of obligatory sinking funds, in many cases for comparatively short repayment periods, is likely seriously to affect the ability of the Joint Electricity Authority to sell electrical energy to railway companies at a price as low as such companies could produce it in their own stations. The probable extent of the railway load has already been mentioned and its acquisition by the undertaking of the Joint Electricity Authority is of paramount importance, and this point should be impressed upon the Electricity Commissioners with a view to a reconsideration of the whole matter.

The cables will be three-core, paper insulated, lead covered and armoured, and will generally be laid direct in the ground: in special cases unarmoured cables will be drawn into ducts, and the sizes used will be 0.15 and 0.25 sq. in. In certain outlying parts of the area overhead transmission may be adopted. During the first stage it is proposed to shut down progressively 34 generating stations, and, by means of interconnecting cables, to supply such stations in bulk from the remaining stations. At the same time certain capital stations would be erected, and, as these became ready for work, the second stage would be reached. Twenty-six of the remaining generating stations would then be progressively shut down. Of the remaining 17 stations existing in the area, two would be reconstructed and considerably enlarged to act as capital stations, and seven would be permanently retained to act as auxiliary generating stations in conjunction with the new capital stations. The other eight, near the outskirts of the area, would have to be kept at work for a considerable period until it became commercially possible to extend the transmission mains to their neighbourhood. The installed capacities of the capital stations would vary, in the first instance, between 70,000 and 200,000 kW. mostly in units of 25,000 kW. Several of the sites would permit of much larger stations if required.

It is not proposed that any works should be constructed by the Minister of Transport, under Section 18 of the Electricity (Supply) Act, 1919.

It is proposed to leave the existing generating station (tramways) of the London County Council (Greenwich), and the existing generating stations (railways) of the Underground Railways (Lots Road), Metropolitan Railway Co. (Neasden), Great Western Railway Co. (Park Royal), London and South-Western Railway Co. (Wimbledon), and London and North-Western Railway Co. (Stonebridge Park), to supply energy as heretofore to their respective systems.

In most cases the plant at these stations is already fully loaded, and no good purpose would be served by incorporating it in the general system of supply; moreover, two of the stations, viz., Lots Road and Neasden, supply at a non-standard frequency of $33\frac{1}{3}$ cycles. Any railway system in the area, not already electrified, would be able to obtain its supply of energy from the new capital stations, while additional supplies could be given from them to those railways already electrified. On the south side of the river Thames supplies at either 25 or 50 cycles would be available, and on the north side a supply at 50 cycles.

The estimated capital expenditure by the Joint Electricity Authority for the first stage of the scheme, ending 1925-26, is: (*a*) Secondary transmission and interconnecting mains, including switchgear and transformers, £2,050,000; (*b*) primary transmission mains from capital stations, including switchgear and step-down transformers, with buildings, £2,000,000; (*c*) capital stations (first portions of) (200,000 kW installed capacity), £8,000,000; and (*d*) interest on capital during construction (say), £1,000,000, the total being £13,050,000. For both the first and second stages, ending 1930-31, it is as follows: (*a*) £2,550,000; (*b*) £4,700,000; (*c*) 875,000 kW installed capacity £22,000,000; and (*d*) £1,500,000, the grand total being £30,750,000. The above estimates are based on present-day prices, but do not include the cost of the acquisition of existing generating stations or of existing interconnecting mains.

THE HEATING OF BURIED CABLES.

Discussion at Liverpool.

The N.P.L. report on the above research work, which was abstracted in our issue of December 31st last, was discussed before the Liverpool Sub-Centre of the North-Western Centre of the Institution of Electrical Engineers on February 7th. Mr. E. B. Wedmore introduced the report, and was followed by Messrs. Melsom and Fawssett, and Dr. Marchant, who each in turn introduced his contribution to the research work.

Mr. J. A. Morton opened the discussion, pointing out that the report left the information in such a form that it was not readily available for use by cable users, although it was useful to the manufacturer. They wanted tables or simple formulæ. Now the ground had been cleared in that preliminary report, the question was what next to do to bring about that desirable consummation. Dealing with paper cable, it would probably be necessary to obtain lengths of armoured cable built to the B.E.S.A. (July, 1919) standards (preferably all from one maker), a small, medium, and large size of each type. Temperature rises could be obtained in earth with a certain moisture content and depth, and corrections would be made to certain agreed standard K values of dielectric and soil, and tables built up like those prepared by Mr. Melsom for the I.E.E. Wiring Rules giving currents for, say, 60 deg. and 90 deg. F. temperature rises in the different types of armoured cable, laid direct. Possibly Mr. Melsom could arrive at multiplying constants for different thermal resistivities of dielectric and soil, by which the standard figures in the table could be modified as required. Those experiments would also show how long the different types of cable took to reach their steady temperature, a point of some importance which was not sufficiently dealt with in the report. They should want some cooling curves also, for the rate of cooling would probably not be the same as the rate of heating. He also thought that they might try the effect of laying from three to six three-core cables in the same trench at, say, 6 in. centres, which would enable constants to be obtained for multiplying the one-cable currents to provide for more than one cable in a trench. The consideration of dielectric heating at 20,000 volts or over was not necessary, because different makers used different compounds for impregnating their cables, giving different electrostatic capacities and different dielectric power factors. With regard to e.h.p. cables, makers could draw up their own tables for safe currents in the copper, based on the committee's tables, but making their own allowance for dielectric heating in their own cables. The portion of the report dealing with bitumen cables was excellent, and very complete so far as single cables laid solid were concerned, and he did not think anything more needed to be done on those lines, but bitumen cables were largely used for mining work, for running down pit shafts, and he thought experiments might be made on such armoured cables run vertically, say, 6 in. from a wall, such as would be the case in a pit shaft, to find out what current could be carried for a 40 deg. F. rise, which was about all that could be allowed in that class of cable. It had been usual to take the ground temperature at 60 deg. F., although it would sometimes be rather higher in summer, but seeing that the heaviest loads were usually in the winter months when the temperature was lower than normal, he thought 60 deg. F. would be a good figure to work upon. There was also the permissible maximum temperature rise to be allowed, and so far as paper cables up to 11,000 volts were concerned, 90 deg. rise (from 60 deg. F. initial temperature) was quite all right, but one had to take account of the longitudinal expansion of conductors on the long lengths of cable as now made. Generally a 60 deg. F. rise was sufficient, because the expansion in a 220 yards length of copper with a 60 deg. F. rise was $4\frac{1}{2}$ in., which was quite enough to deal with if they were not going to use expansion joints. Of course, all the expansion did not occur at the end of the cable; if it did, 60 deg. F. would cause trouble. Large expansions distorted the lead, which was not elastic, and might cause trouble, in fact, it had caused trouble in certain cases. For cables built for, say, 20,000 volts and over, probably 60 deg. F. rise (*i.e.*, a maximum working temperature of 120 deg. F.) was sufficient, because above a temperature of 120 deg. F. the dielectric losses tended to rise quickly, though possibly that might be got over by the cable makers in the near future. The great difference between the K values of the l.p. and h.p. cables brought into prominence for the first time the importance of the thermal resistivity of the dielectric. He did not think that they ever realised before the importance of that, and he did not see why the l.p. K values should not be brought more in line with those for h.p. cables. What about the K values of the jute servings over and under the armour? Nothing appeared to be said about those in the report. Apparently the effect of armouring was of little importance on the heating, though the figures related to cables in air, and showed that when the armour was removed the temperature rose slightly. He would have imagined that if the cable was buried in the earth the armour would act as a lagging, and they would get the opposite effect, but apart from that it did not follow that the dielectric round the conductor had a lagging effect. It had been found from experiments with bare cables in air that a braiding of cotton soaked in ozokerite tended to cool a small wire, while with a very large cable similar braiding acted as a lagging, and on some intermediate sizes the braiding had no effect at all one way or the other upon the carrying capacity of the wire; a little more light on that subject might be useful. The K value of the soil for general work in Great Britain might be taken as 100 which meant that the soil contained about $12\frac{1}{2}$ per cent. moisture. A very dry soil might reduce the carrying capacity of cables by 25 per cent., and there were places in this country where that might be the case. Three-core cables with shaped conductors would carry about 3 per cent. more current than a similar cable with round conductors, and cables in ducts would carry less than armoured cables laid direct, the actual amount depending on the diameter of the cable in relation to the duct. It seemed that armoured cables buried in the earth had the advantage from every point of view. The report said that there was no appreciable difference between the heating effect with alternating (50 periods) and direct currents, which was what they had always thought, but some little time ago Major Taylor, at Birmingham, discussed that question and caused rather a flutter in certain quarters. He apparently showed that the sheath loss of a.c. 3-core cable might be 50 per cent. of the I^2R losses in the copper of an unarmoured cable, but he (Mr. Morton) did not think a true comparison had been made. Major Taylor should have taken 230 amps. d.c. per core, *i.e.*, in all three cores as in the a.c. test (instead of 400 amps. in one core), and he would have got a different result; one which would come nearer that of the committee; Major Taylor's conclusions seemed to be at variance with all previous work on the same subject.

Mr. G. H. Nisbett said that the report contained far too many variables to be of any ready use to users of cable, although he appreciated the value of the research to the cable maker. One could not safely generalise, but to take an example: For a 33,000-V cable with a load of 167 amperes per phase, the annual cost of the energy lost and the interest and depreciation added together approached a minimum figure for sizes between 0.1 and 0.25 sq. in. of copper; between those sizes the total annual charges did not vary very much, even with considerable variations in the price of copper and the cost of energy. That being so, a supply engineer would install the larger cable, and in that way avoid all possible over-heating, and so would never need to bother his head about the figures in the paper, except in cases where a miscalculation had been made about the possible load. Mr. Melsom suggested that the measurement of the resistance of the lead sheath would be of considerable use in practice to ascertain the temperature of a cable already laid, but it would seem that Mr. Melsom was much too sanguine, and did not weigh up the difficulties to be met with. Mr. Melsom drew attention to the relative heating of h.p. and l.p. cables of the same copper section, and pointed out that a h.p. cable in air was the cooler of the two. The opinion that when the cable was laid the difference would disappear was probably true, but attention should be drawn to the fact that the test was not sufficiently long to produce heat saturation in both of the cables, as the curves were approaching each other when the test was discontinued. The object of the cable-insulating paper test was not very apparent, the temperature used being far above the limit that any cable maker would guarantee his cables to work at.

Mr. W. P. Fuller outlined seeming discrepancies in the application of some of the formulæ in practice, and offered suggestions for a more accurate determination of those formulæ. For instance, the thermal resistivity formula for 3-core cables was the same as the formula given by Russell for the capacity of three cores to the lead sheath, with the addition of the 4π constant. The formula, however, gave capacity figures which were too low by from 20 to 30 per cent., and it seemed possible that, if the correct relationships between the size of conductor, &c., and the thermal resistivity were known, the 3-core figures and those for single-conductor cables would more nearly harmonise. A great deal of attention had been paid to thermal resistivity, but there was another thermal constant (the specific heat) of which he saw no mention in any paper. To show its effect, in a 0.15 sq. in. 3-core, 20,000-volt cable working at 250 amperes, if the current were raised to 300, even if none of the extra heat generated were conducted away from the cable, it would take an hour and a quarter to raise the temperature of the cable 10 deg. F., although the final temperature of the cable from the authors' fig. 6 would be enormous; therefore, in estimating the overload capabilities of a cable, the thermal capacity came in materially. The thermal capacity of the ground, in the case of buried cables, was as important as the resistivity. He did not believe a cable laid in the ground ever reached a steady temperature, as a matter of fact, all the curves in the report were still rising. With cables in air, convection so arranged matters that heat was carried off as rapidly as it was generated, and so a steady temperature was reached, but such was not the case with a cable buried in a fixed medium. It might be a good idea to give curves of temperature rise and time for different diameters of lead piping at different watts loss per square centimetre of surface. One could then work back and find the temperature of the copper, by using the steady results obtained with the cables in air. The authors anticipated making experiments on cables with applied voltage, a different state of affairs to that of a cable carrying current alone. In the latter case the maximum temperature was next to the copper, but when voltage was applied, it was likely that the maximum temperature would shift to the centre of the cable.

Mr. F. J. Teago suggested that co-ordination of the information might be obtained by a close study of the manufacture of the different classes of cable. Temperature rise was closely bound up with the intimacy of contact between the various dielectrics and the copper, and the inclusion of slight air films caused banking of heat pressure, that was, greater difference of temperature between interior and exterior.

Mr. W. Holttum thought the report did not give much definite guidance to cable users or manufacturers. The research, as so far conducted, had been mainly directed to the cables, but there was very considerable room for further investigation, not only regarding the nature of the ground in various places, but of the behaviour of the ground when occupied by warm cables. In many cases cables in continuous use would maintain the ground in average weather in a condition continuously different in its heat dissipating qualities from the normal. It seemed likely that a special piece of apparatus for ground tests would be more useful than an ordinary cable; for example, a spherical unit containing a heater and means for taking continuous observations of its surface temperature, also a number of buried thermo-junctions or other convenient apparatus for taking the temperature at various distances from the heating unit, and some form of buried moisture indicator if such could be devised, would be very useful adjuncts. The nature of the contact of the cable with the ground was of considerable importance, and there seemed room for trials to be made with identical cables in identical earth, but with the earth in different degrees of contact with the cable. Also the effect of slightly wetting the ground while laying and before ramming down might be determined, tests being taken after normal dryness had been reached; watering the ground during laying with a solution such as calcium chloride might, in certain cases, yield profitable results. With regard to determinations of thermal resistivity of the dielectric, was it not possible that the wide variation in the results given was accounted for, not by actual differences of thermal resistivity, but by differing degrees of intimacy of contact between the paper and the copper and lead? It would appear desirable to investigate that factor by experiments on artificial test cables, in which the copper and lead were replaced by mercury.

Messrs. Wedmore, Fawssett, Melsom, and Dr. Marchant replied to the various points raised by the speakers, and expressed appreciation of the various suggestions put forward, which would be reviewed in more detail when the full report of the discussion was available.

GAS v. ELECTRICITY.

Under the auspices of the National Association of Supervising Electricians, a debate on the respective merits of gas and electricity was held at St. Bride's Institute, Fleet Street, on March 9th; Mr. J. S. Highfield, M.I.E.E., occupied the chair.

Mr. F. W. Goodenough, of the Gas Light & Coke Co., opened the case for gas, and said he was sorry to appear as the representative of an industry which, according to some of its critics, ought to have been dead years ago. However, during his 18 years' experience of the industry he had come to the conclusion that after all there was room for both the gas and electrical industries in the service of civilisation. Each had its special field in which it was supreme, and the debatable ground was really very small. Therefore, each should recognise the other's usefulness. There were three fields of comparison for the two agents—illumination, mechanical energy, and heat. In the first of these three the physical limits of each had not yet been reached. There had been rapid improvement in electric lighting—gasfilled lamps, &c., but so there had been in gas lighting by the introduction of higher pressures, &c. The physical limits in the other two directions were known, but the speaker asserted that there were more possibilities of improvement in the application of gas as only from 25 to 30 per cent. of the heat units were used in the present types of gas engines. The heat equivalent of the electrical unit could not be improved upon, as it was a definitely fixed quantity. The gas industry now had to conform to a thermal unit in supplying its commodity. This was the "therm" or 100,000 B.th.u., and it would ensure a proper heat value for gas supplied. Returning to the lighting aspect, Mr. Goodenough said that many other factors, apart from efficiency, entered into the question. Renewals in the case of gas, *i.e.*, mantles and burners, were much cheaper than the replacement of electrical lamps. On the other hand, electricity was economical on account of the ease of switching off and on. Electricity was always more expensive than gas, but the efficiency was perhaps greater. Some housing authorities owning electrical undertakings appeared to think that electricity was the only satisfactory method of lighting, and had not considered the wishes of the users. As a proof of the fact that users would *not* always choose electricity, the speaker cited an instance in which 1,300 houses were erected for munition workers. These houses were wired for electricity and piped for gas. Upon a canvass being made among the prospective tenants, 1,289 were in favour of gas; only 11 required electricity, and, of these, five altered their minds. The chief reason for the choice of gas was that a working-class woman wanted an illuminant which would take the chill off a room.

As regarded power, a therm of gas would give from 10 to 12 b.h.p., according to the size of the engine—say, 11 b.h.p. —this was equivalent to about 10 units of electricity. Electric power had many incidental advantages, and even gas manufacturers used electric motors in their works for intermittent duties. Gas, however, proved best on regular loads.

For all heating purposes, a vast field remained with gas, although electrical authorities still put forward surprising claims for electric cooking. In this connection Mr. Goodenough quoted a letter written by Mr. Wright to the Electrical Review, in which young optimists of electrical sales departments were condemned for putting forward exaggerated claims for their apparatus, particularly with regard to electrical water heaters. A saving of meat was claimed for electrical cooking, these claims had been tested and found baseless—only moisture was retained, not nutrition. Some of the war-time National Kitchens were permitted to use electricity, but a letter from the Director stated that gas cooking had proved far more economical, and much further evidence could be given on this subject. A Blue Book issued by the Health of Munition Workers' Committee endorsed the statements made by the Director. Electric cooking was expensive both in initial and running costs. Electrical engineers would do their cause more good if they confined themselves to the many claims which they were able to substantiate; instead of this they endeavoured to kill the gas industry, which was the height of folly. There were many cases in which he would advise a consumer to use electricity; to others he would recommend gas. In conclusion, Mr. Goodenough hoped that his remarks would be taken in perfect friendliness in order to get at the truth of these matters, so that each agent could continue its service in its proper sphere.

Mr. W. A. Gillott, M.I.E.E., who had had his remarks printed and circulated among the audience, said that he proposed only to deal with the every-day use of electricity, and in the first instance would refer to a few of the salient advantages of electric light. In any situation when an artificial light was required, none could be as suitable as electricity, and in certain cases only electricity could be employed, such as shop window cases, enclosed spaces as in explosive factories and coal mines, in submarines, cabins of airships, shops, strong rooms, and similar instances where cleanliness was necessary, pure air essential, and explosion or fire an impossibility.

It was well known that when electric light was installed the cost of decoration was reduced to a minimum. Further, in new buildings lower ceilings were permissible, owing to the fact that electricity did not vitiate the atmosphere or call for the necessity of improved systems of ventilation when employed in confined spaces. From a convenience point of view no artificial illuminant could approach electricity. One could have control of any light, or group of lights, from several positions, and individual lamps could be extinguished or turned down.

For accurate matching of colours, steadiness of light, purity, safety, convenience, definite results, and economy of operation, electricity undoubtedly commanded the complete situation.

For power purposes it was an established fact that the transmission of power by electricity was supreme, from the little motor in the domestic vacuum cleaner to the high-speed locomotive, or the minute dental motor to the enormous ventilation or pumping plants used for colliery work. The smallest or largest of motors could be started, slowed down, controlled, or stopped by the mere movement of a switch.

For industrial and small business purposes, its uses were almost inconceivable. A butcher used a motor to make sausages, a grocer to grind coffee, a works to drive machinery or lift articles weighing many tons and carry them to various positions and raise or lower them within a fraction of an inch. There were certain instances, especially in textile factories, where definite speeds were essential, owing to the possibility of the yarns breaking, if the machine was run at varying speeds, or intermittently. Electricity was employed there because it was so definite and reliable, and further, the output was considerably increased by its use. In large engineering shops it was the practice to employ one motor per machine, because electricity offered the facility of convenience of starting and stopping, the machine was only running when it was actually working, belt drives were eliminated, and it was economical. Upon the question of floor space alone it would pay in many instances to employ electricity; a 10-h.p. motor would occupy approximately 2 sq. ft., a gas engine of similar power approximately 15 sq. ft., even when disregarding the cooling tanks. Electric motors could be installed in almost any position.

The use of electricity for cooking was rapidly increasing because the users found it reliable, cleanly, economical, and definite in its results. During the last two or three years manufacturers of electrical cooking apparatus had introduced many improvements in the electric cooker; the open type boiling plate was doubtless the most important one so far as the used was concerned, it attained its full heat almost at once, performed its work quickly, the heat could be regulated, &c.

Housewives who used electric cookers were thoroughly satisfied with their behaviour, and would not use any other type of cooker. These views were identical with those of cooks who catered for upwards of 10,000 meals per day in the large electric kitchens.

Other advantages of electric cooking were: Cleanliness and absence of fumes; constant heating value, also the facility of reducing the heat to a definite degree, which was impossible with gas; reduced labour costs; less floor space required, owing to the fact that electrical apparatus could be installed in almost any position, and in some cases mounted on tables or one above the other; economy in food, *i.e.*, less shrinkage of meat; saving on renewal of kitchen utensils, and low maintenance costs.

Mr. Gillott gave a statement of the comparative costs of electricity and gas for cooking in private or domestic households. Over a period of 12 years many tests and comparisons had been made in all types of houses catering for from two to twenty persons, with an equally wide variation of the menu, and the comparative cost of fuel only, *i.e.*, electricity or gas was 1d. per unit or 2s. 6d. per 1,000 cu. ft., at a declared heat value of 500 B.th.u. per cu. ft. These were not laboratory tests, but records of actual instances under normal working conditions.

Room heating and water heating could be taken together for the purpose of the discussion. To use either gas or electricity for long periods was not economical. It was better to use a coke boiler for heavy duties, and "top up" by electricity.

Supplementing his printed remarks, Mr. Gillott asked: "Where is the dividing line between gas and electricity?" He was glad that Mr. Goodenough allowed that lighting belonged to electricity. Local conditions always had a great bearing upon any decision as between gas and electricity. The use of electricity in gas works was a fine testimonial to its efficiency. It was strange that gas engineers always expressed great indignation when electric cooking was discussed. The electric cooker of five years ago was nothing like that of to-day, and the gas companies were basing their remarks on out-of-date figures. Electric cooking was becoming more and more popular. In Newcastle the number of meals cooked electrically rose in a short period from 25 per week to 250,000 per day. Regarding costs, Mr. Gillott said that he used electricity in his home, while his neighbour used gas. In one year he (Mr. Gillott) used 8,000 B.O.T. units and four tons of coal, costing £32. In the same period his neighbour's costs amounted to £60, and he always had a dirty house. A restaurant with which he was acquainted formerly catered for 1,500 persons per day at an annual cost of £280. Electricity was substituted, and for £360 per year 2,200 persons were now catered for. In connection with the National Kitchens, the speaker said that the standard fixed for the cooking of meals was that a maximum of 3 cwt. of coal or its equivalent might be used for 1,000 portions. It was found, from results obtained in 50 kitchens in the Metropolitan area, that for 1,000 portions the coal equivalent in the case of gas was 3 cwt. 64 lb.; coal and steam, 2 cwt. 88 lb., and electricity 2 cwt. 28 lb. The speaker then exhibited a number of lantern slides illustrating various applications of electricity.

Mr. J. W. Beauchamp deplored the fact that the electrical industry fell far behind the gas industry in propaganda work and other things. The success of gas had been due, to a great extent, to the continual "urge" and advertisement of its sales organisation. Courteous and competent men were always ready to serve the consumer; this presented a great object lesson to electrical engineers. The business of electrical engineers was to "push" electricity and let the public judge. Mr. Beauchamp suspected there was something behind the continual desire of the gas people to institute these discussions. His opinion was that they were gradually leading up to an agreement of delimitation of the respective spheres of gas and electricity. There might be co-operation upon the generating side, but there could be none in distribution. The dividing line, if there was one, would be fixed by those who mattered—the public. He did not think the "thermal efficiency" type of propaganda was very fruitful, but it might leave an impression upon those in authority—who had considerably increased since the war; therefore this type of propaganda should be scouted.

Mr. Selley said that in 18 years of his experience gas had only increased in use by 44 per cent., while in 17 years the use of electricity had risen by 178 per cent. Under laboratory conditions the gas authorities could produce remarkable figures, but applied to household conditions the position was different. The installation of one electrical appliance led to the adoption of electricity wherever possible. Electric heating, because of its satisfactory performances, was causing great concern to the gas industry; in fact electric heater manufacturers were making fortunes. (Laughter.) Electric radiators were remarkably efficient, although their first cost was often prohibitive. Mr. Selley spoke at some length on the many other advantages of electricity.

Mrs. Cross said that, as a cook who had used both methods, she found electric cookers very much easier to use, cleaner, and more economical. She did not get half so tired when cooking electrically, and the food tasted much nicer. In cooking 100 joints in several ovens she had found the average loss per joint to be only 8 per cent.

Mr. W. Nobbs referred to a chart prepared to give a just indication of the relation between various kinds of fuel heating. With gas at 5s. per 1,000 cu. ft., calorific value 450, used in a gas fire with 60 per cent. efficiency, the cost of 100,000 B.th.u. was 2s. Electricity used at 100 per cent. efficiency, and at 1½d. per unit, cost 3s. 6d. But apart from this there were many other considerations, such as annual charges, attendance, and cost of flues, which gave electricity a 33 per cent. advantage in cost.

Mr. Mason rather objected to the use of lantern slides by Mr. Gillott. Mr. Beauchamp inferred that the discussion was arranged by gas interests; this was not so; the secretary of the Association had organised it. The first electricity supply stations had been worked by gas engineers, and it was a national disaster that they should ever have fallen into separate camps, as there was a lot of time wasted in recriminations. The speaker waxed facetious over Mr. Gillott's description of an "electrical day," and his parody evoked a great deal of laughter. He compared the two industries with the two great English-speaking nations, and said that in many ways electricity was like the United States—standing for vital progress. Electricity had a great future before it—but so had gas. Some politicians were holding up to the people the ideal that electricity was going to bring about a new heaven and earth; it was going to do nothing of the kind. As a policy the gas interests never said anything against the electrical industry, stated the speaker, amid much laughter, except, he was careful to add, when electrical engineers said something that wasn't true.

Mr. Carter pointed out that the heat value of the B.O.T. unit was constant, and although the gas value was to be standardised, the thermal value would vary. Electrical apparatus would always give the same results—provided the voltage remained constant. The calorific value of gas depended on the fuel, and the consumer had to bear deficiencies. Electrical engineers had fuel trouble also, but their consumers did not have to stand this.

Mr. C. Nobbs supported the last view, and he also stated that gas companies were supplying gas to about 500,000 h.p. of engines—a mere fraction of the electrical power in use. Electricity propaganda was only just commencing, but statements of the gas authorities were often misleading, and should be watched. There was no dividing line between the two industries.

Mr. G. D. Bird, speaking merely as a consumer, said that the cost of appliances told heavily against the electrical industry, but their convenience kept down the balance from a woman's point of view. The electrical industry had to contend against the appalling ignorance of electricity shown by the working classes. It was to be hoped that the increased output of electric appliances would cheapen them.

Mr. Goodenough, replying to one or two points raised, said he appreciated the courtesy shown to him, but protested against Mr. Gillott's statement that he (the speaker) had said that electric lighting held the field. Regarding the electric cooker, it seemed that "Man never is but always to be blest." Progress was still being made in gas cooking, and the speaker had seen electric cookers with gas hot plates for water heating. The Newcastle restaurant mentioned by Mr. Gillott still used gas as well as electricity, probably to the extent of 50 per cent. He remembered that an "all-electric" kitchen at Earl's Court some years ago used 250,000 cu. ft. of gas as well as coke. The danger of gas poisoning had been mentioned; statistics proved that the cases of gas poisoning were only one per annum per 2,000,000 gas users. Regarding the alleged constant efficiency of electrical apparatus, was there such a thing as varying voltage? or had he been misinformed? He reminded the audience, that the reduced quality of gas was the result of attention given to the extraction of benzol and toluol, which had practically won the war.

Mr. Highfield thanked the speakers, and said the discnssion had elicited many important facts. Both industries were partly controlled by the Government in their bnsiness, bnt he was envious of the gas people, who could evade the Government so easily. Both depended on the customer—and both got the better of him, although it was not always so, as witness the case of the Holborn street lighting some years ago. The chairman concluded by thanking the secretary (Mr. Revell) for the able way in which he had organised the meeting.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

6,099. "Telephone repeaters." Western Electric Co., Ltd. (Western Electric Co., Inc.). February 23rd.

6,248. "Cover for electric light switch on motor-cycles." L. C. Hughes. February 24th.

6,272. "Apparatus for electrically welding flanges of metal rims or wheels." G. Giorgini. February 24th.

6,278. "Protective devices for alternating-current electric distribution systems." British Thomson-Houston Co., Ltd. (H. Trencham). February 24th.

6,279. "Electric distribution systems." British Thomson-Houston Co., Ltd. February 24th.

6,285. "Telephone instruments." S. A. Lazarus. February 24th.

6,288. "Winding devices for paying out and winding in electric conductors." N. D. G. Robertson and R. D. Stowell. February 24th.

6,315. "Lock for electric lifts." G. Newbury and H. F. Thomas. February 24th.

6,326. "Automatic electric cut-outs." O. Szaszovszky. February 24th. (Hungary, February 25th, 1920.)

6,329. "Tapes for insulating cores of multi-core electric cables." H. R. Williams. February 24th.

6,335. "Lightning conductors." J. S. Borrington and F. Westwood and H. B. Westwood and S. C. Westwood. February 24th.

6,355. "Commutator brushes." J. S. Borrington. February 25th.

6,370. "Inverted voice current transmission." Western Electric Co., Ltd. February 24tb.

6,381. "Electric lamps for motor vehicles." C.L.I. Manufacturing Co., Ltd., and E. A. Watson. February 25th.

6,388. "Rotors for electric generators." G. A. Juhlin and J. A. Kuyser and Metropolitan-Vickers Electrical Co., Ltd. February 25th.

6,390. "Feeding electric arc lamps for projection purposes." R. S. Wright. February 25th.

6,396. "Application of electric distance switches to locks in doors." Y. Remirto. February 25th.

6,407. "Magneto-electric machines." H. W. H. Warren and A. P. Young. February 25th.

6,442. "Electric cables." Johnson & Phillips and D. A. S. Porteous. February 25th.

6,443. "Mounting dynamo capable of acting as starting device in automobiles." E. Buggati. February 25th.

6,445. "Rectification of electric alternating currents." S. A. Pollock. February 25th.

6,451. "Electric hand lamps." J. Davison. February 25th.

6,461. "Labels for telephone transmitters." S. F. Smith. February 26th.

6,469. "Electric ventilating apparatus." A. Charles. February 25th.

6,452. "Electrolytic device for increasing speed of ships." E. Duteil. February 25th. (France, March 16th, 1920.)

6,473. "Roller brackets for commutator, &c., contacts of motor vehicles." F. W. Gowland. February 25th.

6,479. "Electric heaters." British Brass Fittings, Ltd., and H. B. Butler. February 25th.

6,483. "Watertight electric light fittings." J. Scott and J. Scott, Ltd. February 25th.

6,484. "Commutators for motor-car engines, &c." V. Franklin. February 26th.

6,494. "Electric manicure and chiropody machine." F. W. Flote and V. C. R. Pollex. February 26th.

6,496. "Adaptor for converting acetylene lamps into electric lamps." W. T. Harrington. February 26th.

6,507. "Electrical instruments." M. B. Field. February 26th.

6,513. "Electric welding." Metropolitan-Vickers Electrical Co., Ltd. February 26th. (United States, March 23rd, 1920.)

6,517. "Electrical liquid heaters." Festa Akt.-Ges. February 26th. (Switzerland, September 3rd, 1920.)

6,519. "Magnetos." Soc. Duten, Doublet et Cie. February 26th. (France, February 25th, 1920.)

6,520. "Electric cut-outs." J. H. Silley and H. J. D. Thompson. February 26th.

6,523. "Electric transformers." W. Parry. February 26th.

6,528. "Apparatus for registering telephone calls." E. H. Kinnard. February 26th

6,540. "Electric signal for railways." I. Sanchez February 26th

6,548. "Electric switches " J B Tucker February 28th

6,561. "Spark-plug and magneto-tester." C. E. Hall and W H. Norris February 28th

6,568. "Emergency switch-gear in electric installations." J. T. Wright February 28th.

6,575. "Terminal for sparking-plugs." A. Ford. February 28th.

6,585. "Electric heat radiator." S. B. Tax. February 28th.

6,586. "Combined electric call bell and automatic fire-alarm." P. W. Jones and J. Scott, Ltd. February 28th.

6,590. "Automatic, &c., telephone systems." W. Aitken. February 28th.

6,594 "Arc lamps." C. Beck and C. J. Beck. February 28th.

6,595. "Electric furnaces." A. Imbery. February 28th.

6,596. "Production of high-tension discharges and high-frequency oscillations." W. H. Wilson. February 28th.

6,598. "Production of high-tension discharges and high-frequency oscillations." W. H. Wilson. February 28th.

6,619. "Electrically-heated soldering-irons." W. Clark and Clark's Neo Electric Devices, Ltd. February 28th.

6,641. "Thermionic cathodes and manufacture thereof." Western Electric Co., Ltd. (Western Electric Co., Inc.). February 28th.

6,653. "Applying X-rays, &c." E. J. W. Watkinson. February 28th.

6,654. "Controllers for alternating-current induction motors." J. Anderson and G. Ellison. February 28th.

6,655. "Electric storage batteries." Chloride Electrical Storage Co., Ltd. (B. Ford) and B. Ford. February 28th.

6,657. "Apparatus for compounding direct-current motors." Akt.-Ges Brown, Boveri et Cie. February 28th. (Switzerland, March 19th, 1920.)

6,671. "Electric switches." C. Hyland. February 28th.

6,712. "Electric light lamp sets for motor-cycles and side-cars." J. F. Smith. March 1st.

6,713. "Electric lanterns." J. Eaton and Efandem Co., Ltd. March 1st.

6,720. "Electric circuit-breakers." B. Thomas and E. Thomas. March 1st.

6,736. "Electric fuses and holders for same." J. J. J. M. Kluijtmans. March 1st.

6,738. "Electric switches." C. A. Damey. March 1st.

6,739. "Holder for incandescent electric lamps." A. W. Brown. March 1st.

6,756. "Electric-motor installations." Spencer & Co., Ltd., and M. W. Clarke. March 1st.

6,759. "Electric accumplators." Chloride Electrical Storage Co., Ltd. (B. Ford) and B. Ford. March 1st.

6,769. "Insulation of electric cables." C. J. Beaver and E. A. Claremont. March 1st.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

19,370. "Electric battery lamps." Nurnberges & Sackier warenfavrik vorm. Geb Bing, Akt.-Ges. August 11th, 1916. (Germany, October 10th, 1916.)

19,393. "Electric protective arrangements." Akt.-Ges. Brown, Boveri et Cie. August 6th, 1919. (Switzerland, August 18th.) (130,993.)

20,960. "Telephone exchange systems." Western Electric Co., Ltd., and G. Deakin. July 28th, 1920. (158,592.)

21,885. "Electric water-heaters." Filbar Electric Heater, Ltd., and C. Kratt. September 6th, 1919. (158,595.)

24,246. "Electric heating apparatus." Automatic Telephone Manufacturing Co., Ltd., and C. H. Archer. October 4th, 1919. (158,604.)

26,777. "Sparking plugs of internal-combustion engines." J. Jones. October 31st, 1919. (158,615.)

27,255. "Elastic fluid turbines." British Thomson-Houston Co., Ltd. (General Electric Co.). November 5th, 1919. (158,630.))

27,398. "Protective devices for electric apparatus." British Thomson-Houston Co. (General Electric Co.). November 6th, 1919. (15,640.)

27,457. "Magneto-electric machines." R. B. North and A. M. Allen. November 7th, 1919. (158,652.)

27,462. "Electric cable connectors, particularly for use with car-lighting dynamos and the like." C. A. Miller, F. J. Miller and E. A. Sanders. November 7th, 1919. (158,654)

27,464. "Electric lamps for motors and other vehicles." C. A. Miller, F. J. Miller and E. A. Sanders. November 7th, 1919. (158,655.)

27,498. "Electric lamp signalling systems." H. Hawkins, F. J. Hawkins, and T. Johnson. November 7th, 1919. (158,655.)

27,606. "Electrical testing apparatus." A. T. Scorey and Brella Manufacturing Co., Ltd. November 7th, 1919. (158,673.)

27,811. "Electrical insulators." G. N. Twiss. November 10th, 1919. (158,689.)

27,940. "Electric battery plate pasting machines." A. White (U.S. Light and Heat Corporation). November 11th, 1919. (158,701.)

27,950. "Wireless telegraph receiving systems." W. J. Picken and J. G. Robb. November 11th, 1919. (158,707.)

28,320. "Thermionic or oscillation valves." S. R. Mullard. November 14th, 1919. (158,720.)

28,325. "Electric ignition apparatus for internal-combustion engines." N. C. F. Jensen and M J. E. Tilney. November 14th, 1919. (158,721.)

28,599. "Electric transformers and the like." British Thomson-Houston Co., Ltd. (General Electric Co.). November 18th, 1919. (158,730.)

28,772. "Primary electric batteries." B. F. S. Baden-Powell. November 20th, 1919. (158,733.)

28,856. "Protective devices for alternating current electric distribution systems." British Thomson-Houston Co., Ltd., and H. K. Trechman. November 20th, 1919. (158,736.)

29,492. "Grinding and other machines having magnetic work-holders." W. Arter. December 28th, 1916. (135,856.)

30,285. "Protective casing or sheath for sparking-plugs when not in use." J. E. Goodwin. December 4th, 1919. (158,760.)

30,356. "Magneto-electric machines." British Thomson-Houston Co., Ltd., and A. P. Young. December 4th, 1919. (158,761.)

30,488. "Electro-magnetic wave reception apparatus." J. Robinson and H. L. Crowther. December 5th, 1919. (158,762.)

31,059. "Electrical switches." A. P. Lundberg, G. C. Lundberg, P. A. Lundberg, and G. Pegg. December 11th, 1919. (158,771.)

1920.

307. "Electric lamp holder." S. W. Hamlyn. January 5th, 1920 (158,787.)

392 "Means for driving dynamos." T. Davies. January 6th, 1920. (158,788.)

3,810. "Electric cables." H. Lucas and F. Jenkins. February 7th, 1920. (158,796.)

10,666. "Devices for protecting telephone, telegraph, and the like instruments against lightning or excessive electric potentials." A. E. Beattie. April 16th, 1920. (158,804.)

13,067. "Apparatus for extracting fuses or links on electric circuits." A. E Wilson and Callender's Cable & Construction Co., Ltd. May 11th, 1920. (158,809)

15,640. "Thermally-actuated electric switch." P. W. Baker. August 23rd, 1920. (158,812.)

19,496. "Receiving arrangements for the electric detection of fair-ways for shios." Siemens & Halske Akt.-Ges. September 18th, 1918. (147,564.)

26,576. "Dynamo-electric machines." A. E. White (U.S. Light and Heat Corporation). November 11th, 1919. (Divided application on 27,938/19.) (158,821.)

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PUBLIC SERVICE CONTROL.

As we have had occasion lately to refer to the public control of public services operated by companies, it may be of interest to consider briefly the system as practised in the United States, where the great majority of the electricity supply and tramway undertakings are in private hands. The plan usually adopted is to appoint a "Public Service" or "Public Utilities" Commission consisting as a rule of three or five members, to regulate the services of the particular State concerned; the Commissioners are salaried officials, and are armed by the State Legislature with the powers necessary for the performance of their duties. While some States have possessed such Commissions for over 20 years—created originally to deal with railway matters—others have followed their example only within recent years, and some appear to have taken no steps in this direction. The duties, as well as the powers, of the Commissions vary widely; some have control only over railways, others deal with all kinds of public "utilities," prominent amongst which, of course, is electricity supply. The Commissions investigate the income and expenditure of the companies operating under their supervision, and regulate the scale of profits, as well as the relations between the suppliers and consumers. A few examples taken from the *Electrical World* will serve to illustrate their methods:—

"Urging the need for co-operation between central-station companies and their patrons in small communities, the Montana Public Service Commission, instead of granting increased rates to the Eastern Montana Light & Power Company at Wibaux, recommended the establishment of dusk-to-dawn instead of twenty-four-hour service."

Here the Commission exercised control over the operation of the supply undertaking.

"The Public Service Commission of Pennsylvania ordered the Eastern Pennsylvania Light, Heat & Power Company to desist from the practice of requiring deposits to cover the costs of making service connections, holding that electric lighting and power companies are not justified in demanding that a prospective consumer supply capital for the labour and material required to make such a connection, and that they are sufficiently protected by the right accorded them to require a deposit from the customer to secure payment for electrical energy delivered."

This instance will be of special interest to the apparently large number of British communities from which complaints of excessive service charges emanate. The same applies even more forcibly to the following example:—

"In passing upon a new rule of the New Jersey Public Service Electric Company requiring the cost of service connections to be borne by the customer, the New Jersey Board of Public Utility Commissioners refused a change in the rule as to the former free limit and also held that where charges are permissible they should not be fixed sums but based on actual cost of materials and labour."

This case bears a close resemblance to a number that have been brought to our notice in this country.

"A provision in a franchise requiring an electric company to furnish electricity for lighting city buildings free of charge should be eliminated, the North Dakota Board of Railroad Commissioners has declared, since the expense of such service should be borne by all citizens benefiting therefrom and not entirely by the consumers of electrical energy."

It will be noticed that the Railroad Commissioners are mentioned in the foregoing example; it often happened that the Commissioners were appointed in the first instance to deal with railway and tramway affairs, and that their powers were later extended to cover other public services. The Commissioners rightly veto an attempt to levy tribute from a supply company, clearly seeing that the charge must be passed on to the consumer.

"The Georgia Railroad Commission . . . found a return of 6 per cent. too low and endorsed rates designed to yield 8 per cent."

Here the Commissioners recognise the right of the supply undertakers to a fair profit. How otherwise can capital be attracted into the industry?

"In arranging an increased rate schedule for the municipal electric plant at Kiel, Wis., the Railroad Commission of that State found that under existing conditions an increase of 60 per cent. was necessary."

The Commissions hold the balance evenly. In normal times they take care that the charges are lowered as the undertaking develops, but under the existing conditions the pendulum necessarily swings the other way; their function is not to oppress the supply company, but to secure fair play for both parties.

"Granting a revised schedule of electric rates to the Heppner Light & Water Company . . . the Public Service Commission of Oregon insisted that more satisfactory service must be provided and recommended the immediate installation of a voltage regulator at the generating plant."

Here faulty service earns a reprimand, together with a technical suggestion as to the best method of improving it.

So much for the mode of procedure of the Commissions. These examples all appear, with others, in one issue of our contemporary, and similar ones are published every week, indicating that the Commissions are constantly exercising their powers. That their work is regarded with approval and satisfaction by the public is attested by the results of a questionnaire published in the same issue of the *Electrical World*. It appears that in two States (Arkansas and Illinois) the services of the Commissions were disparaged, and in the State elections last November the opponents carried the day. The ground of the attack was the grant of increased rates to the supply undertakers, which was seized upon by the politicians as a lever with which to dislodge the party in power. In this country it has been necessary to grant increased statutory maximum charges to both municipal and private supply authorities, after the undertakers had progressively raised their prices to the maximum previously authorised. In the United States apparently there was no statutory maximum; the question was whether any increase at all should have been made. The Governor of Arkansas, a staunch supporter of State regulation, made inquiries of the other Governors and received replies from 34 States where Public Service Commissions were in existence, all strongly commending the system, in such terms as the following: "Extremely useful: we would not think of abolishing it." "We consider it an indispensable department. . . . It saves our industries and people hundreds of thousands of dollars annually." "An important and necessary adjunct of the State Government." "Its actions almost without exception prove to have been warranted." "Its work has been of incalculable benefit to the people of our State"—and so on.

The system is undoubtedly endorsed by the public; is it resented by the industry? Presumably the latter would naturally prefer to have an entirely free hand—but that is impossible, either in the United States or in this country. On this point our contemporary remarks: "State regulation has not been entirely to the liking of public utilities. Commissions have, as a rule, favoured the public more than the service companies, so that on the whole as agents of the people they have been effective." The *Electrical World*, however, regards the efficiency of State regulation as proved, and scouts the idea that, even in the two States named above, Commission regulation will be abolished. It declares that "State regulation has justified itself, and is too firmly rooted to be dislodged by the political assaults of misinformed demagogues." Evidently, therefore, our contemporary accepts the Commissions as being on balance decidedly advantageous.

Turning to the conditions obtaining in this country, we may note that more than half the industry is in the hands of municipal authorities, whereas in the United States these are in a small minority. Parliament has from the first exercised a tight control over the whole industry by special legislation and through the Board of Trade. Of the earlier Acts, little good can be said, and it is clear that general legislation may have disastrous results. Even the Temporary Increase of Charges Act was a scandalously unfair and oppressive measure. But it will be seen that public control in one form or another has been in force since 1882. Now the conditions are changing; a central board of Electricity Commissioners has been appointed, with very wide powers, which will be amplified if the Electricity (Supply) (No. 2) Bill becomes an Act, and this board comprises members who are intimately acquainted with the technical and commercial conditions under which the industry is carried on, so that its decisions will be based on competent knowledge and not (we hope!) upon political grounds. Whether the Electricity Commissioners will be able to shoulder the whole burden of regulating supply in every district, in addition to their many other duties, is questionable, but they are empowered to set up Advisory Committees, and at least they can act as a final Court of Appeal in disputed cases. Two important companies in Wales and Yorkshire have declared their readiness to operate under the control of the Electricity Commissioners, if authorised to discharge the functions of Joint Electricity Authorities, and doubtless other Power Companies would willingly accept similar conditions. This system, therefore, offers a solution to the great problem which now confronts the industry, a solution which would short-circuit many of the extremely perplexing difficulties that have cropped up directly the attempt has been made to inaugurate the scheme of the Act of 1919. Provision for its adoption has in fact been made in the No. 2 Bill now before Parliament. Such a course would enable development to commence at once; if we wait for the proposed Authorities, it is clear that progress will be delayed for years to come.

We may point out that the proposals of the North Wales and Yorkshire companies are in no sense inimical to the existing municipal supply undertakings; the latter, where able to generate economically, will continue to do so under either of the schemes, and where they cannot establish that claim, they will become distributors of bulk supplies also under either scheme. Bulk supply, in fact, will be the main business of the Joint Electricity Authorities or of the Power Companies, whichever be called upon to operate.

An important point, which was admirably brought out in the report of the conference of Yorkshire authorities to which we recently drew attention, is that the power companies own their rights in perpetuity. They can therefore be purchased only by agreement, involving a heavy capital charge; or allowed to carry on side by side with the new Authorities, involving immense waste of capital and loss of efficiency; or dispossessed by new legislation, involving what amounts to confiscation. And the whole thing is so utterly unnecessary!

The Baltic Provinces and their Industries.

The United States Department of Commerce has issued as a supplement to the customary commerce reports a long report prepared by Mr. Boris M. Baievsky, dealing with the agricultural, industrial, shipping, railway, and other economic conditions in the Baltic provinces of the former Russian empire, namely, Esthonia (Estland), Livonia (Lettland, Lettonia), and Courland (Curonia). The report contains very little of an electrical nature, but such information as may be worthy of reproduction is given below.

It is explained that Esthonia possesses 648,000 acres of peat moors, the depth varying from 2 to 6 metres. Various projects for the working of the peat have been drawn up during the past few years. Among these was one prepared by the Manufacturers' Association in Reval, which provided for the erection of a generating station that would supply electrical energy to the whole of the Reval industrial area. The capacity of the station was to have been 15,000 kW, and overhead wires were to be used with transformers at various points. It was impossible to carry the scheme into effect owing to the lack of funds, as all the machinery and plant would have had to be imported from abroad, and this would have required more credit than was obtainable at that time. It is added that there are also sufficiently extensive peat moors in private hands to warrant the erection of large generating stations.

After mentioning the number of industrial establishments, the number of workers employed, and the value of the products turned out in the three provinces in 1908 and 1912, the report gives a list of the metal, machinery, and shipbuilding works existing in 1913, which had always been compelled to obtain raw materials from abroad and from the interior of Russia. Among the works mentioned are the Volta Electrical Machinery Works of Reval, Esthonia, the Universal Electricity Co. of Riga, Livonia, the Riga municipal power station and the Riga Tramway Co., and the Continental Electric Traction & Lighting Co. of Libau, Courland.

Before the war Riga, Livonia, was the seat of the Baltic and the Phœnix Car Works; there were also large machine shops, locomotive works, and some 400 manufacturing plants. As a manufacturing centre, Riga suffered heavily when in 1915 the Russians stripped the works and transferred much machinery to the interior, including boilers, machine parts, and electrical apparatus. As long as the future of the Russian market is undecided and there is difficulty in obtaining fuel and other raw materials, machinery and capital, only small undertakings seem possible at Riga. The former Baltic provinces are administered as two republics—Esthonia and Latvia. In February, 1920, peace was concluded between Esthonia and Soviet Russia. Under the terms of the treaty no customs or transit duties are to be levied on goods passing through Esthonia, a free port for Soviet Russia is to be established in Esthonia, and the right is granted to the latter to construct a railway from Reval to Moscow and to work 2,700,000 acres of forests. On the other hand, the utilisation of the Narva waterfalls for electric power production is granted to Soviet Russia. The plant of the Volta Electrical Machinery Works was entirely transferred to Moscow on the approach of the Germans. Before the war the company produced electrical apparatus, dynamos, motors, transformers, and electrical cranes, and 600 workmen were employed at the works, which is said to be well laid out for electrical manufacturing on a large scale. After dealing with the shipbuilding yards at Reval and their equipment, the report refers to various proposed new railways in Esthonia, and concludes with a discussion of the general economic situation of the Latvian republic.

Some striking examples of the decline in production in Russia under Soviet rule were published recently by the Russian official journal *Pravda*, thus confirming the statements made some time ago by a German engineer under the title of "Russian Electrical Industry during and after the War." (Electrical Review, October 29th, 1920). The journal states that whereas the output of telegraph instruments by the Ericsson Co. in 1916 was 10,000, in 1921 it only amounted to 250. In the case of machines the Siemens-Schuckert Co. supplied generators, &c., of a total of 11,000 kW in 1916, but is now only able to turn out 6,000 kW per annum; the united cable factories, which formerly consumed 210,000 poods of copper per annum, now only work up 25,000 poods; and the production of Morse apparatus by the Siemens & Halske Co. has declined in the same period of years from 7,500 to 150. The journal attributes the retrogression in the industry to the scarcity of labour, as the number employed has fallen from 30,000 to 6,000, of whom only 10 to 20 per cent. represent skilled workmen, as compared with 75 per cent. formerly.

A further statement on the situation in the South Russian coal and iron and steel industry has just been made by an engineer who recently returned from that district. He states that the scarcity of efficient electric motors at these works prevents the pumps and other plant from being worked, and that many motors lie about the works awaiting repair, but there is a complete absence of wire and insulating materials and of electrical apparatus in general.

"Superpower." In this country we are overworking our long-suffering Electricity Commissioners with the object of developing, as quickly as possible, our resources for the supply of abundance of power to our industries, in order to increase the output of manufactured products per worker per annum, and thus to retain our share of the world's markets. Across the Atlantic precisely the same process is in progress, and for precisely the same reason! Although in the United States no less than 3½ h.p. is used per head, about twice as much as in this country, it is held that in view of the feverish activity of European countries in bringing up their power utilisation towards that figure, and the lower wages paid in Europe, the use of mechanical power must be quickly developed to a far higher degree.

The policy adopted, which is succinctly and comprehensively styled "Superpower," is in the main very similar to ours, except in respect of the appointment of Electricity Commissioners. The densely populated North Atlantic seaboard has been selected for first treatment; although it comprises only 2 per cent. of the total land area, it contains 22 per cent. of the population, and produces nearly 40 per cent. of the manufactures of the United States. This, then, is the first "superpower region," which has recently been the subject of an extended survey. Within this area it is intended to link up the large power stations with heavy trunk mains, to erect large steam-driven generating stations, and to develop water-power resources which could not be profitably utilised without the linking system. Inefficient installations will gradually be abandoned, and the larger and more efficient ones will be incorporated in the network. In fact, each "superpower region" will become a huge power reservoir into which all the power will be dumped, and from which all the industries will draw their supplies in bulk. Obviously the root idea is identical with that which is in course of development here—all too slowly.

The estimated consumption of 1920 for manufacturing purposes was 12,400 million kWh, of which the central stations supplied only about 2,750,000,000; by 1930 it is expected that the consumption will be 19,000,000,000 kWh, of which 10,000,000,000 will be supplied by the "superpower" system, effecting a saving of 53 million tons of coal per annum. There, as here, during the war the manufacturer turned to the central station for power supply as he had never done before; and there, too, the capacity of the manufactories was increased far beyond the requirements of the home markets, so that export is essential.

In the decade between 1904 and 1914 the power installed in U.S. factories increased from 2.5 to 3.2 h.p. per head, and it is now estimated to be 3.5 h.p. In this country, in 1907, the value was only 1.55 h.p. In 1904-1914 the output of manufactured products per worker in the United States increased from $2,700 to $3,430 per annum; in the United Kingdom in 1907 the corresponding figure was only $1,220 per head per annum.

It is interesting to note that the Superpower Survey has recognised as a fundamental principle that the rights and property of the existing public "utilities" must be respected and safeguarded; the system will be restricted to power stations and main transmission lines, giving a supply of electricity in bulk.

An interim report on the subject was recently submitted to President Wilson by the Secretary of the Interior; it contains many features of great interest, to which we shall refer in a later issue.

THE FUNCTION OF WHITLEY COUNCILS IN THE ELECTRICITY SUPPLY INDUSTRY.

By J. W. THOMAS, B.Sc., A.M.I.E.E.

The present industrial situation is causing considerable perturbation in the minds of many thoughtful people both inside and outside the engineering profession. On the one hand they see wages soaring beyond what appears to them to be reasonable limits, and on the other an increasing amount of unemployment, and one is not surprised to find that they take the easy step to the conclusion that the latter is largely the result of the former. The vicious circle of rising wages and rising prices which has been created, has, in their opinion, overstrained the industrial machine, with the result that it has ceased to function normally. Not a few go so far as to openly advocate that the only way to break the circle is for labour to consent to a reduction in wages. Their argument seems plausible, but the less sanguine ones, whilst not disagreeing that there may be something to be said for their contention, recognise that the remedy is much too simple to be effective, and that it leaves out of account many other relevant and important factors. High costs of production and the decline in trade, to which some of the present unemployment may be attributed, may not be due entirely to high wages, but to lessening productivity per unit amongst the employés. In fact, in the opinion of many prominent employers, it is this factor rather than wages which is the most important, and the most disquieting feature in industry at the present time. It is, in a word, the failure on the part of the workers to produce what might reasonably be expected from them. The average working man has come to look upon himself as the victim of a soul-less capitalistic system which is for ever grinding him down and exploiting his labour, and it is not unnatural to find that he is resolved to do as little as he can, and to get as much as he can for it. Employers complain that the service performed by their employés is often both grudging and meagre. Moreover, there is a lack of discipline and of respect towards those in authority. The readiness to respond to orders seems to have diminished, and there is a marked attitude of greater independence when contrasted with what obtained a decade or so ago, when the word of the employer was law, and when his commands were obeyed promptly and without question. As a consequence there is a decrease in the efficiency of production, and it is this symptom in industry which is the most alarming, and which calls for very special attention.

Those whose business it is to direct industry are increasingly incapable of controlling those who are called upon to do the work. In former days, before trade union organisation had reached its present stage, the workers were compelled by the fear of unemployment to carry out the behests of their master without question. If they refused to do his bidding they were dismissed, and had to face the workhouse. Rather than become destitute they were obliged to submit to a discipline which, in these days, would seem intolerable. Some few humanitarians denounced the system as inhuman, but its supporters justified it on the grounds that it was efficient, and that it enabled the employer to get his work done cheaply and efficiently. In these days, when practically all the workers are in protective organisations, the average worker has not the same fear of absolute starvation, partly because he knows his union will assist him during periods of unemployment and partly because to-day the State will not allow the workers to reach the stage of absolute destitution lest there should be a social upheaval. Consequently the old stimuli fail to evoke the same response in human effort. In well organised industries where the employer once commanded he has now to cajole. His absolute authority has been considerably curtailed. He cannot pay what wages he likes, or force his workmen to work more hours than they collectively agree to. Nor can he dismiss arbitrarily those whom he employs or even engage those to whom the workmen take exception. In fact, on more than one occasion the employer has been compelled to dismiss one of his officials on account of the pressure from the unions. In all directions, therefore, he finds himself hampered and crippled and, what is most important, he cannot compel his workers to work harder than they think proper. In short, the old system has ceased to be efficient. It is idle to attribute its failure to the selfishness of the working classes. They are probably no more selfish than their masters. The fact that there appears to be throughout industry a declining motive for economic effort should compel us to inquire whether the fault may not be in the system itself, and to examine whether new motives cannot be discovered. It is obviously foolish to think that mere exhortations to the workers to produce more will have the desired effect. The workers have passed the stage when they were willing to be the docile instruments of the masters, and have learned that they possess power of which in the past they never dreamed. If the motives on which the industrial system has been accustomed to rely to secure efficiency secure it no longer, other motives must be found. Their discovery is largely a matter of psychology. It has already been hinted that the greatest hindrance to effective and willing work is the suspicion in the minds of the workers that their toil is simply to provide profits for the employer, and that greater exertion above a certain recognised standard merely increases the gain accruing to the shareholders. The competitive system in industry is to some extent responsible for this. It has tended to obscure the vital truth that industry is primarily concerned with public service, and that those who labour in it are performing a necessary function for the community. Particularly is this true in the electricity supply industry, though it is an aspect which both employers and workers have yet failed to grasp. Let them once come to feel that they are not helpless and irresponsible pawns in a game of "grab," but workers contributing their quota to the public well-being, and a new interest will be generated. Furthermore, having recognised their powers, the workers must also be given some responsibility for the maintenance and efficiency of the service. This sense of responsibility can only be aroused in so far as they are given a more direct participation in the administration of the industry in which they are engaged. The proposals to form Whitley Councils in various well-organised industries were put forward by the signatories to the Whitley Report with a view to enabling the workers to have, through their organisations, an increasing share in the management of their industry, and to stimulate them to take a more direct interest in its efficient working. It is unfortunate that, up to the present, few of those which have been set up have attained to this ideal. The majority of them, if not all, have become largely wages boards, and their main occupation has been to secure increased remuneration for the employés. In hardly any case has the efficient administration of the industry as a whole been taken seriously. The fault of this is not to be laid entirely at the door of the trade unions, some of it is no doubt due to the reluctance on the part of the employers to alter their customary practice of managing their own affairs in their own way. Many of them have still to be persuaded that the corporate feeling existing amongst the workers, as manifested in their organisations, is not wholly an evil thing. On the other hand, the trade unions themselves are by no means blameless. They have not recognised their responsibility to the industry of which they form a part, and have been more concerned to extract something from it than to put something into it, or to see that their labours were not dissipated by a feeble and inefficient administration. This is as true in the electricity supply industry, where such Councils have attained to a certain maturity, as in any other. Both sides have yet to realise that the object of the industry is to provide the community with service, and that in the task of providing that service both have a collective responsibility. It is no exaggeration to say that the active and constructive co-operation of the employés would do more to increase the efficiency of the supply industry than years of invention. Manufacturers to-day will compass sea and land, and engineers will "scorn delights and live laborious days" in order to improve the efficiency of their machines by one or two per cent., whilst all the time ignoring the latent capabilities of the human element, whose enthusiastic service and co-operation enlisted on behalf of the industry would make the former increase of efficiency pale into insignificance. This co-operation on the part of the employés, through their organisations, can only be secured by the cultivation of what might be described as professional pride. It has always been recognised that the foundation of efficiency in what are known as "the Services" is the *esprit de corps* which animates all ranks, and every means is taken to encourage it. A like spirit needs to be engendered in those who are engaged in the supply industry. There is no reason why the performance of so important a function as the supply of electricity to the community should not be looked upon as being equally honourable as those professions which are concerned with war, and why the same spirit should not be encouraged. It can only be cultivated, however, in so far as the workers feel that they are not merely "hands," but human beings, capable of assuming responsibility, and of contributing to the welfare of the industry as a whole. But responsibility implies power, and it is the function of Whitley Councils to provide machinery, whereby the workers are given such power to co-operate in the general management of the industry, and to voice their views on its administration.

This is the most vital aspect of the matter, as it is obvious that such a delegation of power will involve a fundamental change in the position of both employers and trade unions. Instead of being merely defensive organisations concerned with the maintenance or the uplifting of the workers' standard of life, a kind of permanent opposition in industry, they must become part of the government. There are, of course, many employers who would scoff at any such change as this, and would strenuously oppose any interference in what they claim to be the employers' province. But such opposition is both out of date and futile. If they expect the workers to give of their best they must be prepared to concede to them their claim to be treated as human beings. The employers cannot have it both ways. The enthusiastic service of willing brains can only be secured when the employers are prepared to treat the workers as if they possessed brains and are given sufficient control in the conduct of the industry to stimulate them to give of their best in its service. Furthermore, during the war many of the workers realised a certain amount of power, though perhaps of a negative kind, and it is no more to be expected that they will be content to return to their former state of docility as irresponsible instruments of production, than it would be for Adam, having tasted the fruit of the Tree of Knowledge, to return to his original state of pristine innocence.

The hands of the clock cannot be put back. It would be a most short-sighted policy on the part of employers to shrink from granting increasing power to organisations of workers for fear lest they should become tyrannous or exploit the public. As one economist has put it: "It would be to pour away the baby with the bath and to lower the quality of the service in an attempt to safeguard it." The wise employer will endeavour rather to make use of these collective groups and to enlist their corporate strength on the side of increased efficiency in industry.

There is one aspect of the trade union movement, which even to-day does not appear to have been recognised by either employers or the public, viz., their capacity to foster the feeling of loyalty to the group, and to secure the loyal obedience of the members to their leaders. On more than one occasion the writer has been struck by the loyalty of employés to their group or trade union. When faced with the choice of duties they have chosen to follow the leadership of their trade union official rather than carry out the instructions of the employers, and this, be it noted, not when any financial considerations were at stake, but solely questions of principle. It would be a fatal mistake to attempt to conquer this corporate spirit, it must rather be rightly directed so that the loyalty to the trade union may be made to serve the good of the industry as a whole. The frequent occurrence of strikes or threats of strikes in the supply industry is sufficient indication that this corporate pride in the industry has not been harnessed as it should have been, largely, no doubt, because the machinery has been lacking.

When the machinery for giving the workers larger control is in operation the trade unions will have to learn that it is their duty to instil into the minds of the workers the necessity of goodwill and zeal in the public service. The excuse that they cannot serve with enthusiasm capitalistic employers, who have no other interest in them than to make profit, has no validity in the case of municipally owned services. In such services they without question are the servants of the community. Moreover, if their claim to have a greater control in the conduct of the industry is to be justified it can only be so on the grounds that the result is a more effective service than was possible in the days when their responsibility was negligible. The workers cannot have it both ways any more than the employers; they must either by an increase in internal discipline amongst their members, produce a change in the efficiency of the industry, or else qualify their demands for increasing control.

The immediate practical problem, then, is how the machinery for carrying these proposals into effect is to be set up. Few will deny that useful as the present Joint Councils and Joint Boards have been in the supply industry in dealing with questions of wages and conditions, they have failed to achieve the real purpose for which they came into being. Nor is it open to much doubt that with their present composition they will be unable to achieve much more. In the first place, neither the Joint Councils nor the Joint Boards completely represent all those who are engaged in the industry, nor is there sufficient co-ordination to enable both the Councils and the Boards to work for the good of the industry as a whole. It is not to be expected that such large questions as administrative and technical efficiency, the consideration of improved methods and organisation, the improving of the status of the industry, legislation, employment, &c., can be adequately dealt with either, on the one hand, by a Council on which only the manual workers are represented, or, on the other, by a Board on which only the staffs are represented, and even here only inadequately, as there is now the attempt to exclude the clerical and administrative staffs.

It is extremely unfortunate, in the writer's opinion, that the employers on the National Joint Board are insisting that the clerical and administrative staffs should not be represented on the National Joint Board. It is shutting the door in the face of progress, and will have the effect of converting the Board into nothing more than a wages board. It is still more unfortunate that the unions representing those staffs have not composed their differences and agreed that, as they have an interest in the welfare of the industry, they have also a right to be represented on the Council which deals with it.

It may be laid down as axiomatic that if the good of the industry and the welfare of those who are engaged in it are to be considered with any hope of success, it can only be in so far as all who are engaged in the industry meet together round a common table in a spirit of goodwill and co-operation. Not until machinery to provide for this is set up will Industrial Councils in the industry fulfil their true function. There are, of course, many reasons to be advanced why the operative unions and the supervisory unions should have separate Industrial Councils, especially where questions of wages and conditions are being discussed, but there is no possible reason why both should not co-operate on broader issues. With such joint machinery in being, the workers would have the benefit of the special technical knowledge of the staff, whilst the latter would come to understand more intimately the needs and capacities of the workers, and would in many cases act as a steadying influence. With such united co-operation the idea of purpose in industry would also become more apparent. It is because this idea has been obscured, and because industry has been regarded more as providing opportunities for personal gains than for public service, that the economic life of to-day is in a perpetual state of unrest. It has become a tug of war in which those whose economic force is greatest receive the largest prize. If the conditions which produce this unnatural tension are to be removed there must be a new orientation which will give primary consideration to the purpose for which the industry is carried on. It is high time, in public services at least, that the atmosphere of antagonism and conflict should give place to that of co-operation towards a common end. When such an environment exists, many of the problems which now appear insoluble will admit of treatment on simple lines, and many of the fears of the public regarding the greed of organised bodies will be laid to rest.

Doubtless many of the above suggestions will appear Utopian and idyllic to the practical or conservative. Time will show that their realisation is not merely probable but inevitable. Industry is at the parting of the ways when the old methods are breaking down and when the only new method available is the enlisting of the active interest of the workers, by granting them, through their organisations, a great voice in the control of their working lives, greater scope for initiative, a greater degree of self-direction, and the recognition that they are partners in industry with rights and responsibilities, as a substitute for the autocratic control of the employer. If such an alternative is to be adopted it will require on the part of those in authority, faith in the capacity of their employés to rise to the level of their responsibilities, and on the part of the trade unions it will mean the giving up of much of their sectional and defensive outlook.

Once the experiment is made, and as experience ripens, those who represent the consumers on the employers' side will recognise the value of having the active co-operation of the workers, nor will the workers be slow to grasp the value of the training it affords them and of the opportunities of contributing to the welfare of their own members as well as of the community at large.

There is, of course, nothing to be gained by minimising the practical difficulties, but given the necessary goodwill amongst all sections, there are sufficient brains in the industry to solve them. As fresh experiments are made, new lessons will be learnt which will throw new light on those difficulties which now appear insuperable.

Whether Industrial Councils will come to be a permanent feature in industry is a question too big to be discussed here, but few will deny that the possibilities of success are as great in the electricity supply industry as possibly in any other, and that experiments in joint control by producers and consumers in municipally-owned services are more likely to be fruitful than in most others.

OUR FUTURE TRADE WITH SPAIN.

Present interest in the Spanish market centres chiefly around the projected Customs tariff revision. There is ground for the fear that the new duties will be strongly protective, though the more clear-thinking Spanish economists realise that to restrict the importation of electrical material into the country or raise its cost, will hinder the nation's industrial progress in the many directions where electric power is vital to activity and efficiency. Spain is short of coal, but has almost unlimited water power, and the future of her railways must depend on her development of this power for electrical purposes.

Powerful interests are at work to obtain protection by higher import duties for any infant electrical industry, added to which the Government is faced with the need to increase its revenue and maintain a favourable trade balance. It will, therefore, require all the energy and influence of our own Board of Trade, the Federation of British Industries, and the British Chamber of Commerce in Spain, each of which is watching British interests, to ensure that our manufacturers are not too severely handicapped in the Spanish market.

A little comfort is derived from the fact that the new rates were not settled by the date originally announced (March 21st), and from the practical certainty that the most-favoured-nation treatment formerly accorded to Great Britain will be continued under the new arrangements. The secretary of the Spanish Chamber of Commerce in London recently stated that in the case of Great Britain, and in that of France also, it is possible that the intended increases will not come into force, because at the present time the respective Governments are already engaged in drafting the new commercial agreements between Spain and those nations.

It is interesting to read the British official view on the future of our trade with Spain. In the report just issued by the Department of Overseas Trade, H.M. Commercial Secretary at Madrid says that even with the protective measures demanded by the Catalan and Basque manufacturers, the Spanish market will not be closed to the foreigner owing to the fact that Spain is still unable to supply its own increasing needs.

With the acknowledged preference for British materials and manufactures, the future of British trade with Spain should be assured provided that sufficient study is made of the requirements of the country. In this connection it is noteworthy that exports from Spain to the United Kingdom show 160 per cent. increase in value in 1920, as compared with 1913, and exports from the United Kingdom to Spain show 146 per cent. increase in value in the same period.

Effect of Normal Competition.

While it cannot be doubted that the war brought great wealth to Spain, it is clear that, as a nation, she has not emerged with that prosperity that should have been the result of her neutrality and her wonderful natural resources. While lacking what may be called the spirit of commerce, to give the Spaniards their due, it must be allowed that during the war they showed great commercial activity. As a result of this activity they experienced a period of unprecedented prosperity, which if it had been maintained would undoubtedly have given a great impetus to industrial enterprise. That they did not maintain it is, however, clear from a comparison of their trade balance at the end of the first ten months of 1920 with that at the end of 1919.

Industrial troubles, lack of transport, and other factors, have all helped towards creating this result, but not a little is due to the fact that every issue in the country is more or less dominated by politics.

The Spanish manufacturer early in the war found himself called upon to supply quantities of goods and foodstuffs to the belligerents, and profited accordingly. This naturally brought increasing wealth to all classes, and the increasing purchasing power of the individual created a demand for all classes of commodities in greater quantities and higher qualities than had ever been known before in the country. The Spanish banking institutions experienced increasing prosperity and the country at the cessation of the war was exceedingly prosperous.

With the return of peace, Spain found herself face to face with the fact that the demand for her goods was less, that her manufacturers were no longer free from competition, and that her output was decreasing owing to labour difficulties, with the result that her exports began steadily to decline and her imports, largely of what may be called luxury articles, increased, until, as a result of ten months' trade, her balance is once more unfavourable. Nevertheless, a spirit of independence has been created during the war, and the 1920-21 period is marked by an endeavour to establish that independence by increased taxation against the foreigner, and a tendency towards the nationalisation of Spanish industries.

After foodstuffs, the largest class of imports is that which includes machinery, electrical material, ships, and motor cars. In this class the increase in 1920 over 1919 is 120 per cent., and compared with the year before, 300 per cent.

Especially interesting is the trade in electrical material, motor cars and lorries, and agricultural machinery. Of all these goods, for which the demand may be expected to become increasingly active, the U.S.A. is at present the largest supplier. The import of dynamos and electric motors in 1919 was 3,100 tons, more than half from the U.S.A. Eight hundred tons came from Switzerland. The United Kingdom provided 340 tons, Sweden and France the remainder. France follows the U.S.A. as the second largest source of accumulators. In electric cables the United Kingdom is second. The U.S.A. is also first in carbons. Electric lamps are obtained chiefly from Holland and the United Kingdom.

The impetus received by Spanish industries during the war reached a climax in 1919. The nation had become increasingly self-dependent. The textile industry was strongly established. Electrical goods of good quality were being made at Saragossa. Motor spirits were distilled in Spain from shales and lignites. The national coal and iron industries were developed to a notable degree. Last year, however, witnessed a set-back to Spanish manufacturing industries, a reduction of the lead gained during the war by the United States, and a remarkable revival of German commerce.

In her own market, however, Spain is very much to be reckoned with in the iron and steel industries. If the iron and steel manufacturers succeed in their efforts to get increased protection, they will oust foreign competition almost completely. Other manufactures which are produced in Spain on a competitive scale include accumulators.

American and German Activities.

Although the considerable lead gained by Americans during the war has been increasingly reduced, imports from that country have nevertheless been larger than ever in actual quantity. But their keenness is unabated. They have established direct freight connections. They have distributed widely catalogues printed in Spanish. They have made a free use of the Press. They have cut prices. They no longer insist absolutely on cash terms.

On the other hand, they are no longer the only country fulfilling orders. They have experienced great difficulty in getting return freights, and Spanish bottoms now suffice for their traffic with the largest port of Spain. During the second half of 1920 their trade with that country has fallen off in almost every class of imports except petroleum products. But their hold on the market remains very strong in machine tools, hand tools, and electrical goods.

German manufacturers have reappeared in the Spanish market on a surprising scale, especially in hardware, machinery, machine tools, cutlery, and electrical material. Favoured by the low value of the mark, it is evident that the Germans are out to do their level best to capture the Spanish trade. Despite the great reduction of the German merchant marine, a line of steamers from Hamburg has been specially assigned to the Barcelona route, and numerous German agencies have been established at that port for the sale of small goods. American salesmanship has improved, but other nations have again something to learn from the efficiency and thoroughness of the Germans. Their showing at the recent Barcelona Fair (October-November, 1920) exceeded that of all the other foreign nations put together. They were offering delivery within 24 hours, as four vessels loaded with the goods that were being shown at the Fair had already arrived in the harbour from Hamburg in readiness for delivery!

Spain naturally buys as much as she can from her nearest neighbour, France, and that country has furnished considerable supplies of accumulators, electrical material, armatures, machine tools, and telephonic and telegraphic apparatus.

Electrical material, cranes, hydraulic motors, and other machinery have been supplied by Switzerland, telegraphic and telephonic apparatus by Sweden, and electric lamps by Holland.

The Commercial Secretary has no doubt that British goods only need to be pushed in the Spanish market to recover much of the ground lost during the war. But they *do* need to be pushed. A very important point is that the Spanish market demands that stocks should be held in the country.

(*To be concluded.*)

A Vienna Telephone Factory.—The Vienna telephone works of the German Telephonfabrik A.G. Berliner has been converted into an independent Austrian company, under the title of the Oester Telephonfabrik A.G. vorm. J. Berliner, and with a share capital of 15,000,000 crowns.

ITALIAN ALABASTER.

Although the application of alabaster to lighting purposes is of comparatively recent introduction, this mineral has been used for other purposes from the very earliest times; but it required the discovery of a powerful illuminant such as electric light to bring out the crystalline beauties of alabaster to the full.

Just as electric light has come to stay, so have alabaster bowls, or "lamps," as they are always called in Italy. The same may be said of various other lighting accessories in alabaster, of which some of the small table lamps are probably the most attractive.

Italian alabaster is now reaching this country in steadily increasing quantities, and the following is a brief account of its characteristics, which has been communicated to us by the New Italian Art Association, Ltd., 38, Newman Street, London, W. 1.

Alabaster occurs in nodules, or "blocks," as they are known to the Italians, of very varied size and in shape mostly roundish or oval.

Obviously it is only the largest blocks which can be used for sculptural objects of any size or for lamps of the larger diameters, such as 22 in., 24 in., and above. The blocks are sold by weight, size being taken into account. It is not only in the *size* of the blocks that there is great variation. There are to all intents and purposes three *qualities* of alabaster; the two most important being the pure and unblemished white, or "statuary," variety, which is known as Castellina, and the white with grey markings and veins, which are often very beautiful, called Scaglione. The third variety is of a decided grey colour throughout, somewhat like figured marble, and designated Bardiglio. All three varieties are sufficiently soft to be readily cut by a saw, and they can be worked both on hand and power lathes with comparative ease and freedom from splitting.

So far as lighting purposes are concerned, it is only necessary to consider the pure white and the grey-veined varieties. Bardiglio is too dark in shade for lamp-making; it can be very effectively used, however, for ornamental purposes such as in columns or pedestals.

"Castellina" is used for the best and most expensive lamps. Some of these are plain, but more often they are carved in every style of pattern from the severely plain, such as Greek key, to the most elaborate designs, of which some are conventional and others original.

It will be noticed that most of the lamps so far used in this country are of "Scaglione." In this case carving is the exception, as their chief beauty consists in the grey veining, no two lamps ever being exactly alike in this respect. The variety of the markings and veinings and the different shades of grey are, to most people, extremely attractive. In a Scaglione lamp, whilst the veining and freedom from cracks and flaws, which unfortunately sometimes accompany the veining, are important points, a good deal also depends on the shape. Some of the lamps which have found their way to this country are unnecessarily bad in this respect.

It may be mentioned that when Italian alabaster is veined it is always in some shade of grey, whereas in English alabaster the veins are reddish, or pinkish. It is therefore a very easy matter to distinguish between English and Italian alabaster in their natural state. In Italian alabaster there are, of course, various grades both of Castellina and of Scaglione, depending on the purity of colour, the luminosity, the veining, and the freedom from flaws and cracks.

Whilst the natural colours of alabaster vary only from pure white to grey, a variety of artificial colours and shades can be applied, and the Italian manufacturers claim that this colouring is quite permanent. There is every reason to believe that they have good grounds for saying so. The artificial colouring can now be done in London, and has the advantage of making it quite easy to follow a colour scheme in a room, large hall, or any other situation, or even to match a wall paper. Whilst it cannot be denied that there may be places where cream, pink, yellow, green, or other coloured lights would be extremely effective from an ornamental point of view, it is anticipated that preference will continue to be shown in this country for either the natural white or grey-veined lamps the crystalline beauties of which are, within certain limits, in proportion to the suitability and the power of the electric lamps employed, and the skill with which they have been arranged.

Certain it is that electric light can never be more delicately toned down or the light more beautifully and softly diffused than by the employment of genuine alabaster.

In conclusion, it may be mentioned that the supply of raw material gives no anxiety for the future. The quarries have lasted for centuries, and are still good for very many years to come. Any anxiety there may be arises from the demands for higher wages which are constantly being made by the Italian workers, commencing with the quarrymen. This state of affairs, however, is not confined to Italy.

The A.E.U. Secretaryship.—As a result of the recent ballot, Mr. A. H. Smelhurst has, by a large majority, been elected secretary of the Amalgamated Engineering Union in place of Mr. Tom Mann, who is retiring.

THE OSRAM-G.E.C. LAMP WORKS.

A Tour of Inspection.

Since the year 1908, when it was realised that the metal-filament lamp in practical form had been invented, and the General Electric Co., Ltd., started its manufacture, the story of the Osram lamp has been one of continual progress, to gain some idea of which, together with the wonderful growth in manufacturing facilities, an opportunity was given on Friday last when members of the Institution of Municipal and County Engineers spent an instructive morning at the above-named works.

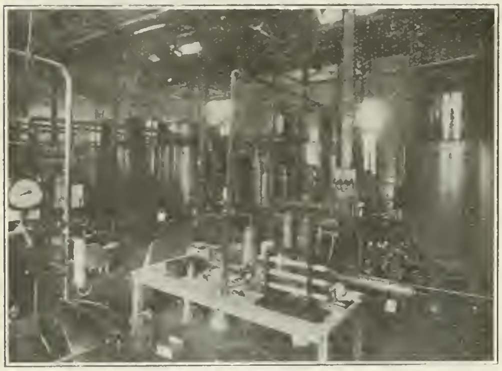

Fig. 1.—Hydrogen Gas Plant.

When certain electric lamp patents expired in 1893, the General Electric Co., Ltd., began to manufacture the "Robertson" carbon-filament lamp. Few persons, however, could have seen in the original modest workrooms at Hammersmith the germ of the spacious modern lamp factory with over 3,000 workers, some of the most ingenious automatic machinery in the world, and a Research Department which constantly links up science with industry. In 1908 the company acquired the patent rights of the manufacture in Great Britain of Osram lamps, and adjoining the Robertson lamp works the first large factory in this country for the production of metal-filament lamps was erected.

A visit to this up-to-date lamp factory is a revelation of modern skill and manufacturing methods; the factory is independent of outside aid, which fact is one of the secrets of its success. Thus the tungsten ore comes to the factory from British Dominions overseas, to be transformed eventually into filaments; the glass is made and the bulbs are blown at the company's Lemington-on-Tyne glassworks; the argon for the gasfilled lamps is produced by an argon plant that was specially installed during the war period. From the Ileene works of the G.E.C. at Birmingham, again, come the brass shells for the lamp caps. Every essential to the complete lamp, in fact, is produced within the range of the company's activities.

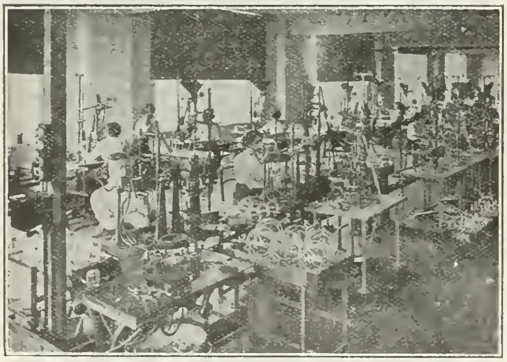

Fig. 2.—Stem Fixing Prior to Exhausting.

The actual making of the lamps is an extremely interesting series of processes, which, however, is too familiar to our readers to need further description; the accompanying illustrations show the interior of three of the departments.

When the nickel wires that support the filament, which are cut and looped ingeniously by a machine, have been inserted, the "spider" is ready for the winding on of the tungsten filament; it is then "set" by flashing in an atmosphere of hydrogen, diluted with nitrogen to prevent explosion. A complete plant for producing hydrogen is included on the premises and shown in fig. 1.

Exhausting the bulb is a most important stage in the manufacture of the lamp, and although modern ingenuity enables bulbs to be exhausted six or eight at a time and rapidly tested, the speed thus attained does not sacrifice accuracy. The girls who carry out this process sit on trolley seats that run on rails, fig. 3, and are thus able to pass quickly from one set of lamps to another, and to supervise several groups with very little trouble; sensitive electrical devices indicate when the exhaustion is as nearly perfect as possible. The caps, as is well known, require the insertion of contact-pieces, and the fixing of these in position by a special insulating material of a glass-like nature known as "vitrite." This operation is carried out on an ingenious automatic machine designed for the purpose, of which several are installed at the works.

With regard to gasfilled lamps, we understand that the old round-shaped bulb with its long neck has been discarded, and the bulb in its latest form is club-shaped. It still has an elongated neck into which the hot gas can rise and cool, but the new form of bulb which has now been standardised is much easier to blow, its shape being a more natural one than the old round one.

In the case of the gasfilled lamp, after the bulbs are exhausted of air, they are filled with the necessary inert gas, which may be either argon or nitrogen, according to the type of lamp; nitrogen is used only for heavy-current lamps. The argon used for the lower-current lamps is obtained by means of a liquid-air plant at the factory, the process being known as direct fractionation; this installation is extremely interesting, but too intricate to be described in the space at our disposal.

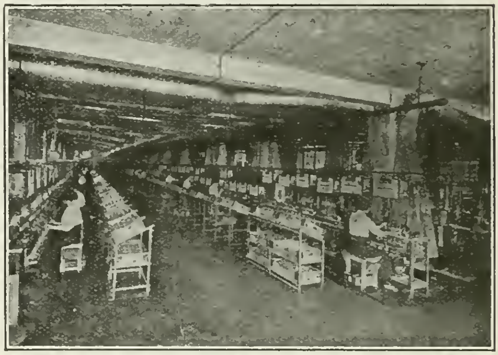

Fig. 3.—Pump Room for Lamp Exhausting.

Automatic machinery, much of it specially designed on the premises and giving rapid and economical production, is a feature of the works, and the uninitiated visitor is invariably astounded at the way glass is "handled," so to speak, by mechanical devices. But even more wonderful is the process of blowing bulbs by machinery at the G.E.C. glass works at Lemington-on-Tyne. In this case there is no intervention of human hands between the red-hot molten glass and the completed bulb, and one attendant can supervise the production of thousands of bulbs in a day. Modern gas-fired furnaces, the temperature of which is controlled by electrical pyrometers, are installed (the works producing their own gas) and every appliance that tends to increased production and efficiency of manufacture has been adopted.

A notable addition to the equipment of the G.E.C. is the Research Laboratory at Hammersmith. Established within recent years, and under the able direction of Mr. Clifford C. Paterson, it concentrates upon researches that will give in the end new and improved processes of manufacture and higher efficiency in the finished product. The Lemington glass works are not overlooked in this important work; a resident chemist, on the staff of the Research Department, gives his whole time to the investigation and testing of the raw material used in the blowing of lamp-bulbs.

Extensions to the Osram lamp works on a large scale are in contemplation, some of which are on the verge of completion, with the aim of not only meeting the requirements of this country, but also filling the enormous overseas demand.

Following the inspection of the processes of electric lamp manufacture the visitors partook of an excellent luncheon at the Clarendon Restaurant, Hammersmith, Mr. C. Wilson in the chair, after which the members of the Institution settled down to a debate over which Mr. Norman Scorgie, borough engineer, Hackney, presided, on the subject of "Employment for the Unemployed."

LEGAL.

Mine Manager Fined.

W. Durney, certificated manager of Gain Clay Mine of the Glenboig Union Fireclay Co., was fined recently at Airdrie for three contraventions of the Mines Regulation Act of 1911. One of the charges was failing to see that the fireman he appointed devoted his whole time to the statutory duties, whereas he permitted him, while acting as fireman, also to work at a coal-cutting machine.

Cost of a Canteen.—Petition of Right.

In the King's Bench Division on March 18th, Mr. Justice Bailhache heard a petition of right brought by Messrs. J. P. Hall and Co., Ltd., electrical, &c., engineers, of Werneth, Oldham, asking for a declaration that they were entitled to reimbursement from the Crown in respect of the cost of building a canteen for their workers during the war. It appeared that Messrs. Hall became a controlled establishment, and were urged in common with others to provide canteen facilities. Sir John Simon, K.C., appearing for the suppliants, said they alleged that there came into existence a contract with the Crown to let them (suppliants) have the cost of making this canteen out of the Crown's share of profits. The Crown proposed to allow the company only £900 instead of the £1,500 which it contended it should have. Mr. Justice Bailhache, giving judgment, said he thought the expenditure upon the canteen was expenditure to be taken into account as current expenditure of the business, and taken into account before the net profits were arrived at. The Crown had so treated it, and he thought the Crown was right. The petition was therefore dismissed.

Catchpole & Maurice *v.* Barnett.

Before Mr. Justice Salter, in the King's Bench Division, on March 17th, plaintiffs, engineers, of New Oxford Street, London, sued Mr. B. Barnett, electrical engineer, of Whitechapel Road, to recover the balance of the price of goods sold.

Mr. Sandlands, for the plaintiffs, said the goods were delivered in January, 1920, and on other dates. He gathered that the only item now disputed was the one of £87 in respect of certain tubing supplied. The defendant, instead of complaining of the goods, asked for time to pay, and when the action had been brought, suggested that the tubing was not all it should have been. He never purported to reject it.

Mr. Lincoln, for the defendant, said the tubing was not of the correct size, and the plaintiffs agreed to take it back. They did not, however, do so, and after several months the defendant used it, and was, of course, liable to pay. He (counsel), however, submitted that a new contract had really been made between the parties when the tubing was used, and that the defendant ought only to pay for it at the lower price which obtained then.

His Lordship said the defendant had failed to satisfy him that there was any breach of warranty. There would, therefore, be judgment for the plaintiffs for the balance of the account, viz., £119 15s.

CORRESPONDENCE.

Letters received by us after* 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Dynamo Excitation.

With reference to your issue of March 18th, there appears on page 342 a paragraph headed "Extra Voltage for Battery Charging." This contains either an error or an omission.

Assume 100 volts normal.

Assume resistance of $AE+CF=100$ ohms.

Assume ampere-turns $AE+CF=1{,}000$ AT.

Then field current as shown $=1.00$ ampere. Again, taking imaginary values for AB and CD—

Assume $AB+CD=140$ ohms.

Then ampere-turns $AB+CD=1{,}400$ AT (with 1 ampere).

The voltage will not rise because the excitation current falls to $100/140$ amperes $=.715$ amp., *i.e.*, ampere-turns remain as before for $1{,}400 \times .715=1{,}000$ AT.

I have neglected any correction for variation in the mean length of the turn in the two portions of the field winding.

W. Hartley.

Calver.
March 19th, 1921.

[Our correspondent is perfectly correct. Neglecting temperature rise, and assuming that all the turns are of the same length, the ampere-turns at constant voltage depend only on the size of wire and are independent of the number of turns of wire, whether it be one turn or 1,000 turns. We have been caught napping!—Eds. Elec. Rev.]

Electrical Wiring Rules.

The point raised by "Bourgeois" in your columns, and answered by you, brings out the fact that there is no authority in England to compel contractors and others to install proper and safe electrical wiring. The remedy you suggest: "The registration of electrical contractors," to my mind, does not go far enough. An absolute cure would be the efficient and legally enforced inspection of all electrical work. This appears at first to be a somewhat tall order, yet it is done, and done well, in most of the large towns on the Pacific slope of the U.S.A. and Canada. In Vancouver, for instance, an electrical by-law exists, which incorporates a comprehensive set of local rules, and the National Electrical Code of the National Board of Fire Underwriters, and these rules are strictly enforced by the city electrician, assisted by a competent staff of inspectors. Any infringement is punishable by a fine not exceeding £20, at a magistrate's court. Before the wiring of any building can be started it is necessary to obtain a permit from the city electrician, and except on minor jobs, a complete wiring plan has to be submitted to him and passed, before a permit is granted. A blue print of each plan is filed for future reference. The cost of this scheme is largely met by the charge of a small fee for each light or motor, &c., installed, a sliding scale being arranged according to number. An additional fee is charged if reinspection is necessary, when the work fails to comply with the rules, and no installation is connected without a certificate from the city electrician. The city is divided into three "fire limits," and the class of building construction, sanitary work, and electrical wiring is graded according to the "fire limit" wherein the work is situated. The use of wooden casing for wiring has long been prohibited, and in the number one "fire limit," where most of the valuable and most modern buildings are located, the use of the screwed steel conduit system alone is permitted for all electrical wiring, this being the only system that comes up to the requirements of modern fireproof buildings. I consider that it is in the best interests of the electrical industry to standardise the quality of electrical installations throughout the country, and with this end in view, suggest that a National Electrical Code be formulated by a body similar in character to the National Fire Protection Association of America, on which are represented all branches of the electrical industry in conjunction with the fire insurance companies.

P. Davis.

Portsmouth.
March 19th, 1921.

An Electrostatic Phenomenon.

Has any fellow reader encountered the following interesting phenomenon? The other evening, when handling a 6-volt half-watt type motor headlight bulb, a strange bluish light was observed to flicker within the bulb, similar to a Geissler tube display. Doubtless this static discharge was induced by friction between the dry palm of the hand and the glass bulb, but it is noteworthy that the effect was at its maximum when the movement of the bulb was almost imperceptible, more vigorous rubbing having failed to accentuate the effect.

F. Cooper.

Wollaston.
March 21st, 1921.

The Direction of Rotation of A.C. Motors.

Would any reader explain how to tell the direction of rotation of a three-phase slip ring motor, before switching in?

Also what difference would it make in phase relation and running of motors if the direction of rotation of a three-phase alternator were reversed?

Inquirer.

March 17th, 1921.

Mr. Luckiesh and the Sheringham Daylight.

I hesitate to ask for your valuable space, but I feel it is necessary for me to clear up a misunderstanding pertaining to my artificial daylight units and the Sheringham unit. I refer to Mr. Sheringham's letter published in your issue of January 7th, 1921, p. 12.

I beg to call Mr. Sheringham's attention to the fact that I have not passed judgment on his invention, as he claims. If he will again refer to my letter to the *Electrical News*, Toronto, published in the issue of November 15th, 1920, he will find that I did not condemn his unit at all. I merely wished to call attention to the fact that his method had been tried by us long ago, and that we came to the conclusion, and still entertain the same opinion after eight years of practical experience with artificial daylight units, that the principle of selective transmission is more practicable than the principle of selective reflection. There are less practical difficulties involved in making his unit, but the device is less desirable from a standpoint of permanency under all kinds of conditions.

I do not wish to start a discussion on this point, but merely to state my opinion that the glass filter will far outlast an unvitrified reflecting colour under severe conditions of application of such devices. I also wish to call Mr. Sheringham's attention to the fact that we made no claims as to originality of principle, for the principle was known as soon as Newton discovered the spectrum, and this applies to the principle which he has adopted. If Mr. Sheringham had been well-informed he would have known that I have discussed many of the developments of others along this line in various publications, and that in my "Colour and Its Applications," p. 227, I mention the unit produced by Dufton and Gardner, notwithstanding the fact that the descriptions I read of this unit show that the colouring was due to cobalt, and therefore was not a good approximation to daylight, for cobalt alone cannot accomplish such a result.

Furthermore, in the last paragraph of his letter he apparently attributes to me the statement that we have sold millions of colour matching units. Again, if he had desired to be accurate he would have found in my original letter to the *Electrical News*, Toronto, that I made no such statement. Incidentally, I find on referring to the ELECTRICAL REVIEW, December 24th, 1920, p. 819, that the REVIEW was in error in quoting me.

To summarise, it appears to me that Mr. Sheringham has written either without being informed or has taken advantage of an error, which he should have known that I did not make, to upbraid me. I do not wish to start another discussion on this matter, but merely to clear up the misunderstanding for which the ELECTRICAL REVIEW, and particularly Mr. Sheringham, are responsible. We wish Mr. Sheringham all the success possible with his unit, but we feel that it has been given more attention than it deserves, considering that for quite a number of years we have had on the market a more permanent device which has involved many difficulties in developing and producing that are not involved in producing a unit after the principle of selective reflection.

M. Luckiesh,
Director of Applied Science.

Nela Research Laboratory,
Cleveland.
February 25th, 1921.

[We regret that in our note of December 24th we inadvertently applied the word "millions" to the colour-matching devices of Mr. Luckiesh instead of "many thousands." The statement contained in his letter to the *Electrical News* is reproduced in full below:—

"For six or seven years we have had on the market our so-called artificial North Skylight colour-matching unit, our Noon Sunlight unit, and our Mazda C-2 (daylight) lamp which is a compromise between artificial daylight and luminous efficiency, and is merely a large step toward noon sunlight. We have many thousands of the first two units installed throughout the country, and since we placed these on the market, The Artificial Daylighting Co. has brought out colour-matching units, and I understand has sold a great many of them. Our Mazda C-2 (daylight) lamp which meets the requirements in a great many cases gives a light approximating average daylight in quality, and is of sufficient luminous intensity to be used for general lighting purposes. These have already been sold to such an extent that millions of them have been manufactured and installed."

It will be seen that the word "millions" applies only to the "daylight lamp." We gather from Mr. Sheringham's letter that he was aware of this, as he refers to "lamps that do not attempt to reproduce north sky light," and we feel that he cannot be held responsible for the misunderstanding. Our interpretation of Mr. Luckiesh's original letter to our contemporary is that it virtually condemns by implication the Sheringham daylight reflectors in the following passage:—

"I do not wish to discuss the merits of this particular unit more than to state that I tried this method out about eight years ago and abandoned it in favour of the straight-forward method of modifying the light by selective transmission."

—EDS. ELEC. REV.]

Wiring in Ferro-concrete Factories.

I am astonished at the tone of the letter written on behalf of the St. Helens Cable & Rubber Co., Ltd., and published in your issue of the 18th inst., and venture to say that it is not one calculated to increase confidence.

The remarks of "Inquirer" appear to be perfectly fair comment, and probably he was considering protection from fire rather than electrical or mechanical protection.

I cannot see any necessity for proving such a conjecture in that case, and to insinuate that such a statement is libellous is absurd.

With regard to the question of name and address, I know it is your invariable practice not to publish letters without receiving these, and doubtless "Inquirer" would have no objection to disclosing them to the firm.

The opening of your columns (of which there have been recent examples) to the discussion of the merits or otherwise of trade products, though attended with some risk of unpleasantness, seems to me to be of great value to all concerned, whether as makers or consumers.

But it is necessary that such discussion should be carried on fairly and courteously on all sides, when I am sure, the manufacturer will benefit as much as anybody.

With regard to the merits of C.T.S., although I have seen a fair amount of this used during the war, I have not had a long enough experience with it to be able to comment upon it, but should be very interested to hear from any of your readers who may care to relate their experiences as to its lasting properties, its suitability or otherwise for laying underground, for use outside exposed to sunlight and weather, and so forth.

A. C. Purday.

Croydon.
March 19th, 1921.

The Cost of Living in China.

Knowing that you like to publish periodically the experience of engineers abroad, perhaps the following up-to-date figures on the cost of living in Shanghai will be of interest to those who contemplate coming out here. Although these figures are my actual costs, they truly represent the average for a man and his wife with no children, in a small house. The total expenses can be reduced by about 15 per cent. by living in a boarding house, but this should be avoided if possible, as it is far from comfortable.

A young bachelor can live on about 350 taels a month if he stays at a boarding house or shares a house with two or three others, but should not accept less than 400 taels unless the firm assists him with a house allowance or provident fund.

I have given detailed costs so that items may be added or cut out to suit the taste of the individual, but very few men out here will admit that any of them can be cut out, and most will think they are too moderate.

An engineer should not be misled by the value of the tael or dollar, as this affects nothing but his savings, and these only if he intends to convert them into sterling.

	Taels per month.
Rent of unfurnished house, 4 or 5 rooms ...	85.00
House tax, 14 per cent.	11.90
Furniture (16 per cent. p.a. on cost) or hired	40.00
Servants	35.00
Electric light and water	9.50
Groceries, provisions, &c.	69.00
Coal (and ice in summer)	21.00
Laundry	9.00
Wines and spirits	8.60
Amusements	19.00
Cars, rickishas and tramcars	18.00
Clothing	58.00
Medical attendance (for wife)	7.00
Club subscriptions and chits	18.00
Papers, tobacco, &c.	7.00
Life insurance, £1,000 at 4.5 per cent. ...	45.00
Savings (20 per cent. of salary)	115.00
Total	576.00

The exchange between taels and dollars does not vary much from 72 taels equals 100 dollars, so a salary in dollars should not be less than 800 per month for the first year.

The above figures are the averages for the last 12 months, during which, strenuous efforts have been made to reduce every item except the last.

This item "savings" is almost invariably lost sight of by employers when fixing salaries, and unless the firm in question runs a generous provident fund it is absolutely necessary to save at least a fifth of one's income to pay for the wife's passage home and out every three or four years, and other necessary holidays and contingencies.

Six Years in the East.

Shanghai.
February 11th, 1921.

[We are grateful for this excellent statement, which will be of great value to many of our readers. By affording such information our correspondent has rendered a public service. Similar statements from other parts of China, East, West, and South Africa, Burmah, &c., would be welcomed.—EDS. ELEC. REV.]

Large Mercury Arc Rectifiers.

At the informal meeting of the I.E.E. on the 14th inst., some questions were asked as to maintenance of rectifiers. Reference to such plants will be found in the following publications:—

Eleck Tech. Zeit.				*Science Abstracts*		
Vol.	Page.	Year.		Vol	Page.	Year.
33	1164	1912	...	16B	82	1913
34	253	1913	...			
34	1415	1913	..	17B	93	1914
34	1479	1913	..	17B	94	1914
38	88	1917	..	20B	247	1917
39	321	1918		21B	410	1918
39	414	1918	.	22B	36	1919

Electrician, Vol. 82, 589, 1919.
Elec. Rly. Journal, Vol. 44, 1343, 1915.
Elec. World, Vol. 60, 1157, 1912, and Vol. 62, 548, 1913.
Elec. Review, Vol. 84, 191, 1919, Vol. 88, 217 and 251, 1921.

Alec. B. Eason.

London.
March 14th, 1921.

Power Installations.

The popularity of the electric drive is such a marked feature nowadays on account of its convenience, low cost, and adaptability to all classes of machinery that the exact calculation of the correct size of motor for each operation becomes a matter of importance, more particularly in connection with alternating-current systems where the question of power factor arises in its relation to the loading of the motors. I have so far failed to discover a text-book or hand-book which gives formulæ covering the calculation of horse-power applicable to drilling, planing and stamping machines, also printing presses, operated either by group or individual drive, and should feel grateful if any of your readers could furnish me with the title of such a book or books, giving also names and addresses of the publishers.

I incline to the opinion that in many instances the low power factor obtainable on power installations is due in some measure to the guess-work methods employed in deciding the size of motor suitable for the job.

Interested.

Lead-covered Wiring.

I have carefully considered your reply to my inquiry, for which I thank you, and the subsequent communication from "Engineer Contractor."

My point is as follows:—A large firm of electrical contractors, who are supposed to be first-class engineers—not glorified plumbers or ironmongers, mark you—wired up three lights for me. I had occasion recently to take up a floor board under which their wires ran. The spaces between the joists were full of chips and wood shavings. What did I find? A perfectly fitted conduit system? No, Sir. Bare wires everywhere except where they dived through the ceiling; then the conduit system commenced.

Now, I ask you, what is your Contractors' Association going to do to prevent this sort of thing? *And this firm belongs to the Contractors' Association.* The stamp is on their notepaper.

Bourgeois.

[It is not always possible to *prevent* bad work, but it can be remedied. The proper course for "Bourgeois," we take it, is to give the particulars and the name of the contractor to the Association, which will no doubt take up the matter.

With regard to the merits of the case, whether it was a serious neglect of duty or not depends upon the circumstances. The use of unprotected wires (not, of course, literally *bare*) under floors is not necessarily blameworthy.—Eds. Elec. Rev.]

Your correspondent "Bourgeois" does not directly make a charge against lead-covered wiring, but he makes an insinuation which it would probably be difficult for him to substantiate. It is unfair and unreasonable for anyone to write to the technical Press that he "has understood that the above-mentioned system is condemned." By whom is it condemned, and for what reason? I have had a lot of experience of such systems, but I have never heard of the condemnation. Little innuendoes have a habit of growing into big canards, and people who jump into print should be careful what they write.

Talk about "fires caused by an electric fuse" will never cease during the lifetime of anyone at present on this earth. That is because all people who have an electrical installation, and all people who write for the lay Press, never will all be electrical engineers.

I cannot understand electrical people giving further publicity to this libel against electricity. Fires are always due to maliciousness or carelessness. The *method* of providing the light is never the cause, but some human failure in the proper use of the method. Candle, oil, and gas lighting are probably *each* responsible for very many more hundreds of fires than electricity. Indeed, electricity is the safest method, providing least opportunity for the intervention of the defective human element. And a good lead-covered or metal-covered system, if it is properly installed by an efficient wireman under conditions laid down in the I.E.E. rules—as *all* systems should be—is just as safe as any other method of electrical installation. I, personally, know of several hundred installations on the Henley wiring-system—a metal-covered system—which have been in use many years, and I have never heard of one single case of fire in any of them.

Othello.

London.
March 19th, 1921.

[Several letters have unavoidably been held over.—Eds. Elec. Rev.]

BUSINESS NOTES.

Bankruptcy Proceedings.—JOHN VINCENT BELL, 21, North Bar Within, Beverley, East Riding, Yorkshire, electrical engineer.—The public examination of this debtor was fixed to be held on March 14th, at the Guildhall, Hull, but the investigation which was being made into the debtor's affairs was not complete, and the examination was adjourned.

JOHN JONES and JOHN RICHARD JONES, trading as J. Jones and Son, 7, Chapel Street, Penzance, Cornwall, electrical engineers.—The first meeting of the creditors of the above was held recently at the Official Receiver's Office, Truro. According to the statement of affairs, the liabilities amounted to £1,078, against assets £776. Debtors attributed their position to serious illness of the senior partner, his wife, and daughter, pressure of creditors, and depreciation of the value of stock. It was stated that they commenced business two years ago, but were not aware of the amount of capital they then possessed. The only books of account kept were a day-book and a ledger, and there were no accounts of receipts and payments. They became aware of their position a month before the receiving order was made. The separate estate of John Jones showed a surplus of £151, while that of John Richard Jones showed assets £10, and no liabilities. It was decided that Mr. W. C. Pezzack, accountant, of Penzance, should be appointed trustee of the estate, assisted by a committee of four of the creditors.

E. A. GOODINGS (Goodings & Son), motor and electrical engineer, The Grove, Watlington Street, Reading.—First meeting March 24th, at 14, Bedford Row, W.C.; public examination, April 21st, at the Assize Courts, Reading.

W. DRYSDALE electrician, 24, Paxton Street, Barrow-in-Furness.—Last day for proofs for dividend, March 31st. Trustee, Mr. H. Mossop, 4, Ramsden Square, Barrow-in-Furness.

G. F. KIVERON. electrical engineer, Sheffield.—First and final dividend of 3s. 10½d. in the £, payable at the Official Receiver's offices, Sheffield, on March 22nd.

Company Liquidations.—FLUORUNDUM FLAME CARBONS, LTD—Winding up voluntarily. Liquidator, Mr. F. N. Clarke, 4, Pavilion Buildings, Brighton. A meeting of creditors was called for March 22nd.

MERSEY ELECTRICAL ENGINEERING CO., LTD.—Winding up voluntarily. Liquidator, Mr. T. L. Hanmer, 24, North John Street, Liverpool.—A meeting of creditors is called for March 29th, at Liverpool. Particulars of claims should be sent to the liquidator by April 15th.

BASTIAN ELECTRIC CO., LTD.—A petition for winding up has been presented to the High Court by Mr. W. F. N. May, of Bedruthen, Barnt Green, Worcester, and Mr. A. E. Wall, of Baddesley House, Hatch End, Middlesex, and will be heard in London on April 12th.

GRIMSBY ELECTRIC WELDING CO., LTD.—Winding up voluntarily. Liquidator, Mr. H. Blanchard, Humber Bank, Fish Docks, Grimsby,

PORTABLE ELECTRIC MOTORS, LTD.—A petition for winding up has been presented to the High Court by Messrs. Electric Tools and Motors, Ltd., of 31-33, High Holborn, W.C., and will be heard in London on April 12th.

Dissolutions of Partnership.—TIERNEY, WOOD & CO., electrical engineers, 484, Oldham Road, Failsworth, Manchester.—Messrs. F. S. Ormerod, J. Tierney, and J. Wood have dissolved partnership. Mr. J. Tierney and Mr. J. Wood will attend to debts and continue the business.

RYELAND & FERGUSON, electrical engineers and contractors, 44, Weston Street, London Bridge, S.E.—Mr. W. L. Ferguson and Mr. A. E. Ryeland have dissolved partnership. Mr. A. E. Ryeland will attend to debts and continue the business.

Trade Announcements.—MESSRS. J. B. SAUNDERS & CO., LTD, announce that on the expiration of the lease of their temporary offices they have returned to Westminster, and their address is now 11, Dacre Street, Westminster, S.W. 1.

MR. ALFRED WHITE has removed from Empire Buildings to 4, Norfolk Street, Sunderland.

THE CAMBRIDGE AND PAUL INSTRUMENT CO., LTD., of 45, Grosvenor Place, London, S W. 1, has now opened two repair depôts. For the convenience of customers in Scotland and the North, a depôt has been established at 12, Westgate Road, Newcastle-on-Tyne. and for customers in the Midlands a depôt at Empire House, Great Charles Street, Birmingham.

MR. S. P. MARSH, electrical engineer, of 63, Regent Street, Rugby, has disposed of his business to MR. F. PRITCHARD, A.M.I.E.E., A.M I.Mech.E., with whom he will, however, continue for some months.

MR. A. W. COWARD, of Mill Lane, Chadwell Heath, Essex, has entered into partnership with MR. C. B MAURICE, of "Berwick House," 139, Oxford Street, W., who will now trade under the name of Messrs. Maurice & Coward, at the same address. Telephone, "Museum 3627."

THE GENERAL ELECTRIC CO., LTD., announces that, as from April 4th, its registered office will be Magnet House, Kingsway, London, W.C. 2.

German Cable Industry.—The electric cable industry of Germany had a bad year during 1920. The goods sold abroad during the first six months did not total as much as 30 per cent. of the pre-war figure, says the *Engineer*, and during the last half-year they fell below 25 per cent. Sales in Germany ceased altogether.

Inquiry.—The name and address of the makers of "Seecol" dimmers are asked for. Also makers of a lamp-testing wattmeter.

Catalogues and Lists.—Messrs. A. Gallenkamp and Co., Ltd., 19-21, Sun Street, Finsbury Square, E.C. 2.—Catalogue No. 75, illustrating and describing a number of electric furnaces for temperatures up to 1,000 C. These are of the tube, muffle, and crucible types. Also Circular No. 207, which describes a furnace for carrying out the Lessing coking test of coal. Both publications are fully priced.

Simplex Conduits, Ltd., Garrison Lane, Birmingham.—A beautifully-produced catalogue of "Simplex" lighting fixtures of many types. The illustrations show bowl fittings, brackets. pendants, hall lanterns, table lamps, switch plates, electric signs, &c. A price-list is included in the booklet.

Messrs. W. T. Henley's Telegraph Works Co., Ltd., Engineering Department, Blomfield Street, London Wall, E.C. 2.—List U E 5, giving illustrations, prices, and full details of terminal boxes for outdoor work. The types shown include boxes for two, three, and four-core cables for voltages ranging from 660 to 20,000. Details of glands and jointing instructions are also given.

Messrs. L. G. Hawkins & Co., 116, Charing Cross Road, W.C. 2.—A poster announcing a special "spring offer" of "Universal" domestic electrical appliances. Also an illustrated folder, "Domestic Service Electrified," dealing with the same subject.

Huntalite, Ltd., 25, Newman Street, W. 1.—A folder giving illustrations and prices of floor and table standards, in antique walnut, for electric lighting.

Westinghouse Electric International Co., East Pittsburg, Pa., U.S.A.—An illustrated catalogue of electric toasters, radiators, irons, cookers, &c.

Messrs. Watson & Sons (Electro-Medical), Ltd., Sunic House, 43, Parker Street, W.C. 2.—"Sunic Record" No. 13, giving some useful notes on radiographic work and curves plotted from results obtained with the firm's spark gaps, giving pressures in kilovolts for various gaps; Bulletin 32 S, a price-list of duplitised X-ray films and dental films and accessories; also Folder 33 S, dealing with the improved "Sunic" X-ray plate.

The General Electric Co., Ltd., 61, Queen Victoria Street, E.C. 4.—Leaflet O.S. 2,465, advertising the "Kingsway" miners' hand lamp, and giving illustrations and prices of screwed and bayonet cap lamps for use with this.

Also an illustrated catalogue giving particulars and reduced prices of "Osram G.E.C." vacuum and gasfilled electric lamps. The list includes views of the lamp works.

The Imperial Engineering Co., 61, Darlington Street, Wolverhampton.—An illustrated and priced leaflet, advertising the "Imperial" 440-watt electric toaster, with flex and adapter.

Messrs. Fraser & Glass, Assembly Works, Middle Lane, Hornsey, N. 8.—Two illustrated leaflets (Lists Nos. 1 and 2) showing examples of steel chains for balancing and driving.

The Electrical Apparatus Co., Ltd., Vauxhall Works, South Lambeth Road, S.W. 8.—Leaflet H 41/5, a well-illustrated price-list of ironclad switches, draw-out pillars, and switchboards, giving full details and specifications.

Metropolitan-Vickers Electrical Co., Ltd., 20, Brazennose Street, Manchester.—Leaflet No. 379/1—1, giving descriptions and details of three phase transformers for rotary converters: No. 379/1—3, illustrations of three-phase transformers for rotary converters; and No. 711/1 A, illustrating and describing transformers for use in collieries.

Messrs. Meldrums, Ltd., Timperley, near Manchester.—Two leaflets illustrated in colour—one showing the "Meldrum" forced-draught furnace applied to a Lancashire boiler, and the other depicting the "Meldrum" mechanical stoker with moving grate and forced draught.

Pope's Electric Lamp Co., Ltd., Elasta House, 5, Arthur Street, W.C. 2.—Leaflet C.L. 1, illustrating and describing "Elastalite" 20-watt candle lamps. Fully priced.

The Edison Swan Electric Co., Ltd., Ponders End, Middlesex. List No. PP 213, an illustrated catalogue giving very full particulars, and also prices, of petrol-electric lighting and pumping sets of capacities ranging from ·3 to 13 kW. Batteries and switchboards are also illustrated and described.

Hart Accumulator Co., Ltd., Marshgate Lane, Stratford, E.C. 15. Catalogue for 1921. The list gives illustrations of all types of accumulators (with prices), and each section is indicated on a thumb index for easy reference; it is bound in stiff covers.

For Sale.—The Lancashire and Yorkshire Railway Co. has for disposal one Yates and Thom compound vertical engine, direct-coupled to a 750-kW Dick, Kerr generator.

Wigan Corporation Electricity Department has for sale a Thompson patent straight water-tube boiler (vertical type).

Elland Urban District Council, consequent on purchasing electrical energy in bulk, has for disposal the contents of its electricity station.

Messrs. Eadon & Lockwood will sell by auction, on April 19th and following days, at Chilwell, Notts., electrical plant, machinery, &c.

By direction of the Disposal Board, Messrs. Fuller, Horsey, Sons and Cassell will sell by auction, on April 20th, at Greenwich, surplus electrical plant, including a 1½-kW wireless transmitting and receiving set, generating sets, &c. For full particulars see our advertisement pages to-day.

Social Events.—The annual dinner of the Torquay Electricity Supply Department took place at the Royal Hotel, on March 12th, Mr. H. F. G. Woods, the borough electrical engineer and manager, presiding. A musical evening followed, the programme being provided by various members of the staff.

A dinner was held at the Connaught Rooms, on March 8th, at which the executive, management, and depôt superintendents of the Edison Swan Electric Co., Ltd., were present. The chair was taken by Mr. C. Jermyn Ford, the chairman of the company, supported by Major Eustace Quilter and Mr. E. A. Gimingham, directors. and amongst the visitors were Messrs. R. C. Lanphier and S. B. Rogers, the former being the vice-president of the Sangamo Electric Co., U.S.A., whilst the latter is the European manager of the Sangamo Co., a concern closely associated with the Edison Swan Electric Co., Ltd., who are the sole Sangamo agents for Great Britain and the Colonies. During the evening the toast of "The Chairman" was proposed by the commercial manager, Mr. C. Horace Cox. "The Depôt Superintendents" was proposed by Mr. J. W. Elliott, joint sales manager, and this was replied to by Mr. J. Taylor (Glasgow), and Mr. A. McDonald (Dublin). "The Visitors," proposed by Mr. E. A. Gimingham was responded to by both Mr. Lanphier and Mr. Rogers. A musical programme was provided by the Misses Violet Holt and Barbara Laughton, Messrs. George Tinney, A. P. Ambler and E. H. Miller; the last of these sang an Ediswan Topical Song.

How American Merchants are Cutting Down Expenses.—Valuable information as to how merchants of the country are cutting down their expenses to meet the present slump in business is being received by the Domestic Distribution Department of the Chamber of Commerce of the United States. More than 15,000 letters of inquiry were sent out to wholesalers, jobbers. commission merchants, and retailers, asking them certain questions regarding their present overhead expenses, and what they are doing to reduce them. Already a multitude of replies has been received at the headquarters of the National Chamber, and in almost every case the merchant is reducing his operating expenses so that he can meet the pressure of the public for lower prices. Most of the answers report that workmen are more efficient than they were this time last year, when there was plenty of work to be had. Some firms have eliminated pay for overtime, while others have reduced salaries. "We are weeding out the drones and keeping our efficient workmen," is a typical statement. In this connection one man stated that he had cut down his force 44 per cent., and that his production had increased 25 per cent. Originally, he employed 25 men. When the first depression in business affected him, he cut down his force to 22, and his output remained the same. He reduced his force a second time to 14 men, and his production went up 25 per cent. At the same time, he reported a wage reduction of 30 per cent. Some firms replied that they were not reducing the wages of their old employés, but that they were hiring new men for less money. Others said they would not reduce wages until the cost of living dropped appreciably. "We are reducing the amount of our bonuses by 50 per cent., and we are cutting down our commissions on sales," is quite a common reply. This is the way in which one merchant explained the manner in which he handled his wage problem when the present business depression set in:—"We called our men together, and laid our cards on the table. We had nothing to withhold. We told them that we could not continue to do business with the present wage scale unless they became more efficient. By increasing their efficiency they made it possible for us to reduce our prices." Everywhere the replies indicate that there is a tightening of credit, without any general reduction of volume. New accounts are being more closely scrutinised, and bills are reaching the hands of collectors a little sooner than when business was brisk. The replies are about evenly divided on the question—"Have you reduced your advertising space?" A number of merchants report a reduction, while some say they are more careful in their advertising. A large number of merchants report that they have increased their advertising appropriations. They point out that advertising is a means of sales promotion, which should be pushed at this time especially. These answers are being collected in digest form by the National Chamber for the purpose of disseminating this information to business men.—*Reuter's Trade Service* (Washington, March 7th).

Water Power in Peru.—The Commercial Secretary to H M. Legation at Lima (Mr. F. W. Manners) has forwarded to the Department of Overseas Trade a translation of a projected Bill recently presented by the Finance Minister to the Peruvian Congress concerning the nationalisation of water power in the Republic of Peru. Under this Bill all water-power concessions will be granted under the provisions of the Mining Code by the authorities therein appointed. The translation may be seen by United Kingdom firms interested at the Inquiry Room of the Department of Overseas Trade, 35, Old Queen Street, London, S.W. 1.

German Companies' Working Agreement.—At a general meeting of the Allgemeine Elektricitäts-Gesellschaft, the president Herr Rathenau, proposed a scheme of closer union with the Linke-Hoffmann works, and an increase of capital.

On the side of the A.E G. the object of union is, briefly, to avoid contraction of the activities of their vast repair sheds in favour of new construction, by attaching themselves to a locomotive concern which disposes also of important partly-finished articles of manufacture. On the other side, the Linke-Hoffmann works are anxious for the union, because they foresee that the electric-locomotive business will gradually increase in importance, and needs for this purpose close connection with a large electrical concern.—*The Times.*

Unemployment Benefit Figures.—Some very instructive figures regarding the cost to the State of maintaining the unemployed are given in a written answer by Mr. Macnamara to Sir W. de Frece. From January 1st to March 11th there was paid out in unemployment benefit £5.300,000, and in out-of-work donation £2,900,000. Since November grants for roads to the extent of £3,000,000 have been paid. An equal sum has been paid by way of loan. The Unemployment Grants Committee has sanctioned £764,545 since January 1st. Productive work has been found for about 100,000 men.—*Morning Post.*

To Finish in Germany.—It is announced in the Finnish Press that arrangements are being made to send some 10 young engineering students, who have completed their course in the Technical High School at Helsingfors, to Germany, in order that they may make themselves familiar with the latest developments in the big industrial establishments of that country. Each student is to stay about a year in Germany, and the firms of Siemens and Halske and Voigt's turbine factory are mentioned as those to which the students will be attached. A sum of 100,000 marks is provided in the budget for defraying the initial expenses of the scheme.

Book Notices.—"The Metropolitan-Vickers Gazette." Vol. VI, No. 95. February, 1921. (23 pp.).—This issue contains the usual interesting well-illustrated articles, including "Electrical Equipment of Oil Wells," "Works Testing Devices," and a description of a new workmen's canteen at the Trafford Park Works.

"*Journal* of the Institution of Electrical Engineers." Vol. LXIX, No. 297. January, 1921. London: E. & F. N. Spon. Price 10s. 6d.—This issue contains the following papers:—"The Distribution of Electricity," by Mr. W. B. Woodhouse; "Some Economic Aspects of e.h.p. Distribution by Underground Cable," by Mr. R. O. Kapp; the Twelfth Kelvin Lecture "Electrons," by Sir W. Bragg, F.R.S.; "A Precise Form of the Kelvin Electrostatic Voltmeter," by Mr. E. H. Rayner; "The Whitened Cube as a Precision Integrating Photometer," by Mr. H. Buckley; and "Range of Wireless Stations," by Captain R. C. Trench.

Scientific Paper No. 408 of the U.S. Bureau of Standards, "Effect of the Rate of Cooling on the Magnetic and other Properties of an Annealed Eutectoid Carbon Steel" (14 pp). Washington: Government Printing Office. Price 5 cents.—This is a record of experiments carried out on six specimens of steel which were heated to 800° C., and allowed to cool at various rates. The following properties were then measured:—Normal induction for ordinary and large magnetising forces, residual induction, coercive force, resistivity and Shore scleroscope hardness.

Fuel Research Board. Technical Paper, No. 1. "The Assay of Coal for Carbonisation Purposes: a New Laboratory Method." By Thomas Gray, D.Sc., Ph.D., and James D. King, F.I.C., A.R.T.C. London: H.M. Stationery Office. Price 6d. (by post 7d.).—The Fuel Research Board has begun the issue of a series of special papers and reports which will be known as Technical Papers of the Fuel Research Board. These papers will be prepared from time to time on the results of the work carried out at H.M. fuel research station or elsewhere, and will, it is thought, be valuable to all who are concerned with fuel problems. The present report, the first of the series, describes the development of a method of coal assay in which by direct weighing and measurement the yields of gas, oil, water and carbonaceous residue resulting from the carbonisation of coal at different temperatures can be quickly and accurately determined. The experimental results given in the paper show that the method supplies valuable information which cannot be obtained directly from the ordinary laboratory methods hitherto used in the testing of coal. Tables and graphs illustrating the experimental work are incorporated in the report.

"Engineering as a Career." By Percival Marshall, A.Inst.M.E., and Alfred W. Marshall, M.Inst.M.E., A.M.I.E.E. (56 pp.) London: Percival Marshall & Co. Price 9d. net.—This is the second edition of a very useful little guide for those seeking an entrance to the engineering professions. Mechanical engineering is dealt with at a greater length than other branches, as the authors state that "it offers the largest field for employment, and is really the basis of nearly all engineering work." A list of the principal engineering colleges and technical schools is included.

British Standard Specification, No. 91—1921, "Electric Cable Soldering Sockets" (for cables from 0·0018 to 1·000 sq. in sectional area). London: Crosby Lockwood & Son (for the B.E.S.A.). Price 1s. net. This specification includes definitions and clauses relating to the material and dimensions of cast and wrought lug sockets, clamp sockets and their clamps. Attention is directed to the care which should be taken to ensure that the cable fits the hole in the socket, so that the current will not have to traverse an undue amount of solder.

Also No. 139—1921. "Red Fir Wood Poles for Telegraph and Telephone Lines." Price 1s. net. This specification deals with light, medium and stout poles of lengths varying from 16 to 85 ft. A section dealing with creosoting is included.

"Welfare Work." Vol. II, No. 15. March, 1921.—This issue gives details of a workmen's compensation scheme in force at the Bournville works of Messrs. Cadbury Bros., and articles on "Progress in China," and "The Science of Industrial Management."

"Science Abstracts A and B," Vol. XXIV, part 2, February 28th, 1921, also index to Vol. XXIII (A and B). London: E. and F. N. Spon, Ltd. Price 2s. 6d. each net.

"Radiographic Technique." By T. Thorne Baker. Pp. xii + 196. 62 figs. London: Constable & Co. Price 15s.

"Electrical Installation Work (including Electric Wiremen's Work)." By J. H. Havelock, Pp. viii + 366; figs. 120. London: Crosby Lockwood & Son. Price 15s. net.

"Lehrgang der Schaltungsschemata Elektrischer Starkstrom-Anlagen." By Prof. J. Teichmüller. Munich: R. Oldenbourg. Price 68 marks.

"Year-Book of Wireless Telegraphy and Telephony for 1921." London: Wireless Press, Ltd. Price 21s.

"Opportunities in Engineering." By C. M. Horton. Pp. 90. London: University of London Press, Ltd. Price 3s. 6d. net.

"Freileitungsbau Ortsnetzbau." By F. Kapper. Munich: R. Oldenbourg. Price 65 marks.

Demand for Machinery in India.—Machinery for brass and iron foundry work, and for sanitary, mechanical, and electrical engineering, is in great demand.—*Reuter's Trade Service* (Bombay).

A Standard Customs Declaration Form.—The question of a standard Customs declaration form for use throughout the British Empire, which was fully considered by the Federation of British Industries in 1918, has again been brought into prominence by the deliberations of the Empire Customs Conference.

The Executive Committee at its meeting on March 9th sanctioned the appointment of a Committee of representatives of the industries most likely to be affected to consider further action on the part of the Federation. The Committee consists of representatives of the B.E.A.M.A., the National Federation of Iron and Steel Manufacturers, the British Engineers' Association, the Association of British Motor and Allied Manufacturers, the Wall Paper Manufacturers' Association, and Messrs. Lennox B. Lee, A. K. Davies, E. R. Firth, George Garnett, W. V. Collier, Harry Allcock, Thomas Bolton, L. J. E. Hooper, P. H. Lockhart, E. H. Matthew, Frank Moore, R. M. Bewick, A. E. Jacob, W. B. Pickering, F. B. Nathan, and R. A. Pilkington.

On the recommendation of this Committee a letter has now been addressed to the Comptroller-General, Department of Overseas Trade, drawing attention to the careful consideration devoted by the Federation to the question of evolving a standard Certificate of Origin and Value, and suggesting the desirability of a joint meeting between representatives of the Conference and the Federation, to discuss both this point and other questions of importance to Industry, such as treatment of commercial travellers, samples, &c., which it is understood the Conference proposes to investigate. A draft form of standard certificate approved by the Committee was submitted together with the letter.—F.B.I. *Bulletin.*

Electricity and Paper-making.—A correspondent of *The Times Trade Supplement* says electrical engineers have been considering the large scope for enterprise that is presented to them owing to what they regard as the backwardness of our paper-making interests in the use of electricity. Statistical information prepared by the paper-makers' organisation is quoted to show that out of 500 paper-making equipments in the United Kingdom, only 21 have adopted electrification. As the British paper-making industry in some sections is faced with the necessity for less conservatism in its attitude toward modernisation as a means for securing efficiency and economy, it is not surprising that electrical installation engineers and manufacturers are looking in this direction for a fair amount of work before long.

Standardisation of Government and Municipal Contracts.—The Executive Committee of the Federation of British Industries, at its meeting on March 9th, considered a recommendation from the De-Controlled Associations Committee that a Committee, representative of all important industries affected, should be set up to investigate the possibility of securing the adoption of a standard type of Government and municipal contract and form of tender; and to inquire and report as to whether any conditions were imposed (including special conditions referring to particular goods), which were unnecessarily onerous, and, consequently, detrimental to the advancement of trade.

It was moved by Sir John Mansell, and unanimously resolved, that the recommendation be adopted, and that representatives of the following industries be asked to serve on the Committee of Inquiry:—Electrical engineers, general engineers, machine tool trades, tube manufacturers, wire rope makers, tanners, brush manufacturers, cable makers, iron and steel manufacturers, cement manufacturers, paper makers, shipbuilders, woollen and worsted trades, builders, aircraft manufacturers, master printers, boot makers, motor manufacturers, wagon builders, explosives trade, food manufacturers, oil and fat producers, and two representatives of the de-controlled associations.

The Committee was empowered to approach directly, and to hold meetings or interviews with, representatives of any Government department and municipalities, particularly the Admiralty, the War Office, the Air Board, the India Office, the Crown Agents for the Colonies, and the Ministries of Transport, Health, and Labour. —F.B.I. *Bulletin.*

Trade with Russia.—The Board of Trade (Licensing Section) announces that licences are no longer required for the export to Russia of any goods other than goods, the export of which is prohibited except under licence to all foreign countries.

Spanish Commercial Treaties.—The Spanish Government has decided to extend the commercial treaties lapsing on 20th inst. until the new Customs tariff comes into effect.—*Reuter's Trade Service* (Madrid).

Patent Application.—Ravul Frère has applied for restoration of Patent 23,018, of 1913, for "Improvements in means for automatically controlling the supply of air to boiler furnaces."

A New Norwegian Electrical Association. — The Department of Overseas Trade is informed by the Commercial Secretary to H.M. Legation at Christiania that at a meeting recently held in Christiania by Norwegian factories and workshops capitalised with Norwegian money for the purpose of producing Norwegian electro-technical products, it was decided to form the National Association of Electro-Technical Industries (Landsforening vor Electro-teknisk Industri) with the object of protecting the common interests of its members and of working to consolidate the position of the electro-technical industry.

LIGHTING AND POWER NOTES.

Aberdare.—Year's Working.—The accounts of the electricity department for the year ended March 31st, 1920, show a total revenue of £11,089, as compared with £8 204 in the previous period. Working costs amounted to £6,927, as against £5,020, leaving a gross profit of £4,162 (£3,184). The net result was a profit of £570, comparing favourably with a deficit of £92 in the previous year. The number of units sold increased from 1,208,960 to 1,371,254. An interesting item in the revenue account of the destructor department is the sale of steam to the value of £1,285 to the electricity department.

Aberdeen.—Proposed Extensions.—At a meeting of the Electricity Committee a scheme for extending the electricity works, at a cost of £210,000, was considered, and it was decided to place the scheme before the Electricity Commissioners.

Arbroath.—Proposed Price Increase.—The Arbroath Electric Light and Power Co., Ltd., has applied to the Ministry of Transport for an order under the Electric Lighting Act (1899) to modify the existing statutory powers under the Arbroath Electric Lighting Order. The Ministry has been asked to approve of an increase in the present rates.

Belper and District.—Extension of Supply.—The Derbyshire and Nottinghamshire Electric Power Co. is applying to the Electricity Commissioners for powers to generate and supply electricity within the urban districts of Belper and Heage.

Burton-on-Trent.—Extensions.—The Town Council has approved the recommendations of the Electricity Committee with regard to plant extensions. It is proposed to purchase some second-hand plant from the Nottingham Corporation at a cost of £10,500; this with the necessary auxiliaries and arrangements for erection is estimated to cost about £33,500.

Camberley.—Electricity Supply.—The Yorktown and Blackwater Gas Co. has completed negotiations with the War Office for a supply of electricity in bulk from the power station at Aldershot; it proposes to supply electricity for lighting at 8d. per unit, and for power at from 4½d. to 5d.

Carmarthen.—Price Increase Deferred.—The Carmarthen Electric Light Co. recently applied to the Corporation for an 80 per cent. increase in the public lighting charge, and a sub-committee of the Corporation, having heard a deputation from the company, recommended an increase of 50 per cent. At a Council meeting the matter was referred back for further consideration, the proposer alleging that the recommendation was carried by the votes of members who were shareholders of the company.

Chichester.—Proposed Purchase of Undertaking.—At a recent meeting of the City Council, the Mayor stated he had received a letter from the Electric Light Co. offering its undertaking to the Council at a price to be agreed upon by arbitration, or as an alternative the Council could make an offer to the company. A Sub-Committee appointed to deal with the matter, recommends that the Council offer the sum of £12,500, subject to the settlement of all outstanding claims upon the undertaking. It is also recommended that sanction be sought to a loan of £14,500 to cover the purchase price and the cost of putting some of the plant into proper working order.

Continental.—Switzerland.—Owing to the protracted drought, hydro-electric undertakings have been unable to keep up their output: this is having a detrimental effect upon the railways, agriculture and other industries which are now dependent upon an adequate supply of electricity. Rain has fallen this week.

Czecho-Slovakia.—Activity is being displayed in the formation of new electrical undertakings in the new kingdom of Czecho-Slovakia. After the launching of the Middle Moravian company, have followed an East and a West Moravian company, each with its separate district to serve. Now, the fourth and the last to be established is the North Moravian, with the object of electrifying Northern Moravia and the parts of Silesia on the border. The new company bears the name of "Nordmährische Elektricitäts Aktien Gesellschaft," and possesses a capital of 4,000,000 kronen. To the capital of the concern the State, the Province, and the communes affected contribute to the extent of 60 per cent., private capitalists to 35 per cent., and officials, workmen, and others, to 5 per cent.

The supply of electricity to the towns, rural districts, and industries of Western Bohemia, was a burning question before the war, and led to many but fruitless representations and negotiations with the former Governmental departments at Vienna. With the new order of things, the matter has been taken up by the Elektricitäts Verband der Nördlichen Bohmerwaldbezirke, representative of district deputies, provincial bodies, communes, and other consumers, and the question seeking solution now is either the erection of a distribution network for the whole province with a single generating station worked by water alone, of which an ample quantity is available, or by heat in some form, or by a combination of the two systems. In favour of the last is the fact that resort must probably be had to heat reserve plant in the drier periods of the year, and that big works like the Skoda Co.'s works in the Pilsen coalfields and other works have large heat plants already available; but the decision depends upon the cost, and to serve the needs of the small as well as the larger consumers, choice must be made of that system entailing the least prime cost. So far as the peculiar circumstances of West Bohemia are concerned, the question is evidently very complex, and the result of the general deliberation will be awaited with interest.

The Moravian Provincial Commission has decided, after thorough examination, on the development of the water power of the river Thaya. The building of two dams and a weir, with a hydro-electric station at Znaim, was approved; 80,000 000 kWh yearly is expected to be the output of these works, which, with two additional weirs, cannot be completed under several years. Before the war, Swiss capitalists were interested in this scheme.

Dublin.—Water Power Possibilities.—In its report upon the possibilities of utilising the water power of the Liffey for the generation of electricity, the Corporation Electricity Committee points out the difficulties placed in the way of the electricity undertaking by the fuel shortage, and considers that from many points of view the harnessing of the Liffey would be of enormous advantage to the city. It is stated that when the question was first dealt with, it was considered that with coal at 10s. a ton, it would pay to undertake a water-power scheme with a maximum capital cost of £50 per h.p. developed. Now that coal costs 50s per ton, that figure can be fixed at £200 per h.p. The report states:—

"Even if the water power were to cost more than the steam power, it would be well worth considering, as it would remove, to a large extent, the menace of a coal shortage. This, however, does not appear to be the case, and it seems quite probable that the water power will prove the cheaper. It is estimated that the Liffey development scheme would not cost much more than £100 per h.p. In other words, the power from the Liffey water-power works would cost little more than half as much as an equal amount of power from the Pigeon House works. In estimating ultimate costs it must be remembered that the capital costs already incurred by establishing the steam-power stations must continue to be carried until the capital expenditure has been paid off. Even when these costs have been taken into account, the water-power proposition would appear to have much to be said for it from the financial point of view.

"If water power were substituted for steam power for the generation of electricity for the supply of the present Dublin consumers, the result would be a saving of some 50,000 tons of coal per annum. This coal at 50s. per ton would cost £125,000 per annum, and this sum capitalised would amount to over 1¾ million pounds sterling. It will thus be seen that very large capital expenditure would be justified for the purpose of developing the Liffey water power."

Dundee.—Electricity Supply Discussion.—The Corporation's electricity problems were discussed at great length at a special meeting of the Town Council. Prof. Gibson was in attendance, and was thanked for the assistance he had given the Council in compiling reports on various schemes. The convener of the Electricity Committee declared that they must dismiss from their minds any idea of the city's exploiting hydro-electric power on its own account. It was decided to curtail the proposals previously passed to extend the steam generating plant, and to confer further with the Grampian Co. with a view of getting a favourable offer.

Edinburgh.—New Sub-station.—The Corporation Electricity Committee recommends that tenders be accepted for the erection of a sub-station in the Cowgate, which is estimated to cost £10,000.

Galashiels.—Proposed Purchase of Undertaking.—The Town Council is in communication with the Galashiels and District Electric Supply Co., Ltd., with regard to the proposed acquisition by the town of the company's undertaking. The company considers it is premature to enter into negotiations.

Gold Coast.—Electricity Supply Details.—The administration report of the Gold Coast Railways for the year 1919, just to hand, states that throughout that period the electricity supply to locomotive workshops and running sheds, Government offices, and for public and private lighting, had been maintained without interruption of service, and there was a marked increase in the quantity of electricity generated and supplied over the previous year's working. Private consumers' lighting load increased considerably, and more than 400 additional lighting points were installed.

Halstead.—Position of Supply Scheme.—The *Essex County Standard* states that only about £1,000 of the £8,000 required for the carrying out of the Halstead electricity supply scheme has been subscribed.

Hereford.—Extension of Supply.—The Corporation is applying to the Electricity Commissioners for a special order authorising the Council to extend its area of supply of electricity, so as to include therein the urban districts of Bromyard and Kington, the rural districts of Bredwardine, Bromyard, Dore, Hereford, Kington, Leominster, Ross, Weobley, Whitchurch, Wigmore, and parts of the urban district of Ross, and the rural district of Ledbury, the extension and amendment of the Hereford Electric Lighting Act, 1898, supply of electricity in bulk, construction and erection of overhead wires, and further powers with regard to revenue and reserve fund.

Kirkcaldy.—Need for Extensions.—The Corporation is in a difficulty so far as the future of the electricity undertaking is concerned. There is a desire to retain the undertaking rather than dispose of it to the Fife Power Co., but, believing the time premature to consider any scheme for a national power station in Fife, the only alternative would seem to be that of temporarily extending the present generating station, at a cost of £70,000, and erecting a new power station later. The Corporation electrical engineer reports that there is no room on the existing site for further steam plant extensions to meet the needs of the town. He considers that a steam-turbine power station on a new site has become inevitable, and advises the purchase of two 750-b.h.p. land Diesel engines, with alternators, to be placed in a temporary building alongside of the existing station.

Littleborough.—Electricity for New Houses.—After considering the question of the supply of electricity to the housing site, the Tramways and Electricity Committee has recommended that the engineer submit revised estimates for the laying of cables to Hare Hill Mill, and thence to the housing site, for distribution cables thereon, the wiring of the houses, and for street lighting; also that application be made for borrowing powers, and that tenders be obtained for wiring the houses.

Mytholmroyd.—Mains Extensions.—The Urban District Council has given permission to the Yorkshire Electric Power Co. to lay more mains in the district, and also to proceed with the erection of an overhead cable from Mytholmroyd to Acre Mill.

Navan.—Electric Lighting Scheme.—At a meeting of the Urban Council, the Irish Commissioners of Public Works intimated, in reply to an application for a loan of £10,000 for an electric lighting scheme, that such loans were not now granted by the Commissioners. After discussion, it was decided to apply to the Munster and Leinster Bank for a loan of £10,000, repayable in 20 years.

Newport. — Cooling-water Investigations. — The Newport Harbour Board has given its sanction to a scheme put forward by the electrical engineer of the borough of Newport for the establishment of a single-unit pumping station for the purpose of making investigations to ascertain if the use of the river-water for condenser-cooling purposes is practicable.

Runcorn.—Power Co.'s Supply to Ellesmere Port.—The Mersey Power Co. has notified the Mersey Conservancy that it is about to lay cables in the bed of the River Weaver, near Weston Marsh Lock, for the purpose of conveying electrical energy from the Percival Lane power station of the company at Runcorn to Ellesmere Port. Five cables are proposed in all—three power cables and two telephone cables. The cables will be paper insulated, lead sheathed and double wire armoured. They will be laid in a dredged trench in the bed of the river on a solid clay foundation. No interference with tidal waters is anticipated.

Ryde (Isle of Wight).—Minimum Charge Protest.—The Town Council has decided to support the action of the Sandown Urban District Council in urging the Ministry of Transport to modify the order authorising the Isle of Wight Electric Light Co. to make a minimum charge of 50s. on the basis of a yearly consumption, instead of a charge based on a quarterly consumption, as at present.

Sevenoaks.—Proposed Price Increase.—The Electricity Co. has applied for an order to charge 1s. per unit for electricity, with quarterly minimum payments of 15s. in the winter, and 10s. in the summer.

Southampton.— Proposed Price Increase.— In a report to the Borough Council, upon the steps necessary to reduce an expected deficit of about £10,000 in the next financial year, the engineer states that re-organisation should be carefully considered in the first place. Next, he thinks that the prices charged for electricity for heating are too low, and suggests increases which would bring in an additional revenue of £6,286. A small increase in revenue could be effected by charging rentals for the power and heating meters. He states that he is very reluctant to recommend any further increase in lighting charges, although the Corporation's rates are probably the lowest on the South Coast. A special meeting of the Electricity Committee is to consider the report.

Southend.—Inspection of Second-Hand Plant.—At a meeting of the Electricity and Light Railways Committee, the electrical engineer reported that the Rotherham Corporation had laid down a new generating station and was disposing of a quantity of valuable plant from the station which had been closed, including four 30,000-lb. Niclausse boilers which had been in use for a period of two years, and which, if in suitable condition, could be utilised in connection with the new extension scheme, thus enabling a considerable saving to be effected. It was resolved that the chairman, Councillor Butterfield, and the electrical engineer attend at Rotherham for the purpose of inspecting the boilers and other plant which might be considered suitable for use in connection with the Southend scheme.

Street Lighting.—The Electricity Committee reports that it has had before it the question of reverting to the full pre-war standard of lighting in the streets of the borough, and has directed the engineer to submit a report upon the matter to the next meeting of the Committee. Particulars were submitted as to the charges for illumination with arc lamps, and in view of the high cost of this method of lighting, it was decided to obtain an estimate from the electrical engineer of the cost per lamp of fitting and lighting gasfilled lamps on the existing arc lamp standards. The electrical engineer was also requested to inform the Committee at its next meeting when he would be in a position to supply electricity to the electric street lamps (other than arc lamps) at the pre-war standard of street lighting.

Offer of Bulk Supply.—The Town Council having received an offer for a future supply of electricity in bulk from the County of London E.S. Co., has replied that it will be willing to consider carefully any proposals put before it, and asks for particulars as to price, &c.

Stafford.—Separate Committees Recommended.—The Gas and Electricity Committee recommends that, owing to the size and importance of the two undertakings, the existing Committee should control the gas undertaking, while electrical matters should be dealt with by a separate Electricity Committee.

Swansea.—Supply to Amman Valley.—At a meeting of the Electricity Committee, with reference to the supply of electricity to the Amman Valley, the town clerk stated that he had heard from Mr. W. A. Chamen, the general manager of the South Wales Electrical Power Distribution Co., who suggested that if the Corporation desired to supply electricity over a large part of the company's area to the north of Swansea, including the Pontardawe area, an agreement might be arrived at for the transfer of some of the company's powers, and that he had asked Mr. Chamen to state the conditions (if any) to which the company would require the Corporation to agree. The town clerk also reported upon the position with regard to the completion of the agreements and the necessary formalities as to notices, &c., in connection with the supply. The town clerk was instructed to take all the necessary steps to complete the matter, so that the supply might be given on the appointed day.

Torquay.—Extensions Scheme Deferred.—The new electricity scheme, including the provision of a new generating station, has been put in abeyance for the present. It is considered that, having regard to the present financial position of the borough and the unsatisfactory condition of the money market, an expenditure of six figures could not be borne. It is hoped that the present works can be adapted to requirements for some years to come. An independent consultant is to be asked to advise the Electric Lighting Committee on the matter at the expiration of a month.

Torrington (Devon).—Electricity Supply Required.—The Town Council has made arrangements for the promoter of the electric light scheme at Bideford to meet the Council on the subject for providing electricity for the town.

Truro.—Transfer of Powers Refused.—The town clerk has been instructed to reply to a letter from the Electricity Commissioners that having interviewed Messrs. Herd & Smith, Ltd., the Corporation is not prepared to transfer its electric lighting powers to that company.

United States.—Water Power Concessions.—The Federal Power Commission has granted the application of the Southern California Edison Co. for a 200,000-h.p. hydroelectric development on the San Joaquin River, Cal., part of a $100,000,000 project contemplated by the company. The commission has also granted a 50-year licence to the Niagara Falls Power Co. to use 19,500 cb. ft. a second of the 20,000 cb. ft. of water permitted by a treaty with Canada to be diverted from the Niagara River above Niagara Falls. The commission has also approved an application by Mr. Henry Ford for a power development project at Troy on the Hudson River to cost $2,500,000 as the power source for a projected motor factory, involving $7,500,000.—*Reuter's Trade Service* (Washington).

Wallasey.—Cause of Deficit.—Instead of providing £8,500, the Wallasey electricity undertaking has finished the year with a loss of £7,000. This result is due to the extra consumption of fuel owing to the breakdown of two turbines in May and June last. In order to maintain the supply to the tramways and industrial undertakings, the supply was kept going, but with excessively high working costs. Since the repairs have been carried out, the fuel consumption has fallen from 5·5 lb. to 3·42 lb. per kWh. The deficiency on the year is carried forward, and although an increase of ½d. per unit is proposed, it is anticipated that a surplus of £5,900 will be achieved in 1921-1922.

Wigston Magna and District.—Extension of Supply.—The Midland Electric Corporation for Power Distribution is applying to the Electricity Commissioners for powers to generate and supply electricity within the urban district of Wigston Magna, &c., the parish of Bedworth, &c., and Bulkington, Atherstone, and district, &c.

TRAMWAY AND RAILWAY NOTES.

Aberdare.—Year's Working.—The accounts of the tramway department, which combine the accounts of the tramways and omnibuses, for the year ended March 31st, 1920, show a total revenue of £30,162, as compared with £26,820 for 1918-19. Working expenses amounted to £25,485, as against £18,003, leaving a gross profit of £4,677, to which the tramways contributed £4,922, while the 'buses incurred a loss of £245. The net result was a profit of £149; the net profit of the previous year was £2,598.

Birmingham.— Report on Electric Vehicles. — Some interesting figures are contained in a recent report by the superintendent of the Salvage Department to the Council. The report says there are now 32 electric vehicles engaged in the collection of refuse, and the work has been facilitated to a ver great extent. Whereas two horsed vehicles and four men are only able to attend to 1,692 houses per week, one electric vehicle, with the same number of men, visits 2,116 houses per week. The cost of the horsed vehicles works out at 3·22d. per house per visit, while the equivalent cost of the electric vehicles is 2·94d., a saving of ·28d., or about £125 per annum for each electric vehicle. It is estimated that apart from this saving, each electric vehicle saves at least another £125 on account of its releasing two horsed wagons for the inner areas where the work of collection is easier.

Blackpool.—Success of System.—It is interesting to note that from 1893 up to the present date, the tramways have contributed £132,497 to the relief of the rates. Blackpool was the pioneer town in electric tramcars in the country. In 1884 a syndicate laid a length of 2 miles along the Promenade, worked by electricity, and the service was opened with the late Mr. J. Lancaster as manager. The lease expired in 1892, and the Corporation took over the undertaking. At that time Plymouth and Huddersfield were the only towns working their own tramways. The first year at Blackpool resulted in a net loss of £603. but there has not been a loss since then. The average net profit for the last 28 years has been over £9,600 a year.

Bradford.—Reduction of Services.—The short-time being worked in the local textile trades has caused the Tramways Committee to reduce materially the early morning car service on several of the city routes, and this cutting down is being extended to other routes.

Brighton.—Temporary Fare Reductions.—Owing to a considerable falling-off in the number of passengers carried since the introduction of higher fares, the Corporation has decided to revert to 1d. fares for three months as an experiment. It is stated that the extra revenue is not as large as had been anticipated, amounting to only £12,000.

Fife.—Charged Tramcar Handrail.—While a tramcar was proceeding along the High Street, at Cowdenbeath, Fife, a man coming down the stair from the top of the car was seen to be in distress. The car was brought to a standstill, and it was found that the stair-rail of the car was charged with electricity. After great difficulty, the pole was taken off and the man was released in an unconscious state. He was removed to hospital.

Glasgow.—Subway Electric Trains Proposed.—Authority was given by the shareholders to the directors of the Glasgow Subway Railway Co. recently to close the line temporarily to traffic whenever that appeared to be in the interests of the company. In the past year revenue fell short of expenditure by £15,327. A shareholder raised the question of running trains with electrical accumulators. The chairman said this was possible, but it was a question they could not face on account of cost.

Ipswich.—Additional Electric Vehicles.—Owing to the great saving effected by the substitution of two electric vehicles for nine horses and carts, thereby reducing the cost of refuse collection from 18s. 3d. to 11s. 4d. per ton, the Town Council has decided to apply for permission to purchase two additional 3½-ton electric vehicles at a cost not exceeding £1,750 each.

London.—Traffic Regulation Bill Postponed.—In reply to a question put to him in the House of Commons, on March 21st, Sir Eric Geddes (Minister of Transport) said that the report of the Select Committee on London Traffic had been carefully considered, but the proposal to set up a London County Transport Authority was a highly contentious one. In addition to this, in view of the general need of economy in Imperial and local expenditure, it was not desirable to proceed with the Bill at present.

"Linking-Up" Recommended.—With the object of expediting tramway traffic along the Embankment, the London County Council is recommended to institute further "circular routes," linking up certain services and so reducing the number of cars turned on the Embankment. The new connections to be provided under the scheme include Forest Hill and Embankment *viâ* Brockley and New Cross, Southcroft Road and Embankment, Norwood and Embankment, and Peckham Rye and Embankment. Direct tramway communication will be afforded between Catford and the Embankment.—*Morning Post.*

Augmented Services.—On and after March 30th, the London United Tramways will increase its tramway service between Shepherd's Bush and Hanwell during the morning and evening busy hours. In place of the present four-minute interval, the service will be increased to run at three-minutes' intervals, and will operate thus between 7 a.m. and 9.30 a.m. and between 4.45 p m. and 7 p.m. from Shepherd's Bush.—*Financial Times.*

London Electric Railways.—Extension of Time.—The Minister of Transport has extended the time until August, 1922, of the London Electric Railway Act, 1913, for the construction of works, &c.

Newcastle. — Proposed Railway Electrification.—The Newcastle-upon-Tyne Electric Supply Co. announces that negotiations are proceeding with the North-Eastern Railway Co. for the electrification of a portion of the main line.

Portsmouth.—Reduction of Services.—In an endeavour to reduce the working costs, in view of the serious deficit incurred since the introduction of higher fares, the Corporation has decided to substitute a six-minute service for the existing five-minute service. In order that the whole of the present staff may be retained shorter hours are to be worked by the men; the average loss to each is 9s. per week.

South Yorkshire.—Tramway Scheme.—An inquiry by the Ministry of Transport is to be held into a joint scheme of the Urban District Councils of Wombwell, Wath-on-Dearne, Bolton-on-Dearne, and Thurnscoe to construct 16 miles of tramway between Barnsley and Mexborough, at an estimated cost of £300,000. What is being asked for is confirmation and certain extensions of the original Dearne District Light Railway Order, 1915, the operation of which was postponed on account of the war.

Sunderland.—Tramway and Rates.—At a meeting of the Town Council, Councillor G. S. Lawson, speaking on the estimates, proposed that the item of £5,000 from the tramways in relief of rates—which the Committee is unable to provide next year—be restored. He said this sum was really the rent of the street, and ought to be paid, no matter what went without. If the tramways were leased to a private company, they would have got more from them than the Corporation had got from running the tramways, without risking any of the ratepayers' money. Replying, Alderman New, chairman of the Committee, pointed out that the contributions to reserve and renewals fund for several years had been considerably less than the amounts they had taken out. The tramways had paid altogether £70,000 in relief of rates, £65,000 in rates, and £37,000 in renewal of track to the Highways Committee.

TELEGRAPH AND TELEPHONE NOTES.

Argentina.—New Wireless Station.—The Government has granted a concession to the General Wireless Telegraph Co., of Paris, to construct on the Argentine coast a wireless telegraph and telephone station to communicate with France and other European countries. The company, it is stated, expects to establish telephonic connection between Paris and Buenos Aires by a system of continuous waves. The duration of the concession is for 30 years; it authorises the company to carry on experiments in long-distance wireless telephony, and if at the end of three years the experiments are considered by the Argentine Government to be satisfactory, the concession will be extended to permit commercial exploitation of wireless telephone as well as telegraph communication. Three sets of plant are to be erected, and the station will be of 800-kW capacity. *Reuter's Trade Service* (Buenos Aires).

Germany.—Telephone Service.—In a lecture, delivered last October, before the Reichsbund deutscher Technik (German Technical Union), Dr. Bredow outlined the financial position of the German telegraph and telephone service (2,000 million marks deficit in 1920), and suggested remedies for improving the position. The gist of the lecture as reported by the *Reichsbundes deutscher Technik* is that the large deficit is due to the extraordinary rise in the cost of materials and labour; the prices for iron wire have increased 3,000 per cent.; for copper wire 1,200 per cent.; for underground cable, 2,000 per cent.; cable and flexible for internal connections, 3,000 to 4,000 per cent.; and telephones, 2,000 to 3 000 per cent. Both systems are at present strained to their highest possible capacity, and extensions must be undertaken at once. Prior to the war, the cost of a telephone line in Berlin was Mk. 800, and is now Mk. 11,000, while the cost of working and maintaining a line has increased tenfold. Although the telephone fees have increased to about four times the pre-war rates, further drastic alterations are contemplated; the unlimited service rate will be abolished, and a tariff introduced based on the number of calls made—the subscriber having the greatest number of calls paying the highest fees. The cost of installing the telephone has already been increased, and increased revenue is expected from that direction, owing to the large number of prospective subscribers. A compulsory loan is also contemplated, and it is expected that as the result of this and other measures to be taken, the financial situation will improve in time; but it will be many years before the services reach their pre-war level of efficiency.—*Technical Review.*

Ireland.—Telephone Service.—It was reported on March 16th that the telephone wires in different parts of Ireland were cut on an extensive scale. Early on the 16th inst. Belfast was isolated from many parts of the country, and as a number of linesmen and mechanics were leaving the Central Exchange in Dublin they were held up by armed men, who took from them all their equipment. This sort of thing has been taking place periodically for some time past.

Railway Telegraphs.—Maintenance.—It is stated that the railway companies maintain on behalf of the Post Office 61,500 miles of telegraph and telephone wires, and that in respect of their maintenance £63,000 per annum is paid.

Switzerland. — New Wireless Station. — Marconi's Wireless Telegraph Co. has been authorised by the Swiss Federal Government to construct a wireless telegraph station for operation over a period of 25 years by a Swiss company. The station, which is to be erected near Berne, about 1,800 ft. above sea level, will employ a Marconi valve continuous-wave transmitter of 25 kW capacity, the aerial being carried on two towers, each 300 ft. high. Up-to-date apparatus for high-speed automatic working will also be employed. The new station, which will afford special facilities for Press traffic, besides conducting a commercial telegraphic service with England and other European countries, will be ready for use by journalists attending the second session of the Assembly of the League of Nations in September next. It will be recalled that in November last Marconi engineers erected at Geneva, in the record time of nine days, a temporary station which materially assisted the international journalists attending the first Assembly of the League.

United States.—Telephone Rate Increases.—The New York Telephone Co. is to increase its rates by 28 per cent. as from April 1st. In asking authorisation for this increase, the company argued that the payment of increased salaries and other additional expenses, amounting to $11,000,000, had made the step necessary.—*Reuter's Trade Service* (New York).

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—April 27th. Victorian Railway Commissioners, Spencer Street. Caustic soda primary cells, complete (Contract No. 33,914).*

May 2nd. Victorian Railway Commissioners. Twelve miles of ·015 sq. in. two-core, lead-sheathed, wire-armoured, 2,200-V cable.*

June 22nd. Victorian Railways. One electric lifting magnet (capacity ½ ton), one 440-V motor generator.

June 29th. Supply of 1-ton platform type industrial storage battery trucks, also battery charging equipment.—*Reuter's Trade Service* (Melbourne).

Morwell Power Scheme. The Electricity Commissioners of Victoria have made certain alterations, alternatives with additions, to the specifications which will necessitate tenderers cabling any consequent amendments of their tenders before March 31st. (March 18th.)

Bedford.—March 31st. Electricity Department. Electricity meters, h.p. and l.p. cables, for 12 months. (March 18th.)

Belfast.—April 25th. Electricity Department. E.h.p. and l.p. switchgear. (March 18th.)

Belgium. — April 6th. The Société Nationale des Chemins de Fer Vicinaux, 14, Rue de la Science, Brussels. Laying of the underground armoured cables required in connection with the supply of electricity to the lines in the Louvain section. Particulars can be obtained for 3 francs from the Services Electriques, 48, Rue Montoyer, Brussels.

April 11th. The municipal authorities of Schaerbeek, Brussels. Supply of a quantity of electric cable. Particulars can be obtained from the Service d'Electricité, Hotel Communale, Schaerbeek.

Jugo-Slavia.—May 1st. The Serb, Croat, and Slovene Ministry of Public Works. Erection of a power-station, main conductors and transforming stations in connection with an electrical scheme at Kostolac for the supply of energy to Belgrade, Semlin, &c.*

The Commercial Secretary to H M. Legation at Belgrade reports that a prominent business man and proprietor of flour mills in Serbia is contemplating the installation of a complete electric lighting and power station, and is asking for tenders for the necessary plant, which includes one steam engine of 150-h.p., generators, &c., for power for 4,000 to 5,000 lamps (about 90-kW), and overhead cables and conductors for 60 kilometres of circuits (to provide lighting for about 1,400 houses). The name and address of the inquirer may be obtained by United Kingdom firms interested, on application to the Department of Overseas Trade in London.

Canary Islands.—April 7th. The Cabildo Insular de Teneriffe, at Teneriffe, Canary Islands. For the establishment of a telephone service between Santa Cruz de Teneriffe and Guimar.

Cardiff.—April 11th. Welsh National Memorial Association. Electric lighting plant for the Glan Ely Sanatorium. Two 20-kW internal-combustion engine-driven generator sets, battery charging booster, switchboard, battery of accumulators. (See this issue.)

East Ham.—April 2nd. Electricity Department. L.p. paper-insulated, lead-covered, armoured concentric cable, with necessary joint boxes, &c.; also two c.i. lighting feeder pillars. (March 18th.)

France.—April 5th. The French State Railway authorities, 43, Rue de Rome, Paris. Supply of four 8-ton electric travelling cranes for the new railway workshops at Sotteville-Quatre-Mares, Rens. Particulars may be obtained from the Services Electriques (1st Division) at the above address.

April 1st. The French Post and Telegraph authorities at 24, Rue Bertrand, Paris. For the supply of two accumulator charging boards and four sets of current converters for use in connection with the charging of accumulators.

Glasgow.—April 2nd. Corporation Electricity Department. Works required in connection with erection of sub-station in Buchanan Street. Corporation Engineer.

London.—H.M. Office of Works. April 12th. Supply of electrical labour-in-daywork in the Leeds district. (March 18th.)

L.C.C. April 18th. 5,500 tons of standard steel girder tramway track rails, lipless track rails and renewable guard rails with fastenings. Chief Engineer, County Hall, Spring Gardens, S.W.1.

Manchester.—April 7th. Electricity Committee. High-pressure steam and water valves; high-pressure steam and water pipes, steam receivers, &c.; weighbridges and automatic coal-weighing machines; electric and hand-operated cranes. (March 11th.)

South Africa.—Pretoria.—May 10th. Municipality. Switchgear. Tenders, marked "Electric Light and Power Department, 1920 Extensions, Contract No. 5," to Deputy Town Clerk, Municipal Offices, Pretoria, on May 10th. Deposit, five guineas. Further particulars may be obtained from the general manager of the Electric Light and Power Department, or from the consulting engineer, Mr. G. M. Clark, 40-42, Meischkel's Buildings, Johannesburg.

Johannesburg. — June 22nd. South African Railways and Harbours. Electrification of Capetown and Simonstown and Durban-Maritzburg lines; Capetown and Simonstown lines: Overhead equipment of permanent way and overhead transmission line, switchgear and accessories, and trackbonds; Durban-Pietermari'zburg line: Overhead equipment of permanent way, overhead transmission line, switchgear and accessories, and trackbonds. (See this issue.)

Wimbledon. — March 29th. Electricity Department. Annual contracts for cables and conduits, joint boxes and jointing materials, transformers, meters, &c., lubricating oils. (March 11th.)

Worksop.—April 6th. Electricity Committee. E.h.p. and l.p. cables; e.h.p. and l.p. switchgear; transformers; 500-kW rotary or motor converter. (March 11th.)

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

London.—St. Pancras.—Borough Council Electricity Committee :—

Fitting travelling grate stoker to two Babcock & Wilcox boilers at the King's Road station, £2,898.

Six switchboard panels at Regent's Park station.

E. F. Moy, Ltd. (recommended)	**£310**
Northcote, Heaver & Co.	343
W. White & Co.	345
Park Royal Engineering Works, Ltd.	345
Collins Electrical Co., Ltd.	375
Bertram Thomas	453
Switchgear & Cowans, Ltd.	453
Ferguson, Pailin & Co.	478

Steel stanchions, framework, and extension of platform to support these proposed new panels.

Measures Bros., Ltd. (recommended)	**£75**

Rotherham.—Housing Committee. Accepted :—

Electric lighting installation—100 houses in the Doncaster Road scheme.—Lilleker Bros.

FORTHCOMING EVENTS.

Edinburgh Electrical Society.—Friday, March 25th. At the Philosophical Institute. At 8 p.m. Paper on "Automatic Telephones," by Mr. W. Leithead.

Manchester Association of Engineers. — Saturday, March 26th. At the Memorial Hall, Albert Square. At 7 p.m. Annual general meeting. Paper on "Fire Extinguishment by Mechanical and Other Means, including Sprinkler Installations," by Mr. J. T. Clarke.

Institute of Marine Engineers.—Tuesday, March 29th. At the Institute, The Minories. At 6.30 p m. Presidential address by Lord Weir.

Junior Institution of Engineers.—Friday, April 1st. At 39, Victoria Street, S.W. At 7.30 p.m. Paper on "Pneumatic Conveyors," by Mr. M. Jennings.

Manchester Wireless Society.—Friday, April 1st. At the Manchester College of Technology. At 7.30 p.m. Lecture on "Direction Finding," by Mr. J. Hollingworth.

Institution of Production Engineers.—Saturday, April 2nd. At 2 and 4, Tudor Street, E.C. At 6 p.m. General meeting to approve articles of association and by-laws.

NOTES.

Commercial Motor Parade.—The annual parade of commercial motor vehicles, organised by the Commercial Motor Users' Association, will take place at Lincoln's Inn Fields, on April 2nd.

An Automatic Train Indicator.—We are informed that Messrs. Indicators, Ltd., have fitted one of the trains on the Great Northern and City section of the Metropolitan Railway (Finsbury Park to Moorgate Street) with progressive station indicators. These electrical devices, which, it will be remembered, were described on page 60 of our issue of January 9th, 1920, intimate to the travelling public the progress of the train, showing automatically the next stop, all stops, non-stop stations, and so on. The indicator keeps up to date at each station; it is fitted in the roof of the car, and can be seen from any part of the corridor coaches.

Fatalities.—Four men were fatally gassed at the electric power station of the United Alkali Co., at Widnes, on March 15th. Coal is mechanically conveyed into the furnaces, and the resulting ashes and clinkers are also mechanically removed into a large cylinder, and thence into wagons placed at the bottom. During the afternoon a passage in a large cyclinder, through which the ashes go, became blocked, and two men, Russell and Worth, entered the cylinder to try and remove the stoppage. As they did not return, two others, Hallwood and Saunders, also went down. All were gassed, and several would-be rescuers who entered the cylinder were driven out by gas. A workman, protected with a gas-mask, afterwards recovered the four bodies.—*The Times.*

Educational.—Borough Polytechnic Institute.—On Saturday last the annual exhibition of students' work was held; it included demonstrations in the departments of engineering and electrotechnics, and exhibits of the work of pupils in the technical day school and evening classes.

Cardiff Technical College.—The Committee has received a cheque for £18,000 as a donation from Sir William Smith, Mr. Frederick Jones, and others interested in the shipping industry, to the Nautical Instruction Department of the College.—*The Times.*

Third Annual Re-Union of the Ex-British Westinghouse Association.—Annual dinners of Old Boys' and similar associations frequently become stereotyped, and, therefore, boring, finally fizzling out altogether. The annual re-union of Ex-British Westinghouse men will be a long time reaching this stage, judging by last Friday's third gathering at the Holborn Restaurant, London, under the chairmanship of Mr. M. M. Gillespie. The idea of re-union has always been prominently before the Committee, and the hon. secretary, Mr. L. S. Richardson, and this year the company of about 150 was "departmentalised" at separate tables, seating about eight or ten, appropriately labelled:—Upper dining room, G. Aisle, K. Aisle, G. Copper, A. Punch, Brass Foundry, Transformer Test, Pattern Shop, Paint Shop, Iron Foundry, Dipping Shop, Dynamo Test, Boiler House, and B. Aisle. This plan was a huge success, and each member had his corresponding clock card; neither ordinary nor overtime was paid, because everything was at "piece" rates, including the toast-list. The latter included "The Association." proposed by Mr. J. S. Peck, and replied to by the chairman, and Mr. J. Turnbull (still bearded); "The Chairman," humorously presented by Mr. R. G. Mercer (who forgot the show was morning dress); and "Absent Friends and Old Associates," by Mr. G. Layton. Major O. P. L. Hoskyns called on the company for the "Silent Toast to the Memory of Ex-B.W. Men."

The items in the musical programme by Mr. A. P. Ambler, Mr. Val Wood, and Mr. H. S. Aspinall and Miss Muriel Macgregor, were just sufficient not to interfere with the renewal of old friendships. The members also had opportunity to exhibit their vocal powers in the opening and closing chorales; the latter to the tune of "John Brown's Body."

During the evening the opportunity was taken to make a presentation to the hon. secretary and re-union agitator, Mr. L. S. Richardson, for the valuable services he has rendered in assisting in the formation of the Association and organising the first three functions. The gifts were an after-dinner coffee set with silver spoons, a gold watch-fob, and a gold bracelet watch for Mrs. Richardson. Mr. Aspinall introduced the subject in a speech of appreciation and thanks, and Mr. Gillespie made the presentation in a particularly happy manner. Mr. Richardson, in reply, mentioned from experience how little incidents often made great impressions, and that it was undoubtedly that *esprit de corps*, from the managing director downwards, which existed in the old days, that made it always a pleasure and privilege to assist in keeping fresh old B.W. friendships.

The souvenir programme was in great demand, and no further copies are now available. Ex-B.W. men are reminded that new names and over-due "subs." (without which the good work of the Association cannot go on), should be sent to the Hon. Sec., Mr. L. S. Richardson, 14, Sydney Road, Richmond, Surrey.

Rain-Making Again.—According to a Reuter message in the *Manchester Guardian*, the United States Government is now in the rain-making business. Experiments conducted by the Air Service under the War Department, prove that precipitation can be brought about by electrostatic influences, an aeroplane serving as the medium to persuade the clouds to release their moisture. It is stated that showers have already been precipitated in secret trials, and experiments on a large scale are to be conducted this month.

Appointments Vacant.—Assistant electrical engineer (Rs. 400 to Rs. 600 per mensem), for the Madras and Southern Mahratta Railway; charge engineer, for the Bootle Corporation Electricity Works; engineer-in-charge and assistant mains engineer for the Hammersmith Borough Council Electricity Department. See our advertisement pages to-day.

Electrotechnical Meetings in Germany.—The second "Electric Week" is to be held this year in Essen from May 29th to June 2nd. This institution, by which all the great electrotechnical unions and associations of Germany—to the number of 12—hold their meetings together under the direction of the Verband Deutscher Elektrotechniker, took place last year for the first time in Hanover, where it met with general approval. A special attraction for all the circles interested in the re-establishment and development of the technical industries is the holding in Essen of a three-weeks exhibition of electrotechnical products. The exhibition will, in the first place, set forth the basis on which, up to the present, the development of electrotechnics has moved; it will also display the progress made in the electrotechnical world for the general good.

INSTITUTION NOTES.

Institution of Electrical Engineers.—North-Western Centre.—A popular lecture on "Developments in Wireless Telegraphy and Telephony" will be delivered by Prof. E. W. Marchant, D.Sc., M I E E., on April 6th, 1921, at the Municipal College of Technology, Manchester. Prof. Marchant hopes to arrange demonstrations of wireless telegraphy and telephony, and his lecture should be of particular interest. The lecture will be open to the public, but to ensure members and their friends obtaining seats, tickets will be issued on application, which must be made not later than March 30th.

Informal Meeting.—At the meeting of the Informal Section, on the 14th inst., with Mr. A. B. Eason in the chair, a discussion was opened by Mr. R. L. Morrison on "Mercury Arc Rectifiers," and was thoroughly successful. The opener was furnished with some good photographs of rectifiers in service, and with excellent charts and drawings, including a full-scale one of a 900-amp. converter. He explained the function and construction of the rectifier, and claimed superiority for the mercury arc rectifier, chiefly because of its high power factor, and saving in floor space and weight, also because it was noiseless, vibrationless, stationary, and required no heavy foundations.

There followed a keen and animated discussion. Mr. G. A. Juhlin thought the simplicity of the apparatus was bound to occasion its adoption and development, but disputed that rotary converters were at a disadvantage. He asked for information regarding possible interferences with telephones due to the ripples and harmonics. Mr. W. E. Rogers, Mr. W. E. Bradshaw, Major R. Grierson, Mr. P. Kemp, and 13 other speakers (Messrs. C. A. Newell, E. W. Moss, A. G. Hilling, W. H. J. Holloway, J. Aylmer, W. L. Wreford, M. R. Gardner, A. B. Eason, F. Pooley, H. M. Sayers, H. Cooch, E. W. Webb, and G. A. Cheetham) followed. The general trend of the discussion was very critical, and Mr. F. Pooley, who spoke late in the evening, urged that antipathy to the novelty of the apparatus was hardly constructive. Nevertheless, some useful ideas were mooted, and the evening was extremely interesting.

Mr. Morrison, in his reply, was able to point to extensive installations of the rectifiers, and though he agreed that the experience of them was only of a few years' duration, the makers were able to declare that the renewals and maintenance charges were negligible. With regard to telephone disturbances, no data were available, but no complaints were known of. Research and developments were proceeding, and at an early date it was anticipated that any d.c. ripple would be entirely eliminated.

A full description of the rectifier, by Mr. Morrison, was published in our issues of February 18th and 25th.

Institution of Production Engineers.—A general meeting of the Institution will be held on April 2nd, at 6 p.m., at 2 and 4, Tudor Street, London, E.C. 4, when the articles of association and by-laws, which have been drafted by the Provisional Committee, will be submitted for the approval of the meeting. All interested, and particularly prospective members, are invited to attend, and to signify their intention of being present to the Hon. Secretary, Mr. A. T. Davey, 6, St. James's Square, Holland Park, Kensington, W. 11, in order that the necessary arrangements may be made.

Manchester Wireless Society.—On March 9th, at the College of Technology (Mr. J. C. A. Reid in the chair), Mr. J. McKernan delivered a lantern lecture on "The Construction of Electric Motors." Starting with the theory of the subject, the earliest and the modern types of electric motor were described, and the various processes in their manufacture, repair, and maintenance were dealt with. The subject was made quite clear by many working models and parts shown by the lecturer, and by an excellent series of lantern slides.

Birmingham and District Electric Club.—On March 12th a paper was read by Mr. H. C. Young, A.M.I.E.E., upon "Common Sense Methods of Recording, Costing, and Progress in Shop Management." Mr. Young gave much valuable information from his own experiences in the management of large works. He insisted upon the importance of rapidly understood graphic records of day-by-day and, in some cases, hour-by-hour progress. Such records should be simple and easy to understand, kept regularly posted and displayed where everyone interested would see them, so that as soon as the actual line fell below the datum line, steps could be at once taken to investigate causes.

Chief Technical Assistants' Association.—The annual general meeting of the Association was held on March 5th. The retiring chairman, Mr. A. P. MacAlister, A.M.I.E.E., reviewing the work of the past year, referred to the recognition of electricity supply staffs through the activities of the E.P.E.A., and reminded the members that Mr. J. H. Parker, A.M.I.E.E., a former chairman of the C.T.A.A., was deputed to represent the Association on the Council of the E.P.E.A., and owing to his ability, he was elected president, and had contributed greatly to the success achieved.

Mr. J. R. J. Bowden, A.M.I.C.E., A.M.I.E.E., was elected chairman, and in thanking the members for the honour recalled the fact that his predecessor in the chair, Mr. A. P. MacAlister, was the founder of the C.T.A.A., and that the Association was the forerunner of the organisations which had set out to establish the fact that besides Capital and Labour there was a third party in the industrial world to be taken into consideration—the technical staffs.

Illuminating Engineering Society.—At a meeting of the Society, held on March 17th, a paper entitled "Motor-Car Headlights: Ideal Requirements and Practical Solutions," was read by Major A. Garrard, and followed by a discussion. The author dealt with the effects of "dazzle," and means of combating them. The efficiency of various types of beams was discussed, and some information was given regarding regulations framed in this country and the United States The limiting of the candle power or diameter of the beam was not considered satisfactory. The use of parabolic reflectors was commented upon, the author stating that the size of the filament of an electric lamp prevented perfect focusing. The paper concludes :—"It would appear that the American devices have only been tolerable by reason of the slow driving necessitated by the generally bad cross-country roads there. In this country and in many other European countries a much higher standard of safe illumination is necessary, and will become more so, while the road improvements now going on in the States will at no distant date render a solution there equally necessary."

Royal Institution.—Amongst the lecture arrangements at the Royal Institution after Easter, are the following :—Dr. C. T. R. Wilson on "Thunderstorms" (the Tyndall Lectures); Mr. H. S. Foxwell on "Nationalisation and Bureaucracy"; and Mr. E. C. C. Baly on "Chemical Reaction." The Friday evening meetings will be resumed on April 8th, when Dr. R. H. A. Plimmer will deliver a discourse on "Quality of Protein in Nutrition." Succeeding discourses will probably be given by Mr. Ernest Law, Sir James Walker, Sir Frank Dyson (Astronomer Royal), Sir Robert Robertson, Dr. Bateson, Dr. Starling, Mr. A. Mallock, Dr. Leonard Huxley. Dr. A. G. Webster, Sir J. J. Thomson, and other gentlemen.

Institution of Civil Engineers.—At the ordinary meeting of the Institution on March 8th, Mr. Stephen Leggett, Member, read a paper on "The Amritsar Hydro-Electric Irrigation Installation." In this paper the author described the construction of a power station built on the Upper Bari Doab Canal at a point where a head of 5 8 ft. was available. The station contains three low-pressure turbines coupled to alternators through gearing, and has an output of 525 kW. Two h.p. transmission lines are carried to sub-stations on steel lattice towers, strong enough to stand unsupported should all the wires on one side break suddenly. They are set in concrete blocks and are spaced 300 ft. apart in open country. The sub-stations contain three single-phase oil-cooled 6,600/500-V transformers, and the pumps are started from the sub-station switchboard. A special sub-station is provided for transforming alternating current to direct current for the Central Workshops of the Punjab Canal System. Each sub-station feeds six pumps, the designed capacity of the power-station being 40 pumps, together with the workshops; this can only be obtained when the fall is increased to 9·7 ft. The pumps are direct-coupled to 15-h.p. 500-volt electric motors running at 970 r.p.m. Owing to difficulty in obtaining suitable pumps from British makers, the author designed a single-stage turbine pump, which was made in the Central Canal workshops.

Institution of Civil Engineers of Ireland.—Mr. Francis Bergen, President of the Institution of Civil Engineers in Ireland, lecturing before the members in Dublin on "Hydraulic Power for Industrial Development," said the growing demand for the development of industries in Ireland required a means of supplying power at a cheap rate for factories, &c. The many loughs and rivers of Ireland were waiting to give their powerful assistance to the industrial movement, and it was possible to construct dams in various places for storing the excess water in winter and during non-working hours. Should a pipe be brought from the Roundwood (Co. Wicklow) city waterworks reservoir to Dublin, the pressure would be 180 lb. per sq. in.

Rontgen Society.—A meeting of the society will be held at Manchester on May 6th, at the University, when Prof. Sir W. L. Bragg will read a paper, and Prof. A. V. Hill will give a demonstration of some electro-physiological experiments. On the following day it is hoped to arrange visits to works of scientific interest in the district. The gallery of the Royal Photographic Society of Great Britain has been placed at the disposal of the society during June, and it is hoped that a collection of radiographs, illustrating the different practical applications of X-rays, will be furnished by members of the society. The President of the Röntgen Society, Dr. Robert Knox, offers a special prize for work submitted by lay assistants engaged in the production of photographic results, working either as hospital assistants or as assistants to medical radiologists. Further details will be available in April.

Institute of Metals.—A London Local Section of the Institute has just been formed; the chairman is Dr. O. F. Hudson, of the Admiralty Engineering Laboratory, and the hon. secretary is Mr. D. Hanson, M.Sc., of the National Physical Laboratory, Teddington. Membership is available to persons resident within 50 miles of the G P.O. No subscription is required of Members of the Institute of Metals, but non-members of the parent body, when elected as Associate Members of the Local Section, pay an annual subscription of 5s. On March 31st Mr. S. L. Archbutt is to read a paper on "Aluminium Alloys," and on April 21st Dr. W. R Ormandy will present a paper on "Refractories." The London Section already has a membership of over 200.

The report of the Council, presented to the annual general meeting on March 9th, shows that the membership has increased during the year from 1,213 to 1,298. The expenses amounted to £3,620, and the gross income to £1,174.

South African Institute of Electrical Engineers.—At the twelfth annual general meeting, held in Johannesburg on January 20th, Mr. L. B. Woodworth took office as president. It was stated that the total membership had risen from 355 to 489. A vice-president and seven new members of Council were elected.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

The St. Pancras Borough Council has had under consideration the salary of the deputy electrical engineer under the agreement arrived at between the National Joint Board of Employers and members of the staffs (electricity supply industry). When the Council adopted the award in July, 1920, it was stated that his salary was not affected, but that as soon as the new 3,000-kW set was installed at the King's Road station he would be entitled under the schedule to an increase of £108 per annum. The total plant capacity of the undertaking on June 1st, when the award came into force, has now been assessed at 8,025 kW, instead of 7,900 kW, as previously reported to the Council; the difference is due to the bulk supply being estimated, in the first instance, at 400 kW, whereas the record actually shows that it should have been 525 kW for the preceding financial year. The following agreement with the E.P.E.A. has been arrived at :—That from June 1st, 1920, the salary of MR. BARON shall be increased from £660. plus house, coal, and light, to £808. plus house, coal, and light, and from November 1st, when the increased plant came into operation, to £840. plus house, coal, and light. These figures include 5 per cent. extra for employés engaged in undertakings in London, but the salary is not affected by variation in the cost of living unless it drops below 110 per cent. The Electricity Committee is in agreement with the decision, and recommends acceptance.

The Halifax Tramways Committee has appointed MR. BEN HALL, of Wigan Corporation tramways, as general manager of the Halifax tramways. MR. J. W. GALLOWAY continues to retain the post of tramway engineer.

Proposed increases in the salaries of several officials were rejected by the South Shields Town Council. One proposal was to increase the salary of the tramway manager from £600 to £700 a year, the voting being 12 for and 24 against. Another defeated recommendation was to increase the electrical engineer's salary from £700, and place it on a sliding scale according to the number of units sold, which would mean an immediate advance of £185 per annum.

According to a financial contemporary, MR. KNIBBS, the Australian Commonwealth Statistician, has been appointed Director of the Bureau of Science and Industry, at a salary of £2,000 per annum.

The Times states that the Secretary for Mines has appointed MR. F. H. HATCH, Ph.D., M.Inst.C.E., to be technical adviser to the department on questions relating to the metalliferous mining industry.

Shrewsbury Town Council has increased the salary of MR. F. C. CHESTER assistant engineer at the electricity works, from £252 to £300 a year.

MR. G. HART-COX, M.B.E., is shortly vacating his position at Woolwich Arsenal, to take up secretarial duties for Messrs. T. Hood & Co., Ltd., engineers, Bristol.

The Times reports that PROF. B. MOUAT JONES, Professor of Chemistry in the University College of Wales at Aberystwyth, was on Monday appointed Director of the Manchester Municipal College of Technology, at £1,500 a year, in succession to Mr. J. C. Maxwell Garnett, now organiser for the League of Nations Union.

MR. F. A. BROADBENT, late manager of the Portarlington Electric Light and Power Co., Ltd., has been appointed electrical engineer and manager to the Cavan Electric Light and Power Co., Ltd.

Obituary.—MR. A. G. FIELDING.—The death is reported as having occurred at the Presidency General Hospital, Calcutta, of Mr. Arthur Gordon Fielding, an electrical engineer, holding a Government appointment in India. Prior to leaving this country he was engaged at the Formby Power Station of the L. & Y. Railway.

NEW COMPANIES REGISTERED.

Vickers (France), Ltd. (173,677).—Private company. Registered March 12th. Capital, £5,000 in £1 shares. To carry on the business of manufacturers of and dealers in steel, iron, brass and metals, ship builders, shipwrights, manufacturers of ordnance, electricians, electrical engineers, &c. The first directors are: Sir Francis Barker, Lowndes House, Lowndes Place, Belgrave Square, S.W.; M. Caillard, 16, Rue de la Bienlaisance, Paris (director of Troughton and Simms, Ltd., and Société Financiers et d'Entreprises Electrique); S. V. Dardier, The Grange, Grange Road, Ealing, W.5; E. Cohn, Rahna, Wargrave, Berks.; A. Cartwright, 35, Vicarage Road, East Sheen, S.W. Sir Francis Barker, S. V. Dardier, E. Cohn and A. Cartwright are all directors of Vickers, Argentina, Ltd., and various other companies. Qualification, £200. Remuneration, £50 each per annum. Acting secretary: W. F. Sadler. Solicitors: Linklaters and Paines, 2, Bond Court, Walbrook, E.C. Registered office: Vickers House, Broadway, Westminster, S.W.

C. A. Carpenter, Ltd. (173,616).—Private company. Registered March 10th. Capital, £2,000 in £1 shares. To take over the business of an electrical, constructional and general engineer and contractor and dealer in machinery carried on by C. A. Carpenter, at 4 and 5, Mason's Avenue, Basinghall Street, E.C. The permanent directors are: C. A. Carpenter, 4-5, Mason's Avenue, Basinghall Street, E.C.2; Mrs. K. Carpenter, 4-5, Mason's Avenue, Basinghall Street, E.C.2. Solicitor: C. G. Bonser, Pancras Chambers, 90, Queen Street, E.C.

Midlands Telephone Directories, Ltd. (173,651).—Private company. Registered March 11th. Capital, £2,500 in £1 shares. To adopt an agreement with A. Howard and A. R. Tidswell for the acquisition of the rights of publishing a "Classified Commercial Telephone Directory." The permanent directors are: A. R. Tidswell, "Uplands," College Road, Epsom; A. Howard, 61, Kensington Gardens, Ilford. Qualification, £250. Remuneration, £50 each per annum. Registered office: 3, Broad Street Buildings, E.C,

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Reno, Ltd. (117,987).—Return dated December 31st, 1919 (filed December 15th, 1920). Capital, £5,000 in £1 shares (1,000 preference and 4,000 ordinary). 800 preference and 4,000 ordinary shares taken up. £500 paid. £4,300 considered as paid. Mortgages and charges, nil.

Reflecto Metal Co., Ltd.—Particulars of £5,000 debentures authorised December 30th, 1920, whole amount issued, charged on company's property, present and future, including uncalled capital.

Aladdin Renew Electric Lamp Corporation, Ltd.—Particulars of £10,000 debentures authorised February 17th, 1921; present issue £5,000, charged on the company's undertaking and property, present and future, including uncalled capital.

Yorkshire (West Riding) Electric Tramways Co., Ltd. (84,167).—Return dated February 17th, 1921. Capital, £600,000 in 70,000 cumulative preference and 50,000 ordinary shares of £5 each. 46,261 preference and 40,977 ordinary shares taken up. £436,190 considered as paid. Mortgages and charges, £272,373.

Cape Electric Tramways, Ltd. (51,636).—Capital £500,000 in £1 shares. Return dated December 2nd, 1920. 491,222 shares taken up. £91,222 paid. £400,000 considered as paid. Mortgages and charges, £243,500.

City of Ely Electric Light & Power Co., Ltd. (85,444).—Return dated January 14th, 1921. Capital, £5,000 in £1 shares. 3,003 shares taken up. £300 6s. paid (being 2s. per share). Mortgages and charges, nil.

H. W. Smith & Co. (1920), Ltd.—Debenture dated February 11th, 1921, to secure £50,000 charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Lloyd's Bank, Ltd.

East India Tramways Co., Ltd. (74,457).—Return dated December 22nd, 1920. Capital, £100,000 in £1 shares (15,000 preference, 35,000 ordinary and 50,000 deferred). 7,476 preference, 33,433 ordinary, and 50,000 deferred shares taken up. £7,489 paid, including £6 on 24 shares forfeited. £83,426 considered as paid. Mortgages and charges, nil.

Hindhead & District Electric Light Co., Ltd.—Issue on March 1st, 1921, of £100 debentures part of a series already registered.

Tramways, Light & Power Co., Ltd.—Particulars of £375,000 5-year secured notes authorised November 15th, 1920, and covered by trust deed dated February 14th, 1921; present issue £200,000; charged on certain shares and debentures and the company's undertaking and property, present and future, including uncalled capital. Trustees: British Trusts Association, Ltd.

Electricars, Ltd.—Debenture dated February 15th, 1921, to secure £25,000 charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Kynoch, Ltd., Lion Works, Witton, Birmingham.

Westinghouse Brake & Saxby Signal Co., Ltd. (formerly Westinghouse Brake Co., Ltd.).—Particulars of £350,000 8 per cent. first mortgage debentures, authorised October 15th, 1920, and covered by trust deed dated March 2nd, 1921; whole amount issued; charged on freehold lands, buildings and hereditaments, plant, machinery, and the company's undertaking and property, present and future, including uncalled capital. Trustees: Lloyd's Bank, Ltd.

Yorkshire (Woollen District) Electric Tramways, Ltd.—Particulars of £40,000 debentures authorised February 8th, 1921; whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital.

South Metropolitan Electric Light & Power Co., Ltd.—Issue on February 23rd, 1921, of £43,866 debentures, part of a series already registered.

Ferranti, Ltd. (83,718).—Return dated December 24th, 1920. Capital, £130,000 in £1 shares (60,000 preference, 60,000 ordinary and 10,000 deferred). 53,374 preference, 60,000 ordinary and 10,000 deferred shares taken up. £123,374 considered as paid. Mortgages and charges, £123,489.

Gosport & Alverstoke Electric Lighting Co., Ltd. (82,693).—Return dated January 14th, 1921. Capital, £25,000 in £10 shares. 2,300 shares taken up. £23,000 paid. Mortgages and charges, nil.

C. H. Hare & Son, Ltd. (110,911).—Return dated December 31st, 1920. Capital, £16,000 in £1 shares (8,000 preference). All shares taken up. £1 per share called up on 8,000 preference and 502 ordinary. £8,502 paid. £7,498 considered as paid on remainder. Mortgages and charges, nil.

Edison Accumulators, Ltd.—Satisfaction in full on February 25th, 1921, of two debentures dated March 10th, 1915, and July 4th, 1916, securing all moneys due or to become due not exceeding £5,000 and £15,000 respectively.

Napier-Kimber, Ltd.—Satisfaction in full on February 21st, 1921, of debenture dated June 14th, 1920, securing £4,000, notified second and third debentures both dated March 4th, 1921, to secure £2,500 and £4,500 respectively, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: A. W. Kimber, "Chevening," The Drive, Wembley Park.

CITY NOTES.

W. T. Henley's Telegraph Works Co., Ltd.

The annual meeting was held on Friday last at the Great Eastern Hotel, E.C. Mr. George Sutton, M.I.E.E., chairman and managing director, who presided, said that the capital account remained the same as last year, the new capital not having been issued until this year. That issue was over-subscribed. They only asked for £250,000, although they took authority to issue £400,000. The reason why they did not issue the whole amount was not quite because they did not want it, but because at the time capital issues were not going very well. They might have to issue the remaining £150,000 before the close of the year—it just depended on the course of business. They were not going to increase the capital account if they could possibly avoid it, and he was hoping they would be able to get through without any more capital. Creditors showed an increase of £200,000, due to the more than abnormal advance in the business. They were bringing the reserve up to £170,000 by the addition of £20,000, £15,000 of which was taken from an old reserve account which was closed. Turning to the credit side of the account, the item of freehold land and buildings, machinery, plant, &c., had been increased by the large sum of £102,000, and they had not yet reached the end of that expenditure. The additions were buildings and plant and new factories which had been in course of erection for the past two or three years. Some of them were started at the beginning of the war, and had to be stopped until the war was over. Difficulties with regard to material and labour had delayed the erection of those buildings, one of which ought to have been completed some months ago. They would have to spend another £80,000 to complete their projects in that direction. With regard to their investments, they had gone down, because they had been selling them, as they wanted the money. They had sold them at a very considerable loss, and £35,000 had had to be written off. They had made a further reserve of £7,500 to meet the fall in the price of the National War Bonds which they still held. As to the Henley's Tyre and Rubber Co., the capital of that concern had been increased during the year from £110,000 to £200,000, and it had since been increased by a further £50,000. The turnover of the company to the end of September, when the financial year closed, was a record one. At the present time, in common with the whole of the motor industry, they had a slackness of trade. The stocks at September 30th were taken at the very lowest figure—lower than they cost, for they had to write off a considerable amount to cover the fall in cotton. As to rubber, they never had more than a few weeks' supply in hand. The Tyre Co. had made a very great reputation for the quality of both pneumatic and solid band tires for commercial vehicles, and the latter trade continued to expand—it was only the sale of pneumatic tires that had fallen off. He could only say that he had no reason to modify the hopes which he had expressed in the past with regard to that company—they looked forward to a big future for it. Reverting to the Telegraph Works Co., the stock stood at £700,000, against £157,000 a year ago, although the price of raw materials was considerably lower. The rise in the stock was due to two causes. The first was the need that existed for increasing their stocks at all their branches at home and abroad, which had been depleted during the war. The second and principal cause was the large amount of unmanufactured orders on the books, so that in reality the larger amount of the stock was already sold as soon as its manufacture was complete. The stock was all good. It was priced at the lowest price at December 31st, whether that was the purchase price or the market price, but further than that, in years past they had provided for the eventuality that happened during the last six months—a slump in trade and a fall in prices; and they had built up a considerable reserve on the stock account. That reserve had paid income tax and excess profits duty, so that beyond the lowest price at which they had put the stock, they had a large reserve to meet the eventuality of its falling still further. So far he was glad to say they had not had to encroach upon that reserve. The debtors showed an increase of £200,000, due to the increased trade they had been doing and to some extent to the longer credit that was being taken. Turning to the profit and loss account, they had provided £35,000 for depreciation. The balance of the trading account showed £240,000, as against £203,000 a year ago, and the balance carried to the profit and loss general account was £193,000, against £168,000. It should be remembered in making a comparison that in 1920 they had had to pay 50 per cent. more in excess profits duty than in 1919, and there was also the three years' average in the income tax to be taken into consideration, so that on the whole, he thought, the shareholders would consider that the directors had put very fine accounts before them. They had had a splendid year. He did not think they had ever experienced such a difficult and anxious year with regard to the business. At times there were plenty of orders to be obtained. Sometimes they could not keep pace with the orders, but owing to the prices of raw materials, it had needed all the skill of their buyers and the management to avoid disaster. The principal raw materials in their business were copper, india-rubber, lead, and cotton. During the year copper fell from £115 to £71 per ton: lead went from £45 to £23: rubber fell from 2s. 10d. per lb. to 10d., and American cotton from 30d. to 10d. They must, of course, buy forward to meet their future requirements, and it would be apparent from those figures how carefully and successfully their buying had been done. The sale of their products, including their overseas trade, had continued to extend. The turnover for the year was the largest in the history of the company, and the orders carried forward into 1921 also constituted a record. The tendency of recent years had been for the percentage of profit upon their goods to decrease and for the turnover to increase, so yielding to the shareholders a larger profit. If the turnover should decrease, it might be that the rate of profit would go up. They had done a great deal of telephone work—in fact that had been one of the busiest departments of the business. They had supplied telephone trunk cables both for their own Post Office and for foreign countries. They had a long continuously loaded telephone cable which they shipped only this month to be laid across the Straits of Georgia, British Columbia. Another order of interest was that with which they had been entrusted by the city of Birmingham for an e.h.p. cable to work at 33,000 volts—at the time it was placed it was the largest order that had ever been placed of its kind. The contract for that work was nearly completed. Their general trade had gone into all countries. Jerusalem had become a buyer of their cables, and to-day the name of the company was well known in Bagdad and Mesopotamia. With regard to the current year, they had no abnormal anxiety as to the payment of dividends, but that was not the sole object of the company. Dividends were, of course, essential for its continuance, but they absorbed a comparatively small part of the profits earned. A large portion of the profits had been used for the development of the industry at home and abroad, and for the increase of employment. A large export trade was, they knew, essential to the nation, and it was for them as well as others to do their part to create and maintain such a trade. British cable manufacturers generally had hitherto held a record for trade throughout the world which had been held by no other country, and to-day their record for quality of work, for design and manufacture of cables, and for the method of doing their business was unimpaired, but with regard to their sales to foreign countries the red danger light had been showing for months, and whereas up to the middle of last year they could get more orders for foreign countries than they could take, to-day there were hardly any foreign orders coming in to their office. He was not referring to the dominions overseas, but to foreign countries. There were several causes for that condition of things; perhaps the most important was that they were unable to compete in price with the foreigner. How could they compete with Germany, when wages in England were three or four times higher than they were in the German cable factories? They did not like the idea of reducing wages—they might not have to do it; they could certainly earn dividends without doing so, but they wanted to increase employment in their factories, and that could not be done unless they could reduce their prices to meet their foreign competitors. He firmly believed that the rates of wages paid to their workmen at the present time would have to come down, and a good standard of living must be secured to them by longer working hours. To put it in another way, they must have a larger output for their wages, if they were going to keep their foreign trade. War bonuses were given to the workmen and to the commercial staff. In the case of the latter, they decreased with the cost of living, and it seemed to him that the workmen in the factories should be subject to the same procedure. The standard of living must and would be better in the future than it was pre-war, but it must be obtained by mechanical and human devices to improve the output per worker.

Mr. Martin Roberts, M.Inst.C.E., seconded the motion for the adoption of the report and accounts, which, after a brief discussion, was carried unanimously.

Automatic Telephone Manufacturing Co., Ltd.

The profit for 1920 was £15,370, plus £9,341 brought forward. Directors' fees are £2,850; depreciation on patents, goodwill, buildings, plant and machinery, £3,000; preference dividend £12,000. The report reads: "Our activities during the past year have been chiefly devoted to the special measures necessary to give effect to the terms of our agreement with the International Automatic Telephone Co., Ltd., for the promotion of overseas sales of Strowger automatic telephone apparatus. Orders of considerable value have resulted from this alliance, and to cope with these, extensive additions to personnel have been necessitated. The staff of our engineering and drafting departments has been largely increased, and new departments—essential to bulk production—created, involving establishment and development expenses on an abnormal scale. The development work accomplished can, however, be regarded as fundamental and should be beneficially reflected in our future activities. Much productive work has been accomplished against automatic telephone contracts, but the manufacturing period under review was too limited to enable any appreciable volume of this work to be converted into sales. For this reason, coupled with the heavy development expenses referred to, the directors regret that the profits for the year will not allow of any dividend being paid on the ordinary shares."

Brompton and Kensington Electric Supply Co., Ltd.

In the course of his speech at the annual meeting of this company, the chairman said they had secured record results; notwithstanding the difficult times, they compared favourably with the results of any year in their history. The conversion of the larger houses into flats and maisonettes continued, and the demand for cooking and domestic accessories increased, so that they had again not only connected more consumers and made more lamp connections, but had also sold more electricity than in any previous twelve months, and this notwithstanding the extension of daylight saving by a month, and the higher price which they had had to charge to cover the great increase in the cost of coal. The consequence of the coal strike last year was to compel them to pay an average of 11s. 4d. per ton more for coal of a greatly inferior quality, and but for their improved working conditions, which resulted in a smaller coal consumption per unit generated, the coal bill for their increased output would have been much greater than it was. The year before last, when coal cost them 31s. per ton, their coal cost per unit generated was .806d., whereas last year, when coal cost 42s. 6d. a ton, their coal cost per unit was only .97d., so that although the coal cost had gone up 36 per cent., their coal cost per unit generated had only gone up 20 per cent. This economy in production, due to the progress of invention, would continue, and they were this year installing, with the assent of the Electricity Commissioners, another large turbo-alternator of improved design. The gross receipts last year were £102,372, as against £74,045 in 1919, and the working expenses £59,469, as against £44,683, so that the net receipts were £42,902, as against £29,361, or an increase of £13,541, which would enable them to pay the same dividend as last year, after making larger provision for depreciation and reserve. They had written off about £7,000 worth of machinery from the station which had become obsolete for their purpose, and they had spent an additional £5,000 on their mains system, which in weight of copper and carrying capacity, if they should require to raise their declared pressure, was worth to-day at least the whole of the original capital of the company. They had made further advances to the Accessories Co., which were justified by the results of its working. Its assets continued to be worth their book value, it constituted one of their best customers, and its work contributed effectively to the business of supply in their area. In spite of the unsettlement of the electricity supply of London by well-intentioned, but ill-advised, political action, the prospects of the company for the current year were satisfactory.

Notting Hill Electric Lighting Co., Ltd.

At the annual meeting, on March 15th, Mr. A. Hoare, who presided, expressed the view that the Government of this country was interfering a great deal too much with private affairs. Nearly the whole of the company's new capital expenditure during 1920 was incurred in laying new mains and purchasing new meters to connect additional consumers. The provision of further capital would receive consideration in the near future if they were to extend the business. The fact that their undertaking was purchasable by the authorities in 1931, coupled with doubts regarding the interpretation of the terms of purchase, made it difficult to issue new capital at any reasonable rate. The profits rose from £31,200 to £33,800 in spite of heavy increases in the cost of production. Though the revenue from sale of energy was up nearly £19,000, the profit was only £2,600 above that of 1919. The speaker later referred to the new Electricity Supply Bill. Under its provisions, he said, a scheme promoted by some of the London companies in conjunction with the L.C.C. and local authorities, was in preparation for submission to the Electricity Commissioners for the establishment of a Joint Authority for the supply of energy within the London and Home Counties' Electricity District, the boundaries of which had been settled by the Commissioners. The only details of the scheme available at present were rough outlines of the engineering side, and no information was yet to hand of the proposed arrangements to finance the scheme. The company had not, up to the present, joined in supporting the proposal, but, when full details could be obtained, the whole matter would receive careful consideration. It would be a very difficult problem in the present state of the finances of the country to obtain a very heavy amount of capital which would be necessary to finance a scheme of this magnitude. With regard to the future, the business for the current year showed improvement, and as, recently, they were able to come to a satisfactory agreement with the unions representing the workmen throughout the industry in the London area, regulating wages by agreement over a long period, they hoped it would prevent difficulties arising in this direction. Regarding the joint works at Wood Lane, the cost of generating electricity rose considerably, and was due not only to increased wages, but to the higher cost of fuel. To some extent they were endeavouring to counteract this rise in coal cost by the installation of new and more economical plant. One set had already been erected, and two others were in hand.

Pinchin, Johnson & Co., Ltd.

The annual meeting was held at General Buildings, Aldwych, London, on Monday. Mr. E. Robson, who presided, referred to the very satisfactory results of the year's trading, in spite of the difficult trading conditions that had developed in the latter months of the year. After providing for all expenses, depreciation, income tax, excess profits, and Corporation profits tax, there was a net profit of £72,282, plus £4,642 brought forward. After paying 6½ per cent. for the year on the preference shares, a final dividend of 10 per cent. actual on the ordinary shares was recommended, making, with the interim dividend of 5 per cent., 15 per cent. for the year, less income tax. There was £10,000 put to reserve, £8,500 written off preliminary expenses of new capital issue, and £10,588 remained to carry forward. Doing a very extensive business, such as they were, it was necessary to carry extensive stocks, and although on some commitments there had been fairly substantial depreciation in the latter months of the year, the directors had adopted the sound course of writing down the trading stocks to current market prices at December 31st, 1920, which placed their business in a very strong position to withstand what remained of the present trade depression. During the year the company had extended its operations in every market of the world, and in output, volume of sales and net profits the results constituted a record. Arrangements had been completed for substantially increasing the production at their several factories, and they were able to deal efficiently with a much greater volume of business than ever before. Their sales organisation had also been consolidated and extended in every direction. Although the trade slump, which had become evident in the latter months of 1920 was still felt to some extent, he had every confidence that 1921 would be a satisfactory year.

Chelsea Electricity Supply Co., Ltd.

At the annual meeting, on March 16th, the chairman said it was a good many years since they had been able to present such satisfactory accounts. In common with those of all the London companies, their figures showed a very noticeable improvement, as compared with 1919. The amount carried to net revenue was £41,871, as against £33,038 in the previous year, an increase of 26 per cent. This enabled them to recommend a dividend of 6 per cent. for the year, as against 4 per cent. for 1919. The year's results had been achieved notwithstanding increased costs of as much as £14,000, the principal increases being for coal and energy purchased, £5,194; salaries and wages, £2,910; rates, £2,686; and repairs to buildings and machinery, £2,737. The enormous increase in rates was the cause of much anxiety to all industrial undertakings, and increases beyond what appeared in their accounts were to be feared. Fortunately the Councils which governed local matters in their area of supply were not of the socialist order. Ratepayers all over the country were being aroused to a sense of the danger of rising rates. During the year they dismantled the Cheyne Walk station containing their oldest plant, which, although useable, was the reverse of economical. The recent settlement as to wages concluded under the auspices of the District Council No. 10, which was formed to promote agreement as to wages in the London area, was working satisfactorily for the present. They might look forward with confidence to the future if they could hope to be let alone to work out their own salvation. Schemes for consolidating the electricity supply of London, however, involving enormous capital outlay were proposed. Most of the companies had come together for the purpose of safeguarding their shareholders' interests, and their chairmen were in constant consultation. It was difficult to say what the outcome would be, and in the meantime all the directors could do was to wait and watch, and do all in their power to secure fair and reasonable treatment.

Davis and Timmins, Ltd.

Sir Henry C. Mance, presiding at the annual meeting, on March 15th, said that the item "Sundry debtors" was rather higher, but this, he thought, would be found the case with every manufacturing company, owing to the shortage of money, brought about by the difficult conditions in certain trades and the disinclination on the part of the directors to press unduly their customers. Stock was higher, due to the fact that they had found it advantageous to themselves and a great convenience to their customers to keep a larger stock of manufactured articles. It included, also, an increased amount of metal. Trade expenses had advanced, mainly in consequence of the increased costs in every department. Salaries were higher in consequence of various well-deserved promotions. Bad debts were higher, but this, he thought, was a state of things common to every company having such a multitude of accounts. Notwithstanding the increased charges, the net profits had increased by nearly £800. As regarded the future, although he did not share the pessimistic views of many writers, they should not ignore the fact that a good deal of uneasiness existed in certain quarters. Last week he had had occasion to place a substantial order with one of the largest manufacturing firms in the country. Delivery was promised in six weeks. He was quite sure that if that order had been given a year ago the time for delivery would have been six months. It might take some time before they got back to normal prices and normal trade.

Mr. G. E. Davis (managing director) said that since the last meeting they had added a large new building, and were now in possession of a splendidly equipped inspection department. When business revived, which it must do sooner or later, they would be in a better position, and better equipped than they had ever been, to deal with it.

City of London Electric Lighting Co., Ltd.

The ordinary general meeting of the company was held on March 16th, when Mr. J. B. Braithwaite took the chair. Reviewing the financial results, the chairman said that the year's revenue showed an increase of £128,275, but owing to the increased cost of labour, coal, and materials, the net result was only a profit of £31,266. The chairman then dealt at some length with the present position of electricity supply in London, and said that any attempt to amalgamate the municipal with the company undertakings presented great difficulties, owing to the different bases of tenure. In the speaker's opinion, the simplest way of unifying the electricity supply would have been to grant the companies a considerable extension of tenure which would have justified them in making the large expenditure necessary to correct existing anomalies. A step in this direction had been taken by the passing of the Electric Lighting Act of 1908, which substituted the L.C.C. as the sole purchasing authority, and empowered companies and local authorities to link up their stations. Great progress had been made in this direction. Referring to the Electricity (Supply) Act of 1919, the chairman said that one result had been the holding up of development and the erection of the big station at Barking had been effectually blocked. Dealing with the position of the company, he said that they had laid an interconnector between their station at Bankside and the County of London Electric Co.'s station at Wandsworth, which would enable them to give that company 10,000 kW in bulk. The present capacity of their plant at Bankside was 33,500 kW, and they hoped to have a further 20,000 kW installed in the autumn, of which 10,000 would be given to the County of London Co., leaving them 10,000 to meet their own increased demand. The Bankside station must play an important part in the future electric supply of London, as it occupied a central position and had unlimited supplies of condensing water and every facility for the delivery of coal. Its ultimate capacity was about 80,000 kW, and it could supply in bulk the inner ring of the London area more economically than could be done by any station further away. The directors quite anticipated that it would be in operation in time for the revenue to benefit in the last quarter of the present year. The company had not raised any additional capital since 1900, having paid for all the new plant, extensions, and mains, &c., out of revenue, but the large additions to their generating plant which they were now making would oblige them to raise a small amount of additional capital, and they proposed to issue £300,000 of the £800,000 capital, which they still had available, in the form of 8 per cent. cumulative second preference shares. The issue would be made shortly after Easter, and the shareholders would have preferential consideration. Taking the figures for last year, the margin of profit would cover the interest on that issue more than ten times, so that the security would be an excellent one, and should prove attractive. The report and accounts were adopted, and a resolution increasing the borrowing powers of the company was passed.

County of London Electric Supply Co., Ltd.

The twenty-seventh ordinary general meeting was held on March 15th, Sir Harry Renwick, K.B.E. (chairman), presiding. The chairman, in moving the adoption of the directors' report and accounts, said that the total receipts from sales and meter rentals had risen by 24 per cent. to £674,105. Working expenses had risen by about 27 per cent., and an explanation of this was to be found in the higher cost of coal, higher salaries and wages, and the ruinously high rates and taxes. As to coal, the fuel costs were about 82 per cent. of the total generating costs for the year. Coal had cost on the average 7s. 4d. per ton more than in the previous year, the average cost now being three and a half times the pre-war cost, and for inferior quality. Salaries and wages were some 20 per cent. above the 1919 level. The costs of repairs were exceptionally heavy; this was partly due to an accumulation of repairs deferred during the war period, and partly to the rise in cost of materials and wages. Rates and taxes had increased by £12,303, largely owing to the alarming increase in local and municipal rates. To the speaker's mind the question of municipal expenditure and local rates was one of the most pressing questions of the hour, the importance of which was not fully realised by the public. It appeared hitherto to have escaped the criticism it would otherwise have attracted and to be overshadowed by the bigger question of national expenditure, but at last there were signs of an awakening on the part of the public, and there were many who felt as he did that it was time steps were taken to put a stop to municipal extravagance, which was as vicious and baneful in its effects as national extravagance. Dealing with the progress of the company, the chairman said there was a record increase of over 7,000,000 units sold, which reached the respectable total of nearly 50,000,000 units in the year, while applications for new business showed a net increase of 5,678 kW. They had now connected to their mains nearly 90,000 kW, while they were supplying over 35,000 consumers. This indicated in a telling way the continued vitality of the company's business and the potentialities and possibilities of the future, which, having regard to the company's extensive areas, were practically unlimited. As to the prospects for the current year, with so many uncertain factors, it would serve no useful purpose to attempt a definite forecast, but, broadly, he thought he could speak reassuringly as to the progress of business, and he had every confidence that, barring any really big eventuality, the results for the current year should continue to be satisfactory. As to future rates of pay and costs of living, the position was altogether artificial, but in spite of the Government and its policy of political expediency, wages were bound to come down through economic pressure and the dire necessities of the situation, which would be all to the good for the shareholder, for the worker, and for the country at large in the current year. They had done everything that could be done to place the company in a strong position, and they were, therefore, fully justified in looking forward to the future with every confidence.

German Companies.

The accounts of the *Bergmann Elektrizitats Unternehmungen A.G.*, of Berlin, show profits of 40,000 marks for 1919-20, as against 204,000 marks in the previous year on a paid-up capital of 6,000,000 marks. The company has hitherto not paid any dividend.

The accounts of the *Electrochemische Werke*, of Bitterfeld, for 1920, after writing off 1,500,000 marks for depreciation as against 2,100,000 marks in 1919, show net profits of 1,940,000 marks, as contrasted with 2,620,000 marks in the previous year. It is proposed to pay a dividend at the rate of 15 per cent. on share capital of 12,000,000 marks, being the same rate as in 1919, when the participating capital was less.

The report of the *Telephonfabrik A.G. vorm. J. Berliner*, of Hanover, states that notwithstanding the great difficulties in obtaining raw materials and the uncertainty of manufacturing owing to the frequent strikes, it was possible to realise satisfactory results in 1919-20. The net profits were 1,535,000 marks, as compared with 678,000 marks in 1918-19, and the dividend is at the rate of 15 per cent., as against 6 per cent. in the preceding year. It is mentioned that the company's works at Vienna has been transferred to a company entitled the Austrian Telephone Co., with a share capital of 15,000,000 kronen, of which one half is held by Austrian interests.

Rhondda Tramways Co., Ltd.—According to the "Financial Times," it is proposed to convert the 6 per cent. cumulative preference shares of the Rhondda Tramways Co. into 8 per cent. non-cumulative participating preference shares with a 25 per cent. participation in the surplus divisible profits, the arrears of dividend being waived as consideration for the suggested alteration. In the course of a circular to shareholders of the Rhondda Tramways Construction Syndicate (in liquidation) the joint liquidators, Messrs. L. B. Schlesinger and W. B. Cownie, state: "We have no doubt that the conversion would be of considerable advantage to the shareholders, inasmuch as upon a distribution of securities they would receive a more marketable security."

Isle of Thanet Electric Tramways & Lighting Co., Ltd.—For the year ended September 30th last the traffic receipts, including omnibuses, were £74,110, and from sale of electricity £22,626, the total receipts from 1920 being £97,244, against £66,394 for 1918-19, and the balance carried to appropriation account of £32,144, against £30,553. The sum available is £24,797; to reserve, £2,500 (increasing it to £15,000); to permanent way reserve, £10,000 (making it £30,000); to rolling stock reserve, £7,500 (making it £15,500); forward, £4,285. The directors (according to the *Financial News*) look forward to the resumption of a dividend on the preference shares for the year to September 30th, 1921.

Clyde Valley Electrical Power Co.—For the year 1920 the balance of profit was £149,392, plus £58,302 brought forward. The preference dividend absorbs £18,000; a total of 7½ per cent. for the year on the ordinary shares requires £45,000; there is put to contingency fund £75,000; carried forward £69,693. The 15,000-kW turbo-alternator installed at Yoker power station has been running on commercial load since March last. The installation of the 15,000-kW turbo-alternator at Clyde's Mill power station has been considerably delayed, but it is expected that the plant will be in operation in June. Mr. J. K. Stothert has resigned from the board; Dr. R. T. Moore has been elected in his place.

Companies to be struck off the Register.—The following companies are to be struck of the register unless cause is shown to the contrary within three months:—

A. B. Vibro & Domestic Electrics, Ltd.
Feltham & District Electric Lighting Co., Ltd.
Non-conductors, Ltd.
Snyder Electric Furnace Co., Ltd.
Wholesale Battery Co., Ltd.

American Telephone and Telegraph Co.—Earnings for 1920, after meeting all operating charges and providing for depreciation and obsolescence and for Federal taxes payable in 1921, totalled $70,686,904. Interest charges were $18,865,688. Dividends paid at usual rate of $8.00 per share per year amounted to $35,376,792, appropriated for contingencies $8,000,000, leaving $8,444,422 carried to surplus account. During the year investments in associated companies increased $33,653,891.—*Financial Times.*

Butlers, Ltd.—The accounts for year ended July 31st, 1920, show, after paying directors' fees and salaries, and providing for E.P.D. and corporation tax, a profit of £23,353, plus £846 brought forward. Owing to present financial stringency and necessity for conserving resources, says the *Financial Times*, the directors propose to carry forward balance of £8,949 remaining, after payment of 5 per cent. dividend on ordinary shares in November, 1920.

Denmark.—Aktieselskabet Nordiske Kabel-og Traadfabriker realised during 1920 a net profit of 2,720,000 kr. Out of this sum over 1,200,000 kr. is devoted to writing down of machinery, &c., 133,000 kr. is placed to reserve, and the directors propose to pay a dividend of 12 per cent., carrying forward 11,000 kr.—*Reuter's Trade Service* (Copenhagen).

Salisbury Electric Light & Supply Co., Ltd.—The profit balance for 1920 was £7,531, against £5,733 for 1919. Interest on debentures requires £742, and depreciation of investments £249. £3,095 is brought forward, and the balance is £9,634. The dividend for the year is 7 per cent; £3,000 is put to depreciation and reserve fund; and £4,184 is carried forward subject to E.P.D.

International Automatic Telephone Co.—A financial contemporary states that the profit for the ten months ended December 31st, 1920, was £11,778; dividend on preference shares £11 136; carried forward £633. Profits will not allow of dividend on ordinary and deferred shares.

Hadfields, Ltd.—Further dividend of 6d. per share on the ordinary shares, making 5 per cent. for the year, free of tax.

Belgium.—The report of the Société d'Electricité de l'Escaut, of Antwerp, for the last financial year shows a profit of 1,086,652 fr., as compared with only 187,702 fr. in 1919.

Globe Telegraph & Trust Co., Ltd.—Quarterly interim dividend of 3s. per share on preference shares, less tax; 5s. per share on old and new ordinary shares (tax already deducted); 4s. 8d. per share, being interest at rate of 10 per cent., tax free, in respect of instalments paid on new ordinary shares.—*Financial Times.*

South London Electric Supply Corporation, Ltd.—A dividend of 9 per cent. per annum is announced on the ordinary shares for the last half of 1920, making 7 per cent. for the year. £5,769 carried forward.

Robey & Co., Ltd.—Dividend of 2½ per cent., less tax, on the preference and ordinary shares. Carried forward £27,995, subject to E.P.D. and corporation tax.

Sir W. G. Armstrong, Whitworth & Co., Ltd.—Dividend on ordinary shares for half-year ended December of 1s. per share, making 2s. per share for the year 1920, less tax.

Wemyss & District Tramways Co., Ltd.—Final dividend of 6 per cent., free of tax, on the ordinary shares.

Shawinigan Water & Power Co.—Dividend of 1¾ per cent. on common stock for the quarter.

STOCKS AND SHARES

Monday Evening.

The main interest in the Stock Exchange centres upon the movements in gilt-edged securities. These are held, naturally enough, to reflect the possibilities with regard to cheaper money. Some hoped that there would be a reduction in the Bank Rate before the Easter holidays, but other quarters—and those probably better informed—look for no relief until Budget time. The remarkable rises that occurred in the War Loan and other stocks of this sort gave way a little, on sales evidently of the profit-taking order. There is, however, an atmosphere of cheerfulness, and the Stock Exchange looks forward (as it has done for the last many decades) to an improvement in business "after Easter."

Several important issues are pending in the electricity supply world. Amongst these one of the first comers will certainly be the 300,000 City of London Electric 8 per cent. second preference shares. The prospectus indeed may be out this week. Later, there may be expected an issue of about half-a-million pounds in Central Electric 8 per cent. Notes. It is said that these will be offered in the neighbourhood of 97. With the guarantees which the Central Electric commands, the terms certainly look tempting, so far as can be surmised without the necessary details. The Metropolitan Electric Supply Co. is another which will probably be in the field before long with a debenture issue.

With the prospect of these newcomers appearing in the early future, it is natural that prices in the electrical market should be quiet, as might be the case, anyway, at this season of the year. There is Summer-time just ahead, and rightly or wrongly, the investor seems to think that this has an unfavourable effect upon illumination shares. Nevertheless, Westminster ordinary have stiffened to £5 and Metropolitan ordinary to 3. City of London preference are better at 18s.

Interest will watch with attention whether the Metropolitan Company, if it makes a new debenture stock issue, will invite co-operation from London firms in connection with the underwriting.

Metropolitan Railway ordinary stock is better at 22, and Underground Incomes have hardened to 66½. The market in steam stocks is hesitating. How the railwaymen and the miners will take the automatic reduction in wages, which should come about in the course of the next ten days, is a matter upon which investors feel a trace of dubiety. This, however, has not affected iron, steel and similar shares. Babcock & Wilcox keep good at 2⅜.

British Aluminium have recovered sharply to 17s. 6d. Callender's are 1/16 up at 1 7/16. Henley's keep a good market at 1⅜. The cable manufacturing companies are doing well, and the chairman of Henley's at the meeting the other day spoke of the good results which his company is achieving with its golf balls. The impoverished golfer may be moved to wonder why, with rubber at 1s. a lb., some enterprising manufacturer does not reduce the present 3s. ball to a price more suited to the aforesaid golfer's pocket. Telegraph Constructions are better at 20½, General Electrics improved to 23s., although the preference eased off to 18s. The market in electrical manufacturing shares as a whole is quiescent. That the past year is bound to have turned out a bad one from the point of view of profits is now generally acknowledged, and the protracted fall in prices has discounted to some extent whatever unfavourable reports there may be to come.

Mexican issues are weaker, both the Mexican Light & Power and the Mexico Tramways bonds going back owing to the scarcity of news from the country. Vera Cruz shares are 2s up at 17s. 6d. No changes have occurred in the Argentine, Brazilian or British Columbian groups.

The telegraph and telephone list is firm, with Eastern

Extensions up to 16 again. Cuba Submarine ordinary are a little better at 6½. Marconi's advanced to 38s. 9d. The International Automatic Telephone Company issues its report and balance-sheet for the ten months ended December 31st, 1920. The profits amount to £11,778, of which all but £610 is absorbed by the preference dividend. The company carries forward the balance, with an expression of regret from the directors that the profit for the period covered by the accounts will not allow of a dividend being paid on the ordinary or deferred shares. Of these it may be remarked that there are 208,570 ordinary shares issued and 360,000 deferred, all of £1 each fully paid. Good people in America, we observe, seem to be very much annoyed at the proposal to advance their telephone rates by 28 per cent.

The rubber share market is not bad, in spite of the flatness of the raw stuff. There is, of course, no business worth mentioning. Sellers are conspicuously absent, and there are a few buyers who take the longer view in regard to the future of the rubber industry, and are laying in small parcels of shares in the good companies at the present prices. One or two concerns, it may be observed incidentally, are having no little difficulty to raise money at this present juncture. The armament group is also better. Armstrongs provided something of a pleasant disappointment by declaring a dividend making 10 per cent. for the year, less tax, as against 12½ per cent., free of tax, a year ago. The price rose from 17s. 3d. to 18s. 3d. In view of the recent results achieved by certain kindred companies, Armstrongs are deemed to have done well, and Vickers, both ordinary and tax free preference, hardened in sympathy to 12s. 6d. and 14s. 3d. respectively.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1919.	Dividend 1920.	Price March 21, 1921.	Rise or fall.	Yield p.c.
Brompton Ordinary..	12	12	6¼	+ ⅛	£9 12 0
Charing Cross Ordinary	7	8	8¾xd	—	10 13 4
do. do. do. 4½ Pref. ..	4½	4½	2¾	—	8 8 8
Chelsea..	4	6	8⅛	—	9 10 6
City of London	18	14	25/-	+ 6d.	11 4 0
do. do. 6 per cent. Pref. ..	6	6	18/-	+ 6d.	6 13 4
County of London	8	8	7¼	—	10 6 6
do. do. 6 per cent. Pref.	8	6	8¼	—	7 6 5
Kensington Ordinary	7	9	4	—	11 6 0
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref...	6	6	9¾	—	10 18 2
Metropolitan..	6	7	8	+ ⅛	11 13 4
do. 4½ per cent. Pref. ..	4½	4½	2 13/16	—	8 16 8
St. James' and Pall Mall	12	12	8	—	10 0 0
South London	6	—	2⅝	—	9 2 10
South Metropolitan Pref.	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	6	+ ⅛	10 0 0

Telegraphs and Telephones.

	1918	1919			
Anglo-Am. Tel. Pref.	6	6	80½	—	7 9 8
do. Def.	33/6	1½	16	—	9 7 6
Chile Telephone	8	6	5½	—	*6 8 8
Cuba Sub. Ord.	7	7	6½	+ ⅛	*10 15 4
Eastern Extension	10	10	16	+ ⅛	6 5 0
Eastern Tel. Ord.	8	10	160½	—	6 4 7
Globe Tel. and T. Ord.	8	10	16⅜xd	—	6 8 0
do. do. Pref.	6	6	9xd	—	6 18 4
Great Northern Tel.	22	22	20½	—	10 14 8
Indo-European	13	10	80	—	8 6 8
Marconi	25	25	1 15/16	+ 1/16	—
Oriental Telephone Ord.	10	12	2 1/16	—	*6 9 7
United R. Plate Tel.	8	8	6⅛	—	*6 10 8
West India and Panama	1/3	Nil	1/16	—	Nil
Western Telegraph..	8	10	16	—	*6 6 0

Home Rails.

	1919	1920			
Central London Ord. Assented ..	4	4	48½	—	9 4 0
Metropolitan	1¼	1½	22	+1	6 16 4
do. District	Nil	Nil	15½	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅞	—	Nil
do. do. "A" ..	Nil	Nil	5/-	—	Nil
do. do. Income ..	4	2	65	+1	8 0 2

Foreign Trams, &c.

	1918	1919			
Anglo-Arg. Trams, First Pref. ..	Nil	5½	2⅝	—	10 9 6
do. do. 2nd Pref. ..	Nil	Nil	8⅛	—	Nil
do. do. 6 % Deb. ..	6	6	69½	—	8 8 0
Brazil Tractions	Nil	Nil	87	—	Nil
British Columbia Elec. Rly. Pfce.	6	6	66	—	8 18 6
do. do. Preferred	2½	6	64½	—	*8 14 0
do. do. Deferred	Nil	8	61½	—	*11 17 6
o. do. Deb. ..	4½	4½	65½	—	7 11 8
Mexico Trams 5 per cent. Bonds..	Nil	Nil	87	- 2	Nil
do. 6 per cent. Bonds..	Nil	Nil	21½	—2	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	18	—	Nil
do. 1st Bonds	Nil	Nil	59	- 2	Nil

Manufacturing Companies.

Babcock & Wilcox	15	15	2⅜	—	*6 6 4
British Aluminium Ord.	10	10	17/6	+1/9	11 8 6
British Insulated Ord.	12½	15	1½	—	10 0 0
Callenders	25	15	1 7/16	+ 1/16	10 18 2
" 6½ Pref.	6½	6½	17/6	—	7 8 7
Castner-Kellner	20	17	2⅞	—	7 12 9
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	10	10/-	—	—
do. do. 6 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	15/9	—	12 14 0
English Electric	—	8	11/-	—	14 11 0
Do. Pref.	—	6	13/6	—	8 17 10
Gen. Elec. Pref.	6½	6½	18/-	—6d.	7 4 6
do. Ord.	10	10	23/-	+6d.	*8 13 10
Henley	25	15	1⅜	—	10 18 2
do. 4½ Pref..	4½	4½	8½	—	6 18 8
India-Rubber..	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	1⅜	—	9 17 0
Siemens Ord...	10	10	20/6	—	*9 15 2
Telegraph Con.	20	20	20½xd	+ ¼	*5 16 3

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

Tuesday, March 21st

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	9½d.	1½d. dec.
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	"	£65	..
a Bisulphide of Carbon	"	...	...
a Borax	"	£31	£1 dec.
a Copper Sulphate	"	£35	...
a Potash, Chlorate	per lb.	6½d.	½ dec.
a " Perchlorate	"	10d.	...
a Shellac	per cwt	£15	£1 dec.
a Sulphate of Magnesia	per ton	£16	...
a Sulphur, Sublimed Flowers ...	"	£20	£1 dec.
a " Lump	"	£18	...
a Soda, Chlorate	per lb.	4½d.	...
a " Crystals	per ton	£7	...
a Sodium Bichromate, casks ...	per lb.	1/-	...
METALS, &c.			
p Babbitt's Metal Ingots	per ton	£95 to £300	...
c Brass (rolled metal 2" to 12" basis)	per lb.	11¾d.	½d. dec.
c " Tubes (solid drawn)... ...	"	1/1¾ to 1/2	...
c " Wire, basis	"	1/0⅛	½d. dec.
c Copper Tubes (solid drawn) ...	"	1/3¾	
c " Bars (best selected) ...	per ton	£114	£2 dec.
c " Sheet	"	£114	£2 dec.
c " Rod	"	£114	£2 dec.
d " (Electrolytic) Bars ...	"	£71	£1 dec.
d " " Sheets ...	"	£143	...
d " " Wire Rods..	"	£87	£1 dec.
d " " H.C. Wire ..	per lb.	11½d.	⅛d. dec.
f Ebonite Rod	"	8/6	...
f " Sheet	"	8/-	...
n German Silver Wire	"	2/9	...
h Gutta-percha, fine	"	14/- to 16/-	...
h India-rubber, Para fine	"	11½d.	...
i Iron Pig (Cleveland Warrants) ...	per ton	Nom.	...
l " Wire, galv. No. 8, P.O. qual.	"	£45	..
g Lead, English Pig	"	£21 5s.	15/- inc.
g Mercury	per bot.	£12 10 to £12 15	...
e Mica (in original cases) small ...	per lb.	4d. to 4/-	..
e " " " medium..	"	5/- to 10/-	...
e " " " large ...	"	12/6 to 25/- & up	...
p Phosphor Bronze, plain castings	"	1/4 to 1/9	...
p " " rolled bars and rods	"	2/1 to 2/6	1d. to 3d. dec.
p " " rolled strip & sheet	"	2/2 to 2/7	1d. to 2d. dec.
d Silicium Bronze Wire	per lb.	1/4	...
r Steel, Magnet, in bars	"	1/8	...
n Tin, Block (English)	per ton	£153 to £154	£5 to £5 inc.
n " Wire, Nos. 1 to 16	per lb.	4/-	6d. dec.
p White Anti-friction Metals ...	per ton	£78 to £300	...

Quotations supplied by—

a G. Boor & Co.	*g* James & Shakespeare.
c Thos. Bolton & Sons, Ltd.	*h* Edward Till & Co.
d Frederick Smith & Co.	*i* Bolling & Lowe.
e F. Wiggins & Sons.	*l* Richard Johnson & Nephew, Ltd
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.	*n* P. Ormiston & Sons.
	p ———

r W. F. Dennis & Co.

Aircraft Lights.—To assist in the successful development of night-flying facilities for aircraft, experiments have been carried out at the Government terminal aerodrome at Croydon and along the route to the Channel coast with various types of aerial lighthouses, searchlights, pyrotechnic lights, and obstruction and landing lights. In order that those different forms may be tested by observation from the air, it has been arranged that the civil airship G.F.A.A.G. (late H.M. Airship R 33), which is now carrying out mooring-mast experiments at Pulham airship station, will undertake an observational flight along the London-Folkestone route. The observational flight will be carried out on the first suitable occasion. The ship will leave the mast at Pulham shortly after dusk, will proceed over London to the neighbourhood of Croydon aerodrome, and will test the range and efficiency of the aerial lighthouse and searchlights from the point of view of easy location of aerodromes. Observers will also decide on the value of certain pyrotechnic aids to navigation and examine the obstruction lights, and, if they are completed, the illuminated landing "L's" which are being fitted to provide a semi-automatic indication to aeroplane pilots of the direction and position in which they should land and take off. Observation will also be made of a new "Cone" light which is being experimented with as a local pilotage light at aerodromes. This light is projected downwards on to a white cone, and, if found to be satisfactory, will be used as the main location light at civil aerodromes, the aerial lighthouse proper being reserved for marking intermediate points on routes. From Croydon the airship will proceed along the London-Continental route to Lympne, where she will survey from the air a spot that has been tentatively selected for an aerial lighthouse. For observation purposes a small war-time lighthouse has been temporarily erected on the spot. The ship will then pass over the coastline, and will carry out observations of various types of marine lighthouses and light-vessels in the Channel and the North Sea which are visible from the air. During the flight, wireless practice for direction-finding purposes will be carried out, and general wireless telegraph and telephone communication will be maintained with land stations.

THE INFLUENCE OF TRANSFORMER CONNECTIONS ON THIRD HARMONIC VOLTAGES & CURRENTS.

By S. AUSTEN STIGANT, A.M.I.E.E., M.Am.I.E.E.

(*Concluded from page* 361.)

Objectionable Features of Third Harmonics.

These naturally come under two headings: (1) due to third harmonic currents; (2) due to third harmonic voltages, and they may be summarised as follows:—

1. *Due to third harmonic currents.*

(*a*) Overheating of transformer windings and of load.

(*b*) Telephone and discriminative protective gear magnetic disturbances.

(*c*) Increased iron loss in transformers.

2. *Due to third harmonic voltages.*

(*a*) Increased transformer insulation stresses.

(*b*) Electrostatic charging of adjacent lines and telephone cables.

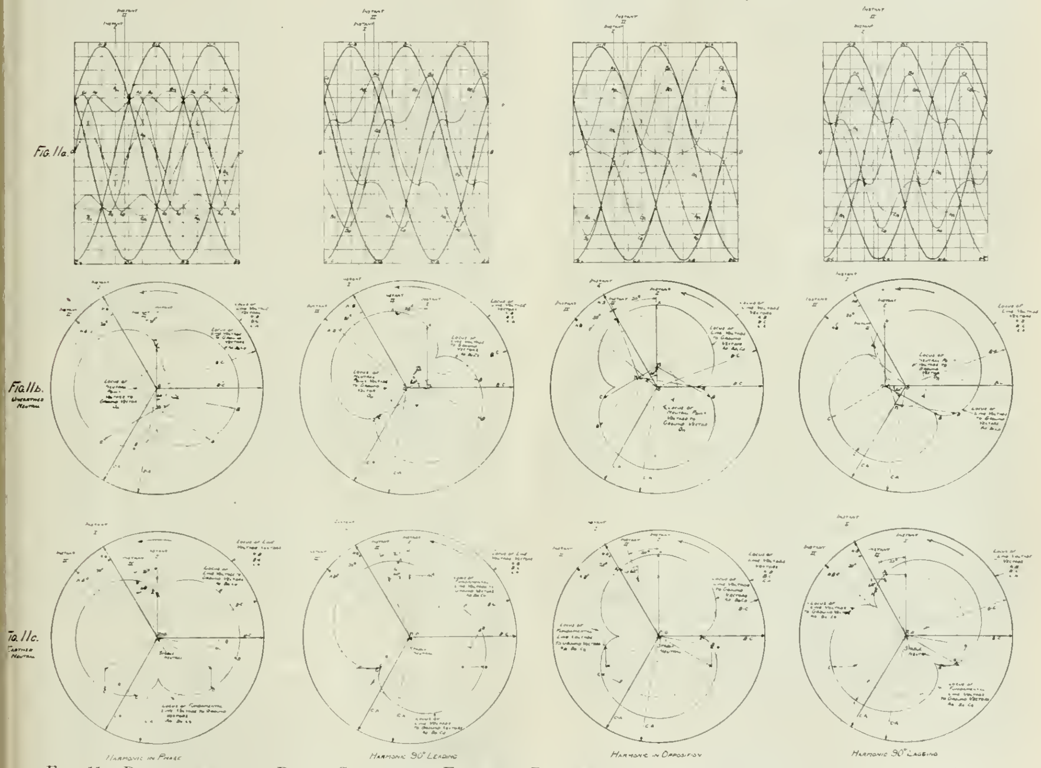

Fig. 11.—Rectangular and Polar Co-ordinate Forms of Fundamental and Third-Harmonic Voltages in a Symmetrical Three-phase, Three-wire, Star-connected System.

(*c*) Possible resonance at third harmonic frequency of transformer windings and line capacity.

These disadvantages may briefly be referred to as follows:—

1*a*. In practice, overheating of the transformer windings and load due to the circulation of third harmonic current very rarely occurs, as care is generally taken to design the transformer so that the flux density in the core is not given too high a value which would increase the third harmonic component of the no-load current. Apart from the question of design, a transformer might, of course, have a higher voltage impressed upon it than that for which it was originally designed, but in this case (which also seldom occurs), the increased heating from the iron loss due to the resulting higher induction would be much more serious than the increased heating in the transformer windings due to larger values of the third harmonic circulating current. These remarks hold good irrespective of whether the transformer windings are delta connected or star connected with a fourth wire.

The only case where the circulation of the third harmonic currents is likely to become really serious in practice is where the transformer primary windings are connected in the interconnected star manner, the generator and transformer neutrals being joined together, as mentioned previously in this article.

1*b*. It is well known that harmonic currents circulating in lines paralleling telephone wires or through the earth where a telephone earth return is adopted, produce disturbances in the telephone circuit. This is only of practical importance in transmission or distribution lines of some length (as distinct from short connections to load), and then as a rule only occurs with the star connection using a fourth wire, which wire may be one of the cable cores or the earth.

Similar interference may take place in the pilot cores of discriminative protective gear systems, and unless special precautions are taken relays may operate when the main power circuit is quite normal.

The remedy is, of course, obvious, and consists either of using a delta connected transformer winding or omitting the fourth wire and earthing at one point of the circuit only.

1*c*. In the case of three-phase core type transformers using a star/star connection, it has been proved experimentally* that a fourth wire connection on the primary side between transformer and generator neutrals (which allows the circulation of third harmonic currents), results in an increase of the iron loss in the transformer of a figure of the order of 20 per cent. higher than that given with the neutrals disconnected. This figure is, of course, variable according to the design of the transformer and the impedance of the primary circuit. The conditions are similar for single-phase transformers.

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* "Transformer Core Loss as Affected by Triple Harmonics," by H. M. Lacey and C. H. Stubbings. *The Electrician*, September 17th, 1915, p. 874.

2*a*. It has been pointed out previously that with the three-wire star connection and isolated neutral a voltage occurs from the neutral point to ground having a frequency of three times the fundamental, so that while measurement between the lines and from lines to neutral indicate no abnormality, a measurement from neutral to ground with a sufficiently low reading voltmeter would indicate the magnitude of the third harmonic. In practice with single-phase transformers the third harmonic voltages may reach a magnitude of 60 per cent. of the fundamental, and this is a measure of the additional stress on the transformer windings to ground. While due to the larger margin of safety it may not be of great importance in the case of ordinary power distribution transformers, it will have considerable influence on the reliability of transformers as higher voltages are approached.

2*b*. Due also to the conditions outlined in 2*a*, star connected banks of single-phase transformers connected to an overhead line or underground cable, and operated with an earthed or unearthed neutral will result in an electrostatic charging at third harmonic frequency of adjacent power and telephone cables. This produces abnormal induced voltages to ground, if the adjacent circuits are not earthed, the whole of the circuit being raised to an indefinite potential above ground even though the voltages between lines remain normal. The insulation to ground, therefore, becomes unduly strained, and the life of the apparatus probably is reduced.

2*c*. A further danger due to the conditions outlined under 2*b* is the possible resonance which may occur at third harmonic frequency of the transformer windings with the line capacity. This can occur if the transformer neutral is earthed or unearthed, and the phenomenon occurs perhaps more frequently than is usually appreciated, but due to the present-day complicated networks, and the resulting large damping constants, the magnitude of the quantities is such as often to render the disturbances innocuous.

Acknowledgments.—The various curves in the article have been built up from data relating to the hysteresis and permeability of transformer silicon steel which were kindly supplied by Messrs. Joseph Sankey, Ltd., of Bilston, to whom the author expresses his cordial thanks. He is also considerably indebted to Mr. H. M. Lacey, B.Sc., for his co-operation in mathematically analysing the non-sinusoidal wave forms contained in this article, and to Mr. A. C. Turner for the preparation of the illustrations.

APPENDIX.

As, in practice, third harmonic voltages rather than currents are more likely to give trouble, it will be profitable to study the phenomena a little further. Fig. 11 is given, which shows the rectangular co-ordinate method of wave construction translated into the polar co-ordinate form in which the angle represents time, one complete revolution equalling one period or $1 \div f$ seconds. Taken in conjunction, the two forms give a very complete illustration of the progressive variation of the quantities involved while the polar diagram in particular provides a clear insight into the influence of the harmonic.

Fig. 11*a* is in part a reproduction of fig. 8, which shows the resultant voltage waves to ground in a symmetrical three-phase three-wire star-connected system, with different positions of the third harmonic component. In addition, the voltage waves between lines are shown, and these illustrate the well-known fact that no matter what the relative position of harmonic and fundamental may be the third harmonic voltages in the phases cancel out and leave the line voltages free from their influence. In fig. 11*a* the various letters have the following significance:—

An, Bn, Cn = fundamental sine waves of phase voltages.

On = third harmonic sine wave voltage component.

AO, BO, CO = resultant waves of voltages to ground.

A-B, B-C, C-A = sine waves of voltages between lines.

Fig. 11*b* shows the polar diagrams corresponding to the different rectangular co-ordinate diagrams of fig. 11*a* for a system having an unearthed neutral. The diagrams show clearly the locus of the voltage vectors of the neutral point to ground, the lines to ground, and the line to line. The first and third of these, it will be noticed, are true circles having their centres at the point "O," thus indicating that the voltage from the neutral point to ground and also the voltages between lines follow the sine law. The non-sinusoidal characteristic of the voltages from each line to ground is indicated by the expansion and contraction of the curve representing the locus of the line voltage to ground vectors, and the four cases given, corresponding to different positions of the harmonic, indicate that the locus curves are identical in shape, varying only in their relative position. That is, their maximum and minimum values occur at different angles or instants of time, this alone accounting for the different shapes of the resultant waves AO, BO, and CO, in the diagrams of fig. 11*a*. The angular distances between the maximum and minimum values of the locus curves of the line voltages to ground vectors remain constant. To show just how the radial vectors themselves are affected, the conditions at two definite instants are given, the instants being 20 degrees of the fundamental apart; their corresponding position is also shown in the diagrams of fig. 11*a*. In all cases the vertical components of the radial vectors will be found to be equal to the heights of the corresponding waves above or below the zero line of fig. 11*a*.

Fig. 11*c* shows the polar diagrams for the same instances as given in figs. 11*a* and 11*b*, but for the case where the neutral point of the system is earthed. These diagrams show that earthing the neutral in no way affects the locus of the voltage vectors of the lines to ground or the line to line, nor does it affect the minimum and maximum values of the former, or the instants at which they attain these values. As the neutral point is earthed, the third harmonic voltages appear at the line ends of the vectors representing the phase voltages, with the result, as shown, that for the cases of unearthed and earthed neutrals the voltage stresses on the system so far as third harmonics alone are concerned remain the same.

Cable Protection.—The *Technical Review* abstracts an article from the *A.E.G. Mitteilungen* by H. Pfannkuch regarding a cable protection system devised by the author.

With the Merz-Price and other protective systems, defective cable lengths are usually cut out without affecting the rest of the networks, but short circuits between phases or from phases to earth are not avoided. The system devised by Herr Pfannkuch is claimed to remedy this defect. It consists in lightly insulating the wires of the outer layer of each cable core from each other and from the inner portion of the conductor by means of a very light paper lapping. The wires of the outer layer are then divided into two groups, and by means of small series transformers at each end one group is slightly raised in voltage, and the other slightly lowered with relation to the central core. The difference is of the order of 20/50 volts. Electrical stress under fault conditions renders the light insulation conductive, and removes this potential difference, releasing a super-imposed current which operates a switch. There is said to be no appreciable difference in cable diameter or cost over the ordinary type.

The method adopted is reminiscent of the means proposed by Mr. L. R. Lee, in an article contributed to the ELECTRICAL REVIEW,[*] a short time ago, to determine the condition of the lead sheath and insulation of a cable. In this case, however, the outer wires were composed of pairs of dissimilar metals lightly insulated from one another and from the cable. The ingress of water, due to faulty sheathing, caused a small current to be set up by the couples, deflecting the needle of a connected galvanometer.

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[*] "Maintenance Insulation Tests on Electric Cables," ELECTRICAL REVIEW, July 30th, 1920, p. 154.

THE APPLICATION OF ELECTRIC LOCOMOTIVES TO MAIN-LINE RAILWAY TRACTION.

By LIEUT.-COL. H. E. O'BRIEN, D.S.O., A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

At the present time there are about 1,200 electric locomotives in service on the railways of the world. Three-phase and single-phase motors did not lend themselves to compact designs, particularly if speed variation was to be obtained economically, and, therefore, improved design of d.c. motors led to a tendency to revert to the use of the geared d.c. motor, which has now become simpler to construct, more efficient, flexible, compact, and cheaper to maintain than the other types; *e.g.*, commutators as now designed give practically no trouble, and brushes and contactors can run for long periods without attention. To illustrate the reliability of motors and equipment designed even so long as 16 years ago, an extension of the figures presented to the Institution of Mechanical Engineers by Sir J. A. F. Aspinall in his presidential address in 1909, and the schedule of overhaul periods adopted on the Manchester and Bury line with the most modern designs are given by the author in appendixes. The commutators of the Manchester and Bury motors give indications of having an indefinite life, while on the Liverpool and Southport line 90 per cent. of the original commutators are still running. Desire for simplicity in the construction of the locomotive, a much extended knowledge of the design and manufacture of gears (the average life of the gears on the Liverpool and Southport line has been 300,000 miles, and of the pinions 200,000 miles), and the necessity for preserving space in the superstructure for control gear, has also inclined designers in this direction. The original commitments have influenced the practice in different countries; generally the a.c. motor driven by a rod linkage is the more favoured on the Continent, while the Anglo-Saxon opinion tends towards the geared d.c. motor.

Design.—Electric locomotives fall into two main divisions: Freight, the maximum speed of which need not exceed 45 m.p.h.; and passenger, which must be capable of a maximum speed of 70 m.p.h. The characteristic torque of an electric, as compared with a steam locomotive, is such as to enable the draw-bar pull of the electric locomotive to be maintained at lower speeds in a way that is not possible with a steam locomotive. This characteristic makes the high acceleration of the suburban electric passenger train practicable. On a heavily graded line an electrically hauled train will maintain higher speeds on the up grade, and will be equally fast, if required, down grade; hence, for fast schedules on lines with gradients, the electric locomotive need not be capable of as high a maximum speed as the steam locomotive, and the electric locomotive on a line containing grades enables a 20 to 30 per cent. faster schedule to be maintained. The increase in schedule is also partly due to the possibility of the regenerative braking, and to a small extent due to the more rapid acceleration of the train from rest. In the Zossen experiments a speed of 120 m.p.h. was obtained with a coach carried on two six-wheel bogies; on the Liverpool and Southport line and the Manchester and Bury line 60 m.p.h. is attained with perfect steadiness, in the former case on a road bed with a sand foundation. When the bogies are placed together and carry a heavy superstructure the natural period of the whole vehicle is increased and oscillation tends to occur at high speeds; it has, therefore, become general practice to provide high-speed electric locomotives, whether the driving wheels are carried in a fixed frame or in bogies, with carrying axles fore and aft, either of the pony, radial, or bogie type, whereas practice again has shown that for goods locomotives no carrying axles are necessary. Excessive wear on curves due to the low centre of gravity of the motor bogies of suburban electric coaches, has led to a desire to raise the centre of gravity of the bogie, and incidentally of the whole locomotive. The height of the centre of gravity of a motor bogie coach is 43 in., whereas that of a steam locomotive of comparable power is 58 in. As long as the geared design of motor is adhered to, the only possible method of increasing the height of the centre of gravity is to rotate the motor into a vertical position. In the case of a 250-h.p. motor on a 42-in. wheel, this involves carrying a dead weight of approximately 4 tons on the axle, instead of 2 tons, as in the case of nose suspension; a compromise is to tilt the motor at 45 deg. By the use of a quill the motor weight can be entirely spring borne, but at the expense of complication of moving and, therefore, depreciating parts.

This design is comparatively untried, and little is known about its maintenance costs. In any case the room required in the superstructure for accessories precludes any greater raising of the centre of gravity than is given by tilting the motors to 45 deg.; a 25 per cent. increase in the height of the centre of gravity of wheel axle and motor resulting in only a 13 per cent. increase in the dead weight on the axle. The motor weight is approximately 25 per cent. of the total locomotive weight As the electric locomotive will in general be designed with a 58-in. wheel to obtain better adhesion, form of tooth in the gearing, and lower journal speeds, this in itself raises the centre of gravity of the motors by 8 in., as compared with the usual motor bogie design for suburban services in which a 42-in. wheel is the maximum diameter used. If the motors are carried on bogies, the bogie tends to behave as a separate vehicle so far as lateral movements induced by a low centre of gravity are concerned. The raising of the centre of gravity is, therefore, more important in the bogie type of locomotive than where motor axles are carried in frames to which the superstructure is rigidly attached. The use of bogies carrying motors, so far as high-speed electric locomotives are concerned, appears to involve an undesirable complexity for any 4-motor unit, as the rigid wheel base in such a case will not exceed that of a 0—8—0 steam locomotive, while a larger degree of side play in the boxes will be permissible than is the case with the steam locomotive with coupling rods. Where it is desirable to use 6-motor units, an articulated 2—6 + 6—2 design will be cheaper to build and give better results in running than a similar design with a loose superstructure carried on bogies.

The maximum steam locomotive draw-bar pull occurs at starting, and falls off continuously with increase in speed, whereas the maximum draw-bar pull can be maintained in the electric locomotive up to from one-third to a half of its maximum speed. Higher speeds on up grades can, therefore, be maintained without increase in the maximum draw-bar stresses imposed on the train couplings, and as the maximum draw-bar h.p. of typical powerful British steam locomotives does not exceed 900 h.p., it may be assumed that for many years to come no electric locomotive exceeding 1,500 draw-bar continuous h.p. will be required on English railways. No motor exceeding 250 h.p. is likely to be required for British railways, as a combination of six such motors will give 1,200, or two four-motor equipments in multiple unit will give 1,600 draw-bar h.p.

A 4/1 gear ratio is sufficient to give as high a tractive effort as can be utilised with a 58-in. wheel on a locomotive on English railways with a 250-h.p. motor unit. Such a motor with a rated h.p. speed of 600 r.p.m. and a maximum speed of 1,200 r.p.m. would give a maximum speed of 45 m.p.h. with a 4/1 gear, and 90 m.p.h. with a 2/1 gear.

The usual gear construction, with the gear pressed and keyed on to the axle, gives rise to torsional stresses which invariably produce fracture near the wheel seat. The axles of the L. & Y. motor cars equipped with 150-h.p. motors run an average of 170,000 miles before signs of incipient fracture occur. The failures of axles could probably be completely eliminated by keeping the gear wheel clear of the axle and transmitting the drive directly to twin gears bolted and pressed directly on to the wheel centres.

The value of utilising the full number of motor combinations in 4- or 6-motor equipments has not been proved in suburban traction owing to the greater weight and complication involved and the short period of acceleration, but for locomotive work the acceleration periods are bound to be much longer, and much greater speed variations are required; hence for main-line work the full number of combinations will be found essential, and the cost and complexity due to the number of contactors will have to be overcome either by standardisation and quantity manufacture or by reversion to the type of control employed on the Liverpool and Southport line. The direct control system has but two disadvantages, its inadaptability to double heading with a single engine crew, and the rather heavier manual work thrown on the driver. It has been shown that a single electric locomotive within the standard loading gauge can handle heavier and faster trains than any steam locomotive that can be designed for British conditions, and that such a locomotive will not exceed 1,500 rated h.p.

Operation.—The advantages of the electric locomotive from an engineering point of view may be briefly enumerated:—

1. Mechanical efficiency is constant for any given tractive effort throughout the life of the locomotive, while that of the steam locomotive diminishes, particularly as regards the boiler, in progressively increasing ratio to the time it has been out of the shops.

2. No coal and no water has to be carried; as the weight of coal, water, tanks, and tender represents 20 tons per locomotive on the average, the electric locomotive on this score alone has increased hauling power of two loaded 5-ton wagons, or one bogie coach per train.

3. The mechanical efficiency is probably higher than that of the steam locomotive, even at full loads. Hobart shows that the efficiency of collector shoe to draw-bar for medium speeds is in the neighbourhood of 80 per cent. Actual dynamometer car tests show a mechanical efficiency of the steam locomotive of 72 per cent. at 40 m.p.h. for a 2—6—0 type. with a 5 ft. 8 in. wheel, and 82 per cent. for a 2—8—0 type at 20 m.p.h. with a 4 ft. 6 in. wheel. Owing to the efficiency characteristic of the series traction motor, trains can be run more efficiently than with a steam locomotive, for the efficiency remains practically constant from full to half load, which is not the case with a reciprocating engine and boiler;

hence the electric locomotive can, without loss of efficiency, handle a wider range of loads than the steam locomotive.

4. The tractive effort is more even, the gain in adhesion being of the order of 20 per cent. With a steam locomotive the slipping that occurs may often take place for a portion of a revolution only, and slipping that starts with a full regulator opening, results in a momentarily reduced coefficient of friction between rail and wheel and continues until the regulator is closed. With the series motor, on the other hand, the back e.m.f. rises, due to the increased speed, and the current and torque are automatically reduced.

5. The repairs are smaller. An electric locomotive may be expected to run 100,000 miles without failure or renewals of anything except brushes. The average life of the principal parts of the Liverpool and Southport motor cars is given below; the average for locomotives on main-line working, which is much less severe as regards the electrical equipment than a suburban service, might be expected to be double these:—

	Miles.
Armature life between rewinds	131,250
Gear life between renewals	250,000
Armature bearing life	73,000
Average life of a steam locomotive boiler to complete renewal	212,000

It should be borne in mind that the design of standard electric locomotives for main-line work in this country can be commenced on the basis of a wealth of experience gained in the much severer service of high-speed electric traction. It is stated by McHenry that the actual coal economy effected by electrification on the New York, New Haven, and Hartford Railroad was: Passenger services 50, freight services 60, and shunting services 66 per cent., while the cost of repairs per engine-mile was expected to be less than half. The substitution of the electric for the steam locomotive would effect an economy of not less than 33 per cent. in repairs, and 50 per cent. in coal consumption. It should be further taken into account that the repairs to electric locomotives do not in general demand any complete dismantling of the locomotive; the repairs are confined to the periodic removal of the wheels for turning, and the motor armatures for rewinding at much longer intervals.

(6) No washing out of boiler or removal of ashes, (7) less cleaning, and (8) less lubricant required, 0.01975 pint per mile, Liverpool and Southport and Manchester and Bury cars approximately 800 h.p. rated motor capacity; 0.0726 pint per mile, average of Lancashire and Yorkshire locomotives, (9) no detentions due to lack of steam, (10) less failures, causing interruption of traffic, (11) more rapid shunting, (12) regenerative braking possible, (13) no turn-tables required, (14) cheap and efficient supply of electricity for lighting, cranes, &c., (15) roads now used by engines going to and from shed to turn, for water or for coal, would be available for traffic purposes, (16) more than half the wagons now used for locomotive coal would be freed for other traffic, equal to 2.4 per cent. of the whole wagon stock, (17) owing to the more continuous use made of the locomotives, and the consequent smaller number, at least 33 per cent. of the locomotive sheds and shed yards could be devoted to other purposes, (18) the electric locomotive within the standard minimum load gauge of the British Isles can be made 50 per cent. more powerful than any existing steam locomotive. Any necessity for strengthening bridges to meet the needs of more powerful locomotives could be obviated by a general electrification. One of the serious problems in connection with increasing the load gauge in the British Isles to the Continental load gauge would be the consequent necessity for strengthening the bridges and viaducts to meet the more powerful steam locomotives which would have to be used, (19) double heading with a single train crew is possible, (20) automatic increase of torque with reduction in speed enables tonnage loading to be maintained over variable grades without reduction in schedule.

The disadvantages are: (1) Liability of hold-up of all trains due to failure of power supply, (2) difficulty in heating existing carriage stock, (3) in controlling acceleration in shunting operations, (4) arising from presence of a trolley wire or third rail and the collection therefrom, (5) in arranging locomotive and stock workings to give the locomotives the continuous use of which they are capable, (6) assumed higher cost per ton of electric locomotive as compared with a steam locomotive of same maximum horse-power.

Difficulty (3) can be overcome by the use of all four or all six motors in series and the use of liberally proportioned resistances and by field control; the a.c. motor has an advantage in this respect in a greater number of running speeds being available. Regarding (4), the trolley is inflexible with regard to extensions, and difficult to install or repair without interruption to traffic, and is a serious obstruction to the breakdown crane. The third rail is an obstruction on the track and, therefore, objectionable inherently; it is rather a serious obstruction to the ordinary maintenance of the track and intolerable in sidings where much shunting is done. The probability is that in main-line electrification the third rail will be used where track complications are not great and where little shunting is done; the trolley elsewhere. In Great Britain there exist two types and three positions of the third rail, three d.c. and one alternating voltage, but the most suitable voltage of supply remains undecided. The author does not consider that the existence of the comparatively few suburban electrifications at 600 or 1,200 volts should militate against the adoption of a standard of 1,500 volts. The use of 1,500 volts is desirable solely for the sake of future main-line electrification work for the economy arising from concentrating the sub-station machinery in fewer sub-stations. It is practicable to operate locomotives at two voltages, but the facility is dearly bought as regards first cost and maintenance. The suburban electrifications that exist at 600 volts are almost self-contained, and on the short mileages where main-line stock utilises suburban tracks, duplication of the collecting system by putting the higher voltage overhead is preferable to saddling the main-line system with other motors permanently in series and additional contactors. In some few cases half-speed operation of the main-line locomotives would meet all requirements.

The cost of electric locomotives is high, but this is due more to the experimental nature of the designs and the small number built to any particular design rather than to any inherent feature of the electric locomotive. The frames, wheels, brake rigging, draw gear, and superstructure of an electric locomotive should cost no more than in the case of a steam locomotive. These items represent approximately 60 per cent. of the total weight. The cost of an electric locomotive built in large quantities and to standardised designs should not exceed that of a steam locomotive capable of doing the same work.

Financial Aspect.—Deductions favourable to electrification have been drawn from general figures applying to the whole of the railways of Great Britain or the United Kingdom, but even as indicating tendencies only, such figures must be taken with caution. There is a certain density of traffic below which an economy will not be obtained sufficient to pay an adequate rate of interest on the capital expenditure in electrifying, or to provide a sinking and renewal fund. Even on the L. & Y. Railway there are many route miles on which the traffic would not warrant electrification. A rough estimate of the cost of electrifying the whole of this railway on which traffic is so dense indicates that probably the return would be less than 3 per cent. The salient points are the very large proportions of the total capital expenditure debited to the transmission (11.2 per cent.), track (40 per cent.), and locomotives (25 per cent.), and the very clear indication given of the substantially greater return on capital expenditure which would be obtained by retaining steam operation for those services on which the expenditure per mile for fuel and repairs was low.

It is evident that if electrification is to be regarded from the point of view of economy in operation denser traffic areas must be sought than are offered by the whole Lancashire and Yorkshire system, dense as is its traffic compared with the average for England and Wales. On the other side of the scale are the improved facilities offered for the movement of traffic and the possibilities of increased revenue. Given sound engineering design the ratio: Cost of power-producing plant/cost of track equipment and locomotives will give a general indication of the probable commercial success of an electrification scheme. For a typical suburban electrification this ratio is approximately 1; in the case under consideration it is approximately 0.25.

It is evident that, in the case under consideration, if the track to be electrified could be reduced by one-half, while the number of locomotives required is only reduced by one-third, then the total capital expenditure would be reduced to one-half, while the economies effected might only be reduced by one-fifth. Immediate electrifications will be limited to densely trafficked sections of the main line when a maximum continuous use can be obtained from both locomotives and track equipment, and where the expenditure on these items is such that the expenditure ratio is 0.5 or more.

Conclusion.—The continuous use of both the locomotives and track is the key to the whole problem of main-line electrification in its financial aspect, and this is rather a railway than an electrical or mechanical engineering problem. It is for the engineer to design an electric locomotive sufficiently flexible to work efficiently either goods or passenger trains; those responsible for traffic operation have the equally difficult task of arranging the workings for the train services, which must suit the public convenience, in such a way as to secure the continuous use of the tractors, which is made practicable by electric traction; not the least difficult point to be dealt with in investigating this is the arrangement of the change-over from electric to steam haulage at the terminals of the electrification. It is also for the traffic department to determine whether greater loads hauled and the higher average speeds and more rapid clearing of the block sections will enable their work to be done so much more efficiently and economically as to compensate for the increased costs of locomotive operation consequent on such increased loading and acceleration.

The author has endeavoured in a broad way to draw the conclusion, confirmed by what has been done on the Chicago, Milwaukee and St. Paul and on the Italian and Swiss railways, that sufficient data and experience exist to enable the engineer to design electric locomotives of the type required, and to predetermine with accuracy the capital expenditure and operating costs, but that the determination of the most suitable sections to electrify is essentially a traffic problem. He ventures to join in the plea for the immediate appointment of committees to deal with the standardisation of third-rail position and voltage, motors, gearing, contactors, and locomotives.

Discussion at Bristol.

The paper was discussed at a meeting of the Western Centre of the Institution of Electrical Engineers at Bristol on February 7th.

The Chairman (Mr. A. J. Newman), speaking with regard to the financial aspect, thought it would be a very long time before they would see main line electrification if 3 per cent. only were offered on the capital invested.

Prof. F. Bacon inquired why a low centre of gravity led to severe wear on curves. Was there not a possibility of substantial saving in rail wear on straight portions of the track, due to the reduced slip and improved adhesion resulting from the uniform character of the driving torque and the absence of only partially balanced reciprocating masses?

Mr. W. Nairn said the author, when dealing with regenerative braking, mentioned the special case of the Chicago, Milwaukee & St. Paul Railway. That line, however, was a very special case, as on one of the electrified portions the train started on the top of the Rocky Mountains and ran downhill for over 200 miles towards the Pacific. One could understand regenerative braking being a success in such a case, but he did not think the extra expense and complication would be justified in this country. The extra equipment on the St. Paul locomotives was a serious item; when regenerating, the motor fields were excited from separate d.c. generators driven from the locomotive axle, two of which generators of 50 kW capacity each were installed on each locomotive. The fields of those exciters were further separately excited from either a battery or a motor generator and were controlled by a motor-driven rheostat. He felt that such complications would not be justified in this country. With regard to axle failures, he agreed that the proper fixing of the gear wheel would appear to be to bolt it direct to the road wheel, and he would further suggest the fixing of gears to both road wheels and the replacement of the 250-h.p. motor with two 125-h.p. motors connected permanently in series, one armature being geared to each road wheel. That arrangement would only give 750 volts across each armature instead of 1,500 volts, and he understood the 750-volt motor was not so liable to flash over as the 1,500-volt one.

Mr. I. A. D. Pedler asked the author how he accounted for the 70 per cent. load factor.

Mr. A. Willis thought it might be of interest to say that last year he attended a demonstration of "Shunting" by the somewhat unsatisfactory and perhaps inefficient battery locomotive. He was assured by the engineer that the saving was more than 50 per cent., as it was possible to arrange the trains and place them on a special piece of track set out for the purpose, so that the main-line engine did not enter the actual goods siding, and he suggested that that might be a solution to the difficulty in connection with the third rail, or overhead network, on sidings. It was difficult to see why breakdowns should be expected more in sidings than on the main line, but where overhead wires were being used there was an unfortunate tendency to replace the soft aluminium collecting strip by materials of a much harder nature, such as copper or even steel. That must lead to excessive wear on the trolley wire and eventual breakages of the overhead line. With reference to the author's comments in connection with pantograph current collectors, in most systems pantographs were controlled by compressed air; the pantograph was normally down, and was raised by the driver letting the air flow from the air chamber to the pantograph cylinder. Surely it would not be difficult for him to carry out that operation when he saw a tunnel or obstruction ahead? As regarded the third rail, what was the possibility of trouble occurring in connection with the motors due to the constant making and breaking of the current as it would appear in such a country as this, where large towns were very close together, and the mass of crossings, points, junctions, &c., would necessitate the constant breaking up of the third rail into sections?

Mr. T. Hood said the advantages of a.c. for long-distance transmission had been on the Continent the factor which determined its use for railway electrification, and motors of the single-phase type, designed by Winter and Eichberg, appeared to have been satisfactory. It was true that when the electrification of the underground railways was projected the controversial advantages of a.c. and d.c. formed the subject of an inquiry, and finally the d.c. system advocated by the Americans was adopted.

Mr. H. I. Rogers, as a manufacturer of trolley standards, more particularly for tramways, was naturally in favour of overhead transmission rather than the third rail, but there were, probably, advantages in both. The automatic raising and lowering of the pantograph bow at certain points might be got over. In tramway work various devices had been manufactured for raising and lowering the arm in the case of de-wiring, but the speed and weight of trains made the problem more difficult on railways. As regarded shunting, the author thought there would be no reduction in the number of electric locomotives as compared with the number of steam locomotives. The speaker had always thought it was one of the great advantages of electric over steam traction that shunting would be very much simplified, and the much greater mileage of the electric locomotive before it was necessary to overhaul it must surely in itself mean a saving in the number of locomotives involved in shunting.

Mr. C. F. Waddington explained that one reason why d.c. had been adopted was that batteries could be used for levelling up the loads on the peaks.

Mr. W. A. Chamen considered geared motors hopeless for heavy continuous loads. The financial aspect of the whole thing came as a bit of a shock to him.

Mr. A. C. Macwhirter pointed out that the author advocated 1,500 volts, but in America 3,000 volts was adopted. He considered standardisation was the one thing which ought to be forced right home in railway equipment.

Mr. S. P. Haslam congratulated the author on the very fair manner in which he summed up the disadvantages and advantages of main-line electrification. Some of the disadvantages appeared almost insuperable. He thought the author had underestimated the mileage run by steam locomotives between repairs, and he considered 100,000 miles a fair figure.

Discussion at Liverpool.

The paper was first read and discussed at the Preston Sub-Centre on January 5th, 1920, and at the Liverpool Sub-Centre of the North-Western Centre on March 15th, 1920, but was not then available for publication.

Prof. E. W. Marchant, chairman of the Sub-Centre, presided, and said Col. O'Brien had referred to the fact that, with electric trains, it would be possible to carry heavier loads than with steam traction, because of the more even distribution of the weight of the locomotive, but the speaker had understood from Mr. Roger T. Smith's presidential address that the largest expenditure in connection with electrification was involved in the alteration of the "structure gauge." Mr. Roger Smith made out a strong case, on commercial grounds, for the electrification of railways for goods traffic, and the speaker thought that electrification for passenger traffic was likely to come about through the greater comfort of the passengers travelling in electrically-driven trains.

Mr. J. Shaw quoted a number of figures from his own experience on the Mersey Railway of an average of three years' working under steam and three under electricity on the same line of railway. The consumption per ton-mile during steam working was 0.453 lb. of coal costing 16s. per ton, and during electrical working 0.436 lb. of slack at 8s. 9d. per ton, which showed a saving of practically the 50 per cent. quoted in the paper. The position of the motors and the horse-power to be adopted were closely allied to the problem of design and strength of the axles. Col. O'Brien stated that on the Southport line the motor cars equipped with 150-h.p. motors ran an average mileage of 170,000 miles before incipient signs of fracture occurred. On the Mersey Railway they had recently had the first broken axle since electrical working commenced 17 years ago. The majority of their axles were of American manufacture, and the one which broke was one of the few English axles which they had in service; it was a motor-car axle, and had run 650,000 miles, and the fracture occurred between the running and the gear wheel. The suggestion of making the gear wheel part of the running wheel would appear to be worthy of serious consideration when dealing with motors of large power, but it would probably resolve itself into a question of whether it was cheaper to spend money on running wheel replacements or axle replacements. In the paper a comparison was made of the costs of steam and electric locomotives, the figures being respectively £900 and £1,500, but the speaker did not agree that that was a fair comparison. A steam locomotive when put into service had all the power to drive it, whereas an electric locomotive required a power house and a proportion of the cost of the power house plant and distributing system must be added to get a fair comparison of the relative values. The figures given with regard to the life of the parts showed that under electric traction the parts as they were designed 16 to 20 years ago had stood remarkably well considering there was very little experience at that time. On the Southport line they had 90 per cent. of their commutators in use, and on the Mersey line there had only been one replacement in 19 years. Their armatures were running about 131,000 miles between rewinds and those on the Mersey line about 380,000 miles.

Mr. F. J. Teago explained that Col. O'Brien's statement about the maximum locomotive draw-bar pull was as it stood questionable, because the maximum steam locomotive draw-bar pull depended upon the throttle opening and the point of cut-off, both of which were controlled by the driver. To avoid skidding it was unlikely that the driver would start "all-out" and, therefore, it would be possible for him to increase his draw-bar pull for some time after starting. Col. O'Brien's curves showed that the steam locomotive sustained its draw-bar pull at high speeds better than the electric locomotive did. That was probably due to the low centre of gravity of electric locomotives in general, which tended to make the vibration high, and caused a loss of adhesion; that, however, was a point of mechanical design which was being remedied. Undoubtedly electric traction would, even in this country, supersede steam traction, and Col. O'Brien had stated the reason clearly.

Mr. S. E. Povey was of the opinion that the electrification of main-line railways required early investigation. It would undoubtedly come from the necessity for the conservation of coal, and because electrification was cheaper than the present railway working; the elimination of smoke in the vicinity of locomotive sheds and large sorting sidings was a feature. The spring-quill drive would be necessary for motors of over 250 or 300 h.p., but the use of the quill drive should be avoided if possible, hence he was in agreement with the author that the use of a number of 200 or 250-h.p. motors was preferable to the use of a few large motors. The author had used the one hour rating in giving the h.p. of the locomotive, but on continuous goods and express-passenger services the continuous rating of the motors would have to be taken into account. The conditions when working express-passenger or goods trains was much less severe than a suburban high-speed passenger train service. The experience already obtained of the maintenance of suburban electric railways showed that an electric locomotive could be designed to run continuously in traffic for a week without any maintenance being required or the necessity for it being taken into the shed. He agreed with the author that the problem was now one for the traffic departments to arrange passenger and goods services to provide for continuous working of electric locomotives.

Mr. J. Hamilton thought that the paper pointed to the need for further progress both in generation and application before they could claim that electricity should be the sole motive power for railways. Taking the author's figures, nine electric locomotives would do the work of twelve steam ones, and assuming 15 units at the power station per engine mile, had the railways of England and Wales been run electrically in 1913 it would have meant an annual output of approximately 6,000,000,000 units, with an average haul load on the power station supplying them of the order of 750,000 kW.

Mr. Lang hoped that before very long they would have electric traction all over the country. It was perfectly obvious that in spite of the difficulties of being able to show the prospect of a financial success, the result always had been a financial success. In putting forward a scheme of that kind, electrical engineers were much too diffident in making claims for success.

Mr. L. C. F. Bellamy pointed out that they had heard a lot about geared motors, and he regretted that time had not permitted the author going more deeply into the merits of the gearless motor, on the same principle as some locomotives that had been operated with remarkably good results for the past ten years on the New York terminal of the New York Central Railroad. If, by the adoption of the gearless motor they could eliminate gears, pinions, jack-shafts, and side-rods, together with both armature and suspension bearings, they ought to be prepared to make some sacrifice in the direction of extra weight of motor which would be necessary by reason of the comparatively low speed of the armature. The speaker also compared some of the author's conclusions with those of Messrs. Merz and McLellan, given in their report on the electrification of the South African railways. The author recommended (1) the third rail (with certain exceptions) as a conductor, whilst Merz and McLellan preferred overhead equipment; (2) a line voltage of 1,500, whilst Merz and McLellan regarded 3,000 as the ideal; (3) raising the centre of gravity of the locomotive, whilst Merz and McLellan emphasised the fact that it should be kept low.

Mr. J. W. Astley said that it was highly probable that the electrification of main lines would be on the third rail system with d.c. at 1,500 volts, whilst sidings, junctions, and probably large stations on main lines, would be equipped on the overhead system. That would necessitate electric locomotives, &c., carrying both third-rail contact shoes and pantographs, but the change over from shoe to pantograph current collection, to maintain continuity of current, presented no practical difficulties. With regard to double gears on the main axles which were now being tried to prolong the life of the axle, the speaker failed to see that very much benefit could be derived from that arrangement. Presuming that axle fractures were due mainly to crystallisation consequent upon vibration being superimposed upon the torsional stresses, then the clearance and ultimate "backlash" in the gears was sufficient to allow the torsional stresses to be effective, and as the vibrations were always there, the life of the axle must approximately remain the same.

Major C. I. Morris said that the problem of gears and broken shafts appeared to occupy a large place in the discussion, but no speaker mentioned the possible use of paper pinions, or Citroen gears. Had they been tried? Those types of pinions had been used with some success on rolling mill induction motor drives, and the speaker imagined that the case in point was somewhat analogous.

Mr. Rettie discussed electrification in general, more especially from the local point of view, and also gave some interesting facts relating to general features in the mechanical and electrical equipment of main and suburban lines. The following gentlemen also took part in the discussion: Major Carr, and Messrs. Holltum and Bolton.

Lieut.-Col. H. E. O'Brien, in replying, explained that experience on the Lancashire and Yorkshire Railway ranged from 600 to 1,500 volts; the principal advantage in operating at the higher voltage was due to the reduced arcing, both in the contactors and the commutators, owing to the smaller currents dealt with. There was a slightly greater tendency to flash over; generally it was improbable that the higher voltages would involve either higher or lower maintenance costs. Dealing with the oscillation of the locomotive, a long vehicle with a bogey at each end ran, he said, quite steadily, but if the bogies were put close together and the weight of the superstructure increased, a tendency to oscillate occurred, and the bogie wheel base must be increased. As regarded twin gears, the North-Eastern Co. used them, and after running 100,000 miles they were in excellent condition. How they would affect the life of the axle would not be determinable till the mileage approached 300,000. They did not use any special steel for the axles on the Lancashire and Yorkshire system. Many of those axles had run a much longer mileage than that given as the average, but no doubt the axles were somewhat on the small side. The conditions of the South African railways were different from those in this country; in that case the length to be electrified would be several hundred miles, with traffic of comparatively small density. The less the density of the traffic and the longer the distance, the higher would be the most economical voltage, but there was no advantage in a high voltage with the density of traffic existing round London or Liverpool; higher voltages for suburban services were only required with a view to ultimate main-line electrification. Mr. Povey had been serving on a committee investigating the rating of motors; the one-hour rating was an unsatisfactory basis in many ways, but at the moment it was their only standard of comparison. The electric locomotive maintained its draw-bar pull constant up to a predetermined point, dependent on the gear ratio and the train resistance, in a way a steam locomotive could not. However, the actual horse-power of the electric locomotive fell continuously after a certain point, whereas the horse-power of the steam locomotive first increased and then decreased again. High acceleration did not produce much effect upon runs that exceeded 4 miles in length, but on a line with dense goods traffic very often the runs between stops were less than 4 miles long. With a modern power station in which superheated steam was supplied to high-speed turbines, the coal consumption with electric traction would be probably 0.25 lb. per ton-mile, whereas even if superheaters were fitted to steam locomotives it would not be less than 0.4 lb. per ton-mile, which confirmed the author's figures showing that the substitution of electric traction for steam locomotives would cut the coal bill approximately in half. The author's point was that so far as the steam locomotive was concerned, no advance was possible without increasing the structure gauge and if the Channel Tunnel was built it would be necessary to enlarge the structure gauge to the Continental gauge. The Channel Tunnel was, however, not built yet and, so far as electric locomotives were concerned, the present structure gauges and bridges would accommodate electric locomotives of the maximum power it was practicable to use in this country.

REVIEWS.

A Handbook of Physics Measurements. By E. S. Ferry. Pp. 484; 273 figs. New York: John Wiley, 1918. London: Chapman & Hall. 2 volumes; price 9s. 6d. net each volume.

What Kohlrausch's Handbuch did for German physics students in the latter years of the nineteenth century, and what Watson's text book of practical physics did in 1908 for the English student, this handbook purports to do for the present-day physics students in the American colleges. In the words of the preface to volume one, "the aim of the present work is to furnish the student of pure or applied science with a self-contained manual of the theory and manipulation of those measurements in physics which bear most directly upon his subsequent work in other departments of study and upon his future professional career." The book, therefore, covers fundamental physical measurements, properties of matter, and optics, in Volume I, and vibratory motion, sound, heat, electricity and magnetism, in Volume II. Each of these sections consists of two parts. The first includes definitions, a description of the apparatus and the general theory of the methods employed; in the second part of the chapter each determination is described with special reference to manipulation of the experiment and computation of the results.

An introductory chapter deals with general notions concerning errors, degree of accuracy, methods of recording results, and the use of graphs. Chapter 2, which occupies nearly 100 pages, treats of the principles of measurement and the properties of matter. The whole range of measuring instruments from the metre-stick to the planimeter are first described, followed by the balance and some notes on density, specific gravity, friction, moment of inertia, elasticity, and viscosity. Then follows a series of 25 experiments designed to illustrate these properties.

The second part of Volume I is devoted to optics, and here the same method of procedure has been adopted. Commencing with light-units, the various methods and standards of photometry are discussed, followed by a brief treatment of lens systems. Considerable space is given to the subject of refractivity and refractometers, all the chief modern forms being described and illustrated. While this full treatment is amply justified by the growing industrial importance of such methods of testing, the absence of specific reference to such industrial uses except in rare cases is somewhat regrettable. Diffraction gratings, spectrometers and spectrophotometers are then dealt with, followed by a very sound treatment of polarisation and saccharimetry. The subject of sugar scales is given a due share of attention, and particular stress is laid upon the effects of fermentation and temperature in relation to the determination of solutions containing more than one form of sugar.

The 25 experiments in optics include practical determinations of illuminating power, candle power, constants of lenses and lens systems, refractivities, wave lengths, colorimetry, and sugar strengths. There are also 16 tables of physical constants appended to Volume I.

Vibratory motion, sound, heat, electricity, and magnetism are treated in Volume II along lines exactly similar to those adopted in Volume I. The author rightly justifies the important place given to acoustical experiments by reference to the utility of such work in the war, and claims that the selection of the experiments in the heat and electrical sections has been made with due regard to the determinations now demanded by science and industry. In heat, the inclusion of flash, fire, and cold tests of an oil, of fuel values by the bomb and gas calorimeters, and determinations of the economy effected by lagging steam pipes is all to the good from the industrial standpoint, while the Barnes constant flow method of determining "J" indicates the author's appreciation of modern methods of performing time-honoured experiments. Quite a feature of the section on heat is the clear treatment of the application of the radiation correction to calorimetric experiments.

Barely half of the second volume is left for the subjects of magnetism and electricity, but there is little to be criticised in the method of treatment. A few of the illustrations—such, for example, as that of the outside of a standard cell—could have been well spared to make room for more useful sectional line diagrams, but this is a minor criticism. The experiments appear to have been well chosen to illustrate the principles of the subject and to provide practice in using the chief electrical instruments. A serious weakness, however, is the meagre treatment of magnetic measurements; there is nothing to justify the limitation of this important subject to two experiments covering only ten pages in a course which includes no less than 10 experiments in sound and 25 in optics.

While, apart from the above, there is little that is open to criticism in the electrical part of the book, yet the impression left upon the reviewer is that the author is certainly less happy in this subject than in the preceding sections, and that he even bears some grudge against it appears to be shown by the entire absence of electrical or magnetic tables at the end of Volume II. While very satisfactory tables of general physical, optical, and heat constants are given, one looks in vain for any tables of magnetic or electric constants.

This failure of the course to hold a true balance among the subjects is the only serious criticism we have to offer. In all other respects these volumes are exceptionally sound, and should form desirable laboratory reference books. Any student who conscientiously works through the course of experiments will have performed a considerable number of tests and determinations having a definite industrial value. Perhaps in a future edition the author may find it worth while to extend the electrical and magnetic side of his course, thus adding to its usefulness. P. H. S. K.

The Mathematical Theory of Electricity and Magnetism. By J. H. Jeans. Pp. vi+627; 178 figs. London: Cambridge University Press. Price 24s. net.

This work, which first appeared in 1908, is too well known to our readers to require any special description at this date. A second edition appeared in 1911 in which was embodied a great deal of the research work which had been made known in the interval, and this is the edition with which most persons are now familiar. The third edition, which was issued shortly after the war broke out, contained the same matter with a few additions, and now, after a somewhat longer interval, the fourth edition has appeared. Our readers, many of whom will be in possession of the work in its earlier form, will be chiefly interested to know what fresh matter is to be found in the book as it is now published, and will, perhaps, not be surprised to learn that what mainly distinguishes this edition from its predecessors is a final chapter on the Theory of Relativity. Indeed, this new theory has made such a profound impression on all branches of science to which it has been applied, that no book dealing with the mathematical aspects of any of them would be complete without an account of the modifications imported, when considerations of relativity are introduced.

We are not here dealing with the general theory of relativity according to Einstein, which explains gravitation as a property of space, but with the special theory of relativity, in Einstein nomenclature, which embraces only co-ordinates moving with uniform velocity. Prior to Einstein's discovery the latter theory was the theory of relativity and the word general prefixed would only have implied that the theory was considered apart from any special application of it. Thus Einstein was taking the validity of the development he contributed rather too much for granted when he appropriated the word general to designate it. In the book under review Einstein's designations are ignored, and his special contribution is referred to as the relativity-theory of gravitation.

Those who have not yet acquainted themselves with the considerations which have to be taken into account when electric phenomena are examined from the point of view relative to the beholder, cannot do better than apply themselves to the last chapter of Prof. Jeans's book. The matter is not simple, and is here treated as briefly as is consistent with lucidity. It is interesting to watch the phases through which faith in an æther goes in the minds of our leading writers on such subjects. As is well known, the theory of relativity requires that if there is an æther there must be as many æthers as there are observers, and each observer must carry his own æther about with him. Now, since each æther is co-extensive with the universe, this is rather a hard doctrine. Mr. Jeans, nevertheless, finds a way of thinking which makes such a state of things less incredible. A number of persons might all see what each one would take to be the same rainbow. In point of fact each one would see a different rainbow—a bow differently placed according to his situation. By careful observation and comparison they might discover that each saw his own rainbow, but this would not show the rainbow to be an illusion, because if the rain stopped there would be no rainbow. And what all see to be, or see not to be, simultaneously, cannot be an illusion. Our author also appears to think that if the theory of relativity is true, and its application to gravitation is not true, the geoid, or surface of mean sea-level on the earth, might be a gravitational equipotential for some one velocity through the æther, but could not remain an equipotential, as the earth's velocity through the æther changed, owing to description of its orbit about the sun. So he deduces that daily and seasonal tidal surges, which are not observed, would occur if the force of gravitation also were not subject to the modifications which considerations of relativity impose. "There seems no longer to be any room for reasonable doubt that gravitational phenomena conform to the relativity condition."

Finally, he places the hypothesis of relativity on the same footing as the two other great dominating principles of physics, namely, the conservation of energy and the second law of thermodynamics. We are inclined to think that the hypothesis of relativity is even more firmly based than that of the conservation of energy, since it reposes on the fact that velocity is relative, and we cannot think otherwise, while conservation of energy has been the slow harvest of experiment. The second law of thermodynamics, on the other hand, is of limited application so far, because it is thought not to apply to living tissue.

We may commend to our readers the fine style with which the whole book down to its smallest detail is wrought.

Electrical Practice in Collieries. By Daniel Burns, M.Inst.M.E., Professor of Mining, the Royal Technical College, Glasgow. Fifth edition. Pp. x+407; figs. 241. London: Charles Griffin & Co., Ltd. Price 10s. 6d. net.

This book, which was first published in 1903, was intended as a text-book for the use of students preparing for certificates of competency as colliery managers, and the fact that it is now in the fifth edition, shows how usefully it has fulfilled its original purpose. It does not, of course, pretend to deal with the latest developments in electrical engineering, or in the details of mechanical construction of electrical plant; but to the mining student who desires a knowledge of electricity and electrical plant as applied to the various purposes of mining work, including winding, haulage, pumping, and coal-cutting, &c., we cannot recommend a better book. Among the features of the book are the fully worked out numerical examples of the various problems and a set of questions and answers at the end of each chapter. Some of these will be found useful not only to the mining student, but to the electrical engineer who may have mining problems connected with haulage, winding and pumping operations to deal with.

The present edition, however, does not differ greatly from previous editions, the illustrations mainly showing old or even now obsolete machines, but, as the author points out in his preface, these are mainly retained to show the development in electrical plant that has taken place in recent years. We question, however, whether this is of benefit to the student, and we think it would be much more to his advantage if the book were brought more up to date. We doubt, for instance, whether any engineer to-day would secure a motor or dynamo with Lewis bolts run in with "sulpher" or even lead, or whether it would be possible to find any incandescent lamps fitted with "loops" in preference to the ordinary bayonet joint holder, and we question whether any motors are to-day in mining work driving machines with either ropes or belts and least of all with "raw hide" belts. Otherwise the book is excellent for its purpose, and we have no hesitation in recommending it to students seeking general information on mining electrical practice, as it deals with every application of electricity from winding machinery to shot-firing.

T. C. F.

An Argentine Wheel Contract.—The Argentine Stat Railway has awarded a contract to Krupps, of Germany, for 10,000 laminated steel car wheels. The price is 40$\frac{3}{16}$ Argentine gold pesos for each wheel, delivered. The German corporation agreed to deliver 200 wheels per week, beginning in August. Seventeen companies competed for the contract, bids being received from the United States, the United Kingdom, and other countries.—*Reuter's Trade Service* (Buenos Aires).

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

6,770. "Direct-current electric motors." Metropolitan-Vickers Electrical Co., Ltd., and R. J Butler. March 1st.

6,807. "Apparatus for remote control of electric motor lamps, &c." L. Kardorff. March 1st.

6,815. "Electric transformer voltage-regulators." B. Thomas and E. Thomas. March 2nd.

6,840 "Electric starters and cut-outs for electric lighting plant employing combustion engines." C. C. Garrard, A. H. Railing and W. Wilson. March 2nd.

6,867. "Overhead aerial control." G. Bennie. March 2nd.

6,868. "Electrical apparatus for distant indication of movements of rotatable shafting, &c." H. Mechan and Mechans, Ltd. March 2nd.

6,876. "Telephone transmitters, microphones, &c." S. Hockly. March 2nd.

6,891. "Lanterns, &c., for electric lamps." D. J. Duncan. March 2nd.

6,896. "Electric device for heating liquids, &c." H. J. Preston. March 2nd.

6,912. "Electrically-heated melting, &c., furnaces." Morgan Crucible Co., Ltd., and C. W. Speirs. March 2nd.

6,917. "Electric switches." W. A. Coates (Westinghouse Electric and Manufacturing Co.) and Metropolitan-Vickers Electrical Co., Ltd. (Westinghouse Electric and Manufacturing Co.). March 2nd.

6,928. "Means for electrically controlling ignition of internal-combustion engines." J. R. Charnock. March 3rd.

6,940. "Combined electric fan and radiator." J. George and W. G. H. Morley. March 3rd.

6,942. "Electric lamps for road vehicles." J. Roberts. March 3rd.

6,976. "Electric lamp locking-ring." A. Everett and W. Goodwin. March 3rd.

6,996. "Electrical transmission systems." A. M. Taylor. March 3rd.

6,998. "Using energy given off from the magnetic poles to supply power for machinery, &c." H. Parkes. March 3rd.

7,006. "Shade for semi-indirect electric-light fittings." S. D. White and F. Winstanley. March 3rd.

7,013. "Cooling dynamo-electric machines." H. A. Carney and H. M. Lacey. March 3rd.

7,019. "Electrically propelled vehicles." J. P. Kemp. March 3rd.

7,021. "Electric lamp holders." Compression Starter and Switchgear Co., Ltd., and R. Lomax. March 3rd.

7,029. "Wireless telegraphy." G. M. Wright. March 3rd.

7,032. "Electric motors." A. Rava. March 3rd.

7,033. "Electrophonic signalling and advertising apparatus." A. Rava. March 3rd.

7,035. "Manufacture of electric cables for conveying energy." L. N. Reddie (Soc. Pirelli & Co.) and Soc. Pirelli & Co. March 3rd.

7,036. "Electric cables for conveying energy." L. N. Reddie (Soc. Pirelli & Co.) and Soc. Pirelli & Co. March 3rd.

7,037. "Electric cables for conveying energy." L. N. Reddie (Soc. Pirelli & Co.) and Soc. Pirelli & Co. March 3rd.

7,052. "Electric fuses." H. J. Fuller. March 4th.

7,072. "Adjustable electrical temperature alarm." H. Demaine. March 4th.

7,109. "High resistance conductors." British Thomson-Houston Co., Ltd., and H. W. Taylor. March 4th.

7,110. "Electric motor control systems." British Thomson-Houston Co., Ltd., and H. C. Hastings. March 4th.

7,119. "Aerial cable conveyors." W. J. Adan and G. Craddock & Co., Ltd. March 4th.

7,124 "Sparking plugs." B. Scherer. March 4th.

7,134 "Device for recording number of telephone calls." H. A Levens. March 4th.

7,143. "Electrixators." I. Szarvasy. March 4th. (Hungary, February 15th, 1918.)

7,174. "Railway signalling apparatus." Automatic Telegraph Manufacturing Co., Ltd. March 5th.

7,200. "Electrolysis of brine." J. J. Collins. March 5th.

7,201. "Protective arrangement for high-voltage insulators for electric precipitating installations." Siemens-Schuckertwerke. March 5th. (Germany, March 9th, 1920.)

7,205. "Distributing brush holder for magnetos." Soc. des Moteurs Salmson (Systeme Canton-Unne). March 5th. (France, March 27th, 1920.)

7,216. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. (Automatic Electric Co.). March 5th.

7,220. "Devices for registering telephone calls." W. H. H. Green. March 5th.

7,226. "Electric light generators for bicycles, &c." X. Bullinger. March 5th.

7,241. "Electric generators" J. M. Torrance and J. W. Torrance. March 7th.

7,276. "Electric blasting caps." A. L. Oliver. March 7th.

7,285. "High-tension electric condensers." P. Bunet. March 7th. (France, May, 18th, 1920.)

7,287. "Sparking plugs." B. B. Weatherill. March 7th.

7,293. "Electric relays." Metropolitan-Vickers Electrical Co., Ltd. March 7th. (United States, May 4th, 1920.)

7,294. "Electric burglar alarms." J. Becker. March 7th.

7,297. "Electro-deposition of metals and resulting products." C. P. Madsen. March 7th.

7,303. "Earthing and bonding clip for electric circuits." C. J. H. Stevens. March 7th.

7,304. "Reversing contactors." A. West and A. West & Co., Ltd. March 7th.

7,307 "Magneto-electric machines." C. F. Dufaux and E. C R. Marks (Dufaux). March 7th.

7,325 "Telephone systems." F. W. Davis and Relay Automatic Telephone Co., Ltd. March 7th.

7,326. "Telephone exchanges." G. H. Bryant, B. B. Johnson and Relay Automatic Telephone Co., Ltd. March 7th.

7,327. "Telephone systems." Relay Automatic Telephone Co., Ltd., and F. M. Ward. March 7th.

7,328. "Telephone exchanges." B. B. Johnson and Relay Automatic Telephone Co., Ltd. March 7th.

7,329 "Telephone exchanges." B. B. Johnson and Relay Automatic Telephone Co., Ltd. March 7th.

7,330. "Telephone systems." B. B. Johnson and Relay Automatic Telephone Co., Ltd. March 7th.

7,331. "Magnetos." L. Arnal. March 7th

7,333. "Wireless telegraphy and telephony." H St. J. de A. Donisthorpe. March 7th.

7,340. "Safety apparatus for electric tramcars, &c." S. H. Trippe. March 8th.

7,343. "Electric lighting from dynamos, magnetos, &c." F. H. Farrer and Villiers Engineering Co., Ltd. March 8th.

7,347. "Miners' electric gas-testing safety lamp." J. Evans and R. C. Hayden. March 8th.

7,351. "Self-regulating dynamo-electric machines." Brolt, Ltd., and W. Holt. March 8th

7,410. "Electric measuring-instruments." F. Holden. March 8th.

7,423. "Counter speaking and telegraphing systems with amplifiers." Deutsche Telephonwerke Ges. and H A Gill (Deutsche Telephonwerke Ges.). March 8th.

7,425. "Process of electrolytically separating chromium." E Liebreich. March 8th. (Germany, March 8th, 1920.)

7,449 "Truck type electric switchboards." H G Bailey and Johnson and Phillips, Ltd. March 8th.

7,529. "Sparking plugs, &c." E. V. Murray and H. H. Murray. March 9th.

7,549. "Apparatus for testing sparking plugs." H. H. Sharpe. March 9th.

7,551. "Telephone exchange systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). March 9th.

7,558. "Ignition for internal combustion engines." British Thomson-Houston Co., Ltd., and A. P. Young. March 9th.

7,559. "Electric power transmission and braking systems." British Thomson-Houston Co., Ltd. (General Electric Co.), and General Electric Co. March 9th.

7,560. "Electrical navigation of ships." Signal Ges. March 9th. (Germany, March 12th, 1920.)

7,561. "Electrical navigation of ships." Signal Ges. March 9th. (Germany, March 12th, 1920.)

7,571. "Loud-speaking telephone." Siemens & Halske Akt.-Ges. March 9th. (Germany, March 9th, 1920.)

7,573. "Sparking plugs." C. S. Thun. March 9th.

7,584. "Means for automatically varying resistance of electric circuit" E. D. Peters and Thames Paper Co., Ltd. March 9th.

7,591. "Electrically-propelled vehicles." J. E. Hamilton and Industrial Appliances, Ltd. March 9th.

7,593. "Electrically-driven ploughs." N. Kousnetzoff and G. J. Steinheil. March 9th.

7,596. "Electrical condensers." H. W. Sullivan. March 9th.

7,606. "Electric lamps." C. H. Clarke and W. E. Weekes & Co. March 10th.

7,677. "Electrical heating devices." J. H. and S. M. Carmean. March 10th. (United States, March 13th, 1920.)

7,678. "Electrical measuring devices for polyphase circuits." Metropolitan-Vickers Electrical Co., Ltd. March 10th. (United States, March 31st, 1920.)

7,684 "Telephone transmission systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). March 10th.

7,692. "Electric signalling along conductors." B. Davies and Eastern Telegraph Co., Ltd. March 10th.

7,698. "Loud-speaking telephones." Siemens & Halske Akt.-Ges. March 10th. (Germany, March 10th, 1920.)

7,699. "System of connection for twin-cored connecting leads in telephone installations." Siemens & Halske Akt.-Ges. March 10th. (Germany, April 15th, 1920.)

7,703. "Commutators for dynamo electric machines." W. B. Sayers. March 10th.

7,712. "Electric arc lamps." G. Gehlhoff and Optische Anstalt C. P. Goerz Akt.-Ges. March 10th..

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

3,583. "Galvanic cells." R. Schuster. March 12th, 1917. (158,911.)

1919.

17,208. "Method for receiving wireless signals." E. H. Armstrong. December 30th, 1918. (137,271.)

19,358. "Sparking plugs." W. A. Jones. August 6th, 1919. (158,919.)

20,219. "Electric couplings." Etablissements Belin. August 16th, 1919 (France, March 8th, 1919). (140,047.)

21,244. "Means for detecting proximity of submarine cables, particularly for guiding ships or for locating faults or breaks in the cable." J. C. Manson. August 29th, 1919. (158,923.)

23,510. "Aerial systems employed in wireless signalling." C. S. Franklin. September 24th, 1919. (158,927.)

24,399. "Electric and mechanical couplings or connectors." G. Suckling. October 6th, 1919. (158,930.)

24,633. "Thermostats." H. H Grundy. October 8th, 1919. (158,931.)

24,715. "Insulating means for electrical apparatus." British Electric Transformer Co., Ltd., and J. Roothaan. October 9th, 1919. (158,932.)

25,085. "Electrical heater." B. Thomas and E. Thomas. October 14th, 1919. (158,938.)

25,509. "Electrical commutators." R. S. Dahl. October 17th, 1919 (Convention date not granted.) (133,973.)

25,609. "Core stampings for dynamo-electric machine armatures." A. W. Tomkins. October 18th, 1919. (158,954.)

27,472. "Electric trackless tramway cars." G. A. Bishop and R. A. Chadwick. November 7th, 1919. (158,962.)

28,031. "Fluid current motors." H. G. Lloyd and C. A. Spon. November 12th, 1919. (158,974)

28,087. "Telephone receivers and ear-pieces therefor." R L. Murray and Telephone Manufacturing Co., Ltd. November 12th, 1919. (158,978)

28,154. "Apparatus for electrical treatment of gases." A. Mond (International Precipitation Co., Inc.). November 13th, 1919. (158,982.)

28,369. "Electro-magnetic relays." Automatic Telephone Manufacturing Co., Ltd., and A. E. Hudd. November 15th, 1919. (158,994.)

28,383. "Holders for electric lamps." T. H. A. Brown. November 15th, 1919. (158,996.)

28,390. "Electrical heating devices." M. S. Parnell-Smith. November 15th, 1919. (158,997.)

28,491. "Aerial systems for wireless signalling." C. S. Franklin, W. J. Picken, and J. G. Robb. November 17th, 1919. (159,003.)

29,400. "Ejector condensing apparatus." A. E. L. Scanes and Metropolitan-Vickers Electrical Co., Ltd. November 25th, 1919. (159,034.)

30,215. "Variable-pressure control for circuits operated from batteries and other multiple unit sources." L. Murphy and Edison Accumulators, Ltd. December 3rd, 1919. (159,055.)

30,479. "Cooling or ventilation of dynamo-electric machines." G. Schroeder. December 5th, 1919. (159,061.)

30,680. "Collectors of electric locomotives." Sir J. A. F Aspinall. December 8th, 1919. (159,063.)

30,941. "Devices for securing electric fittings and the like." G. H. Scholes and E. A. Claremont. December 10th, 1919. (159,070.)

31,651. "Electrical signalling and indicating devices for ships and other vessels." R. S. O'Neil. December 17th, 1919. (159,077.)

32,060. "Telegraph and telephone insulators." Taylor, Tunnicliff & Co., Ltd., and E. D. M. Scrivener. December 22nd, 1919. (159,078)

1920.

1,821. "Electric switches." L. Moser. April 19th, 1919. (142,076.)

1,966. "Electric switches." L. Moser. January 21st, 1920. (Addition to 142,076.) (159,087.)

5,435. "Controlling device for rotary electric switches and the like." Landers, Frary & Clark. November 1st, 1918. (139,475.)

7,867. "Electric light distribution devices, decorative plaster work, and the like." C. G. Smith. March 17th, 1920. (159,100.)

8,081. "Production of electric oscillations." Western Electric Co., Ltd. June 4th, 1917. (140,449)

13,700. "Electro-magnetic switches." Igranic Electric Co., Ltd. (Cutler Hammer Manufacturing Co.). May 18th, 1920. (159,111.)

13,767. "Improvements in electrically-heated articles to avoid damage through overheating." G. H. Lofts. May 19th, 1920. (159,112.)

19,165. "Arrangement for the electrical long-distance control of the valve-gear of a hydraulic gun-pointing gear." F. Krupp Akt.-Ges. November 27th, 1916. (147,126.)

23,899. "Telephone and like circuits." Western Electric Co., Ltd. (Western Electric Co., Inc) November 27th, 1919. (Divided application on 155,698, addition to 155,698) (159,122)

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A UNITED STATES SUPERPOWER SCHEME.

ELSEWHERE in this issue we give an abstract of the progress report of the "Superpower Survey" which is acting under the Geological Survey of the United States in investigating the Boston-Washington industrial region; as we recently explained, the object of this inquiry is to secure "a larger supply of cheaper power"—precisely that which was outlined by our Coal Conservation Committee, from which has sprung the Act of 1919. The data so far obtained, and the proposals of the Survey, present features of great interest.

As in our own case, enormous economies are foreshadowed from the operation of the scheme of centralised generation and interlinking of generating stations throughout the area under consideration, which is comparable in size with Great Britain, and much larger than England and Wales. The electrification of railways in the area to the extent of one-third of the mileage is expected to make an annual saving of six million tons of fuel, and to yield a return of 14 per cent. on the capital cost. At least as much coal would be saved by the increased industrial use of electricity, and nearly as much more of anthracite by electrifying the mines. The existing central stations consume on the average $2\frac{3}{4}$ lb. of coal per kWh; it is estimated that this could be reduced to $1\frac{3}{4}$ lb., effecting a saving of four million tons of coal. The total power requirements in 1930 are expected to amount to 48,000,000,000 kWh a year, of which three-quarters will come from the "superpower system," but even in the United States only a quarter of this can be got from water power, so that economy of coal is a fundamental consideration. The legislative Acts which will be required are outlined in our abstract, from which it will be seen that "new capital is the keystone of the project, but the public demand is its foundation." The idea is to form a superpower company supported by the existing supply authorities in the first instance, and by public subscription for the remainder. Arrangements are contemplated which will ensure that the consumer shall benefit by the increased efficiency resulting from the operation of the scheme, while the company will have freedom of action, and a liberal rate of remuneration, any excess above a specified rate being shared with the customers. State regulation of charges will continue without modification.

It will be seen that the plan goes further than anything that we have contemplated in this country. It does not mention Electricity Commissioners or Joint Electricity Authorities—it goes straight to the root of the problem, places dependence "on the incentive of private initiative to lower costs," and provides for the incorporation of a single company to work this vast area as one undertaking! It confidently fixes a pressure of 250,000 volts for the transmission of energy over distances exceeding 200 miles, and half that pressure within the area. Here, on the other hand, we are cautiously splitting up the country into thirteen or more areas which, in comparison with the Atlantic Seaboard scheme, are mere parishes, and we are hoping to place these areas under the control of as many separate communes, plus the Electricity Commissioners—but, so far, our hopes have not shown much prospect of realisation, for even the first authority has still to be born, and we are beginning to fear that after all the travail it may prove to be still-born. *Are we on the right track?*

Some additional light was thrown on the American proposals by the chairman of the Superpower Survey in an article published by the *Electrical World* on January 1st, 1921. Adopting the form of question and answer, he there stated that the new stations might be of the order of 300,000 kW each; a station which is now being built in New York City is expected to produce the kilowatt-hour for 17,000 B.th.u., and that will be suitable for inclusion in the scheme, but stations of lower efficiency will be used only on peak load, when the efficiency is of less consequence than the capital cost per kilowatt. In brief, the functions of the superpower system are twofold: By forming "a great economic pool of power," to effect (*a*) the reduction of the cost of a kilowatt; (*b*) the reduction of the cost of a kilowatt-hour. This is a concise and telling form in which to cast the problem which we also have before us. The network may consist of a "ring bus" connecting the various centres of generation, and working at 110,000 volts, but it is not expected that one generating station will supply power to another; they will supplement one another, and the sub-stations will form the clearing-house for that purpose. A central control system under the charge of a load dispatcher will be necessary. The Survey has received the most hearty co-operation from the public utilities, railways, and industries in the area.

We make no apology for devoting so much attention to this subject; it is by far the most important matter before the electrical world in this country at the moment, and is likely to remain so for months and years to come. Any guidance that we can obtain from abroad that may help us in arriving at the right solution should be heartily welcome, and we must recognise that the supply of electricity in many respects has been more highly developed in the United States than in this country. The outstanding feature of the question here is the dominating position of the municipal or communistic element, which is practically absent from the American problem. We are not concerned to discuss the ethical or economic aspects of this subject—the question is whether it is possible to carry out the desired development and expansion of electricity supply under that régime; so far as the Electricity District Inquiries have progressed up to the present, the indications are unfavourable, and we must focus our attention most closely upon the matter with a view to directing our course into the path that will lead to a successful result.

The Freedom of the Press.

An interesting question has been raised in our "Correspondence" columns with regard to the discussion of the technical merits or demerits of specific materials or apparatus in those columns; on the one hand, we have been taken to task for permitting such discussions, and on the other, our action has been warmly supported by our readers. We agree with the latter that a very important principle is involved in the question, a principle which lies at the very foundations of the "freedom of the Press" which is so highly prized in British journalism, and our readers may rest assured that we shall not suffer that principle to be infringed in the smallest degree. In this respect we act in the capacity of trustees on behalf of the public; our first consideration at all times must be, as it always has been, the welfare of the nation in general and of the electrical industry in particular, and while we make no claim to infallibility, we must be guided by our own judgment in pursuing that aim.

On some occasions, with that principle before us, we have held it to be our duty to withhold from publication letters which undoubtedly were calculated to inflict serious injury upon British industries. To publish every communication that reached our hands, without discrimination, would be to betray our trust. But criticisms of technical devices, made in good faith, fall in a different category, and discussions of this kind undoubtedly make for good. That this is recognised by manufacturers generally may be inferred from the fact that objection on their part is almost unknown in our long experience.

Needless to say, nothing is farther from our thoughts than to inflict injury upon any individual or firm; on the contrary, if the subject under discussion is meritorious, the fact is sure to be brought out, and if it is defective, the sooner the maker realises the nature of the defects the better for him, as well as for his customers.

Protection for X-ray Workers.

The death of Dr. Ironside Bruce, late radiologist to the Charing Cross Hospital, due to exposure to X-rays culminating in blood exhaustion, has called forth a demand for an expert inquiry concerning the action of the rays upon the human body, from Dr. Robert Knox, president of the Röntgen Society. In a letter to *The Times*, Dr. Knox mentions the formation of a committee consisting of eminent physicists, physiologists, and radiologists, with a wide scope of investigation, which he places under four heads:—

1. The changes induced in tissues by X-rays, and particularly the effect on the blood changes.
2. The properties of the X-rays and the best means of controlling their action.
3. The equipment of X-ray and electrical departments with a special view to the protective measures employed.
4. Recommendations for the guidance of the assistants in those departments, particularly dealing with the hours of work and the need for fresh air and change.

In addition to this inquiry, Dr. Knox advocates the institution of co-ordinated research work. He acknowledges the very valuable services of individual workers, which, however, have barely enabled us to hold our own in the advances made since the discovery of X-rays. What is needed is a fully-equipped institute for the purpose, generously endowed for research in the three divisions of the field—physical, technical, and biological. As an outcome of the work of such an institute, means for protecting human lives from the harmful effects of the rays would be devised. Dr. Robert Knox concludes: "Surely it is our duty to put in action at once the steps necessary to help towards the achievement of this end," and in view of the large number of men who have suffered mutilation and death in their attempts to add to the sum of knowledge of X-rays and their application, we earnestly hope that Dr. Knox's appeal will not remain unheeded.

Electricity Supply in Paris.

A new agreement between the Paris City Council and the Compagnie Parisienne de Distribution d'Electricité has now been approved by the former, and the latter's concession has thereby been prolonged from June 30th, 1940, to the same date in 1944. In future the financial risks of working by the company will be at the charge of the City, although the latter will have the power to fix the supply prices in order to meet the high cost of fuel and labour and of new works. The pre-war tariffs of 50 centimes per kWh for lighting and 30 centimes for power supplied on the low-pressure system will remain the basis tariffs, but they will be periodically revised according to index figures for coal and wages which have been established. The sum of 1,700,000 fr. per annum which the company had to expend on new works will also in future be paid by the City, which will recover the amount from a "works fund" to be created by means of a levy on the company's receipts. At the same time the agreement modifies the share of the City in the receipts and the profits. The levy on the company's income, which ranged from 10 to 25 per cent. of the gross receipts formerly, will amount in future to 25 per cent. of the receipts calculated at the old tariff for lighting, 10 per cent. on the same receipts for power, and 5 per cent. on the receipts appertaining to the index numbers for coal. On the other hand, the City's share in the profits, which formerly increased with the latter up to 40 per cent., will now be at the uniform rate of 40 per cent.

TUBE TROUBLES IN WATER-TUBE BOILERS.

By J. CAUTHERY.

In a perfectly designed and constructed boiler worked under ideal conditions as regards feed water, firing, and supervision, there should be no tube troubles. Such a happy combination of conditions is rarely if ever to be found in practice, but in most cases tube troubles can be materially reduced, if not entirely removed, by attention to the advice given below.

Defects.	Causes.	Remedies.
Local Bulging.—This almost always occurs in the row of tubes nearest the fire, but rarely in the second or other rows. The bulges are usually of small area, from 1 to 15 square inches, and occur on the undersides or front sides of the tubes.	Overheating, due to the following causes either singly or in combination:—	Remove the tubes when bulging reaches ¼ in. down.
	(*a*) and (*b*) *Scale and Deposit.*—Scale and deposit composed largely of carbonates, and magnesia lime salts, are the most likely to cause overheating, because they make a very compact non-conducting medium in the transmission of heat.	Preventive measures:— (*a*) More frequent cleaning of tubes. (*b*) Better softening of feed water.
	(*c*) *Grease.*—It has been proved that grease amounting to as little as one-tenth of 1 per cent. in scale or deposit may send up the temperature of plates and tubes several hundred degrees. Steel rapidly softens after about 550 deg. F.	(*c*) *Grease.*—Prevent access of oil to the boilers in any appreciable quantity by more efficient degreasing, preferably done by combined coagulation and filtration methods. If such a plant is already in use see that there is a proper supply of chemicals, and that the filtering material is suitable and in good condition. Test deposit for grease occasionally; always when any bulging occurs.
	(*d*) Excessive density where the water in the boiler contains material proportions of salts or other matter in suspension.	(*d*) Keep down density by sufficient blowing down. Test density periodically by salinometer or fit boiler with a Porter densimeter gauge, which shows the density all the time. The density should not exceed 2/32nds as shown on the salinometer.
	(*e*) *Steam "Pocketing."*—Where circulation is defective steam pockets may occur in the tubes nearest the fire under severest conditions of firing. This is particularly liable to happen with some types of boilers.	(*e*) Should bulging still occur after eliminating all possible sources of tube trouble as above advised, the choice then lies between reducing the rate of firing or bearing with the tube troubles, or putting down extra boilers.
	(*f*) *Hard Firing.*—When any of the conditions referred to under *a*, *b*, *c*, and *d* exist, hard firing becomes a serious factor in contributing to overheating. Where tubes are clean and free from grease, and the water is not dense, and the circulation is good, a boiler may be very hard fired without the tubes suffering.	
Perforation.—Usually a small puncture at the apex of a bulge when the material has been thinned by repeated stretching until it is too weak to withstand heat and pressure. Sometimes perforation takes place without bulging as, for example, when perforation is solely due to corrosion.	(*a*) Overheating from the causes enumerated under bulging.	(*a*) Perforation requires replacement of tubes. If the perforation is due to bulging take preventive steps already advised.
	(*b*) Corrosion internally due to acid, or excessively alkaline or aerated feed waters.	(*b*) If due to internal corrosion consult best authorities as to prevention by suitable treatment of feed water.
	(*c*) External corrosion due to dampness.	(*c*) If due to external corrosion find out cause of dampness, and prevent it. Sometimes it is due to steam jets or excessive moisture in fuel, or with oil firing to moisture and sulphur in fuel.
Rupture or Explosion.—In these cases the tube is rent open, and a gap formed, sometimes of large dimensions, through which the contents of the boiler rapidly escape. These ruptures are a source of danger to those about the boilers. The Board of Trade expect these occurrences to be reported to them under the "Boiler Explosion Acts."	(*a*) Overheating from causes described under bulging.	(*a*) Prevent overheating.
	(*b*) Partial or complete stoppage of circulation in the tube due to accumulation of deposit. This has been the cause of many tube explosions, and is often overlooked by investigators.	(*b*) At cleaning times see that cleaners are pushed right through tubes to back or bottom ends. In boilers of the upright tube type cleaners sometimes brush scale and deposit down the tubes, and there is danger of blocking the tubes up, especially bent tubes. With header types of boilers deposit may not be pushed out of the tubes at the back ends, and there is the greater chance of this should the back header caps not be removed at the cleaning time.
	(*c*) Failure of weld.	(*c*) Lap welded tubes were used to some extent during the war. The failure of lap welds from defective manufacture rarely occurs, however, apart from some contributory overheating. There is now no necessity to use other than solid drawn tubes.
	(*d*) Faulty tube due to material being of uneven thickness or laminated.	(*d*) This is fortunately of extremely rare occurrence. The only safeguard is careful inspection at the makers' works or before insertion in boilers.
"*Hogging.*" — This defect consists of the arching of the first, and sometimes the second row of tubes over or in front of the fire.	(*a*) Hogging, generally due to repeated slight overheating.	(*a*) Remove causes of overheating where possible, and where "hogging" reaches about half the tube diameter from the straight replace the tube.

Defects.	Causes.	Remedies.
Sagging.—The tubes usually bend downward in the case of diagonal or horizontal tubes, and forward in the case of vertical or nearly vertical tubes. Sometimes they also bend sideways.	(*a—e*) *Sagging.*—Overheating due to the low water, or to firing the boiler without any or insufficient water in it.	(*a*) Frequent testing of water gauges. (*b*) Have a good light on the water gauges. (*c*) Have all water gauge passages opened and cleared at stoppages. (*d*) If any low water alarm is attached, see that it is in order before closing up boiler, and test occasionally when working. (*e*) See that the blow-off valves are closed and tight before starting up.
Blisters.—Swellings on tubes, generally in vicinity of fire, having appearance of bulges.	(*a*) Blisters are due to laminated material, *i.e.*, to it being in layer or layers and not homogeneous. This defect is covered by tho presence of impurities in the body of the steel. Overheating occurs at this point from interrupted transmission of heat and tho layer nearest the fire swells and shows the appearance of a bulge. A blister can generally be differentiated from a bulge by the spring back of the hammer on testing.	*a.* Unless the blister be a thin one, say, not exceeding 1/32 in. full, the tube requires renewal.

A METHOD OF CHARGING FOR IDLE CURRENT.

By C. G. CARROTHERS.

The present increase in the demand for a.c. supply by every description of power user has convinced most power supply companies that if they are to make as good use of their stock as before, it is necessary that means of inducing consumers to take their supply at a high power factor should be devised. It is now a matter of common knowledge that the transmission of power at a low power factor demands unnecessary expenditure in new mains and limits the possibility of connecting further consumers to existing mains. There is also an undue waste of power through carrying needlessly heavy current for a given power, the cost of which varies inversely as the square of the power factor. Beyond these widely appreciated effects of a low power factor, there is now a disadvantage not hitherto encountered. The amount of power which is being linked together on the larger systems demands that stations operating in parallel with each other, or even the different bus bar sections of one large station, should not be coupled directly, but should be coupled up through current-limiting reactances. Stations connected with each other in such a manner are not able to assist each other in supplying the wattless current demanded by the loads on their bus bars unless a different voltage of operation is allowable at each station. The sets coupled to a section which is having power fed into it must, therefore, supply the wattless current for the power which they are generating, and also that corresponding to the power which is being fed in. This condition may make regulation so difficult that it is impossible to run the sets on the assisted sections at their full capacity, unless the power factor of the load on that section is above normal. (This point may be more readily understood by the examination of vector diagrams such as are given in a paper by Messrs. K. M. Faye-Hansen and J. S. Peck, published in Vol. LII, p. 511, of the I.E.E. *Journal.*) The above considerations are sufficient to justify any attempt to secure a high value for the power factor of the load taken by consumers.

The only methods of improving power factor which are at all practicable at present lie with the consumer. He should, therefore, be induced to make use of them by a clause in the rate book, the clause being worded and operated so that the consumer's savings due to an improvement in power factor are immediately apparent to him. The readings necessary should not involve the use of complicated or unusual measuring instruments. Also, they should show the amount to be charged without any cumbrous computation. The rate charged per unit should be equitable, if possible, so that the supply company is recompensed for the expense of supplying wattless current, while the consumer is not unduly penalised.

To fix these rates we must first examine the components which, added together, give the total cost of supplying power. Suppose we say that p pence covers the cost of generating one kWh, and q pence is the cost of transmission of one kVAh, including capital charges and maintenance and a percentage for profit. Then the amount to be charged should be:—

$$(p + q/\cos\phi) \text{ per unit of true power.}$$

Prof. R. Arno has devised a method of modifying ordinary integrating wattmeters so that, with a flat rate per unit indicated, the consumer is charged an amount exactly corresponding to that given by the above law. This method does not seem to be used as much as it deserves to be, possibly because it has not yet had time to become sufficiently widely known. There is also the possibility that consumers might not favour the use of an instrument which for reasons outside their understanding reads at a non-uniform rate.

A more favoured practice at present is to equip the consumer with two of any type of integrating watt-hour meter. One of them is connected in the usual way to register kWh, and the other to register kVA sin ϕ. h.

This is easily arranged in any polyphase system, and demands merely a change-over of connections without the use of any other apparatus beyond that usually required. From the ratio of the readings the average power factor is deduced. The consumer is then subject to a rebate or penalty of, say, d pence per 1,000 units for each 1 per cent. by which his power factor is greater or less than a value laid down in the rate book. That is to say, if x per cent. is the power factor as found from the meters, and C pence is the cost per unit at a power factor of X per cent., then the amount charged per unit $= C - (X - x)d/1{,}000$ pence.

This system has the advantage of being easily understood, and is readily accepted by consumers. It has the disadvantage that there is no longer a flat rate for power, since each customer must have two meter-readings taken, his power factor calculated, and from that a rate per unit deduced. Account-keeping is therefore no longer a simple matter. The word "penalty" may also prove alarming to prospective consumers. A less important shortcoming of this method is that it is based on a straight-line law, so that it cannot be made to correspond with the hyperbolic law:—

$$\text{cost per unit} = p + q/\cos\phi$$

except over a short range of values of power factor.

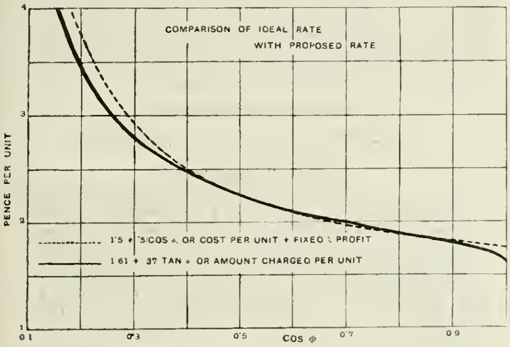
With the instruments at present available, the following gives a method of charging according to power factor which combines the consistency of Prof. Arno's meter with the simplicity of the second scheme. As in the second method, the customer has two standard meters which read: kVA cos ϕ . h and kVA sin ϕ . h respectively.

For each meter a separate account is kept, each at a different rate per unit indicated. If he is charged a pence per unit indicated on the true power meter and b pence per unit shown on the other, then for each unit of true power consumed he will be charged $(a + b \tan \phi)$ pence.

We must choose values for a and b such that

$$(a + b \tan \phi) \text{ approximates to } p + q/\cos \phi$$

for as wide a range of values of $\cos \phi$ as possible. Let the two be exactly equal for $\cos \phi = 0.5$, $\tan \phi = 1.73$, and $\cos \phi = 0.85$, $\tan \phi = 0.62$, a condition which is satisfied by putting: $a = (p + 0.72\ q)$ and $b = (0.74q)$, so that if p be taken as, say, 1.5 pence, and q as, say, 0.5 penny, true power is charged for at 1.61 pence per unit, and wattless kVA at 0.37d. per unit. The accompanying curves show $1.5 + 0.5/\cos\ \phi$ and $1.61 + 0.37 \tan\ \phi$ to give nearly coincident values for all values of $\cos \phi$ which are likely to be met with in practice. (With the points of intersection chosen, the rates would be suitable for loads with power factors ranging from 0.4 to 0.92. If desired the points could be chosen differently.)



An improvement in power factor is shown by a decrease of units indicated on the idle current meter, which is directly proportional to the saving effected. The appeal to the customer is, therefore, both simple and direct. We must also not neglect the fact that the idea of paying at a flat rate for something which has been indicated on a meter is not one which involves any new habits of thought on the part of the non-technical consumer. On the other hand, the introduction of rebates and penalties for something which he does not understand, and for the existence of which he has only the assurance of the supply company, is to ask him to take rather much for granted. This may seem a minor point, but as already pointed out, the question of rate adjustment demands that some attention should be paid to psychology. The fact that there are two flat rates gives simplicity of computation of accounts without any special form of calculation, the only change being that each consumer has two accounts instead of one as hitherto.

American Copper Mines Closing.—The North Butte Copper Co. has ordered a suspension of production, and other companies are expected to follow this example where the properties are unprofitable at present prices of copper. This will result in an estimated monthly reduction of 30 to 40 million pounds in the United States surplus stocks.—*The Times.*

Electrical Goods in South Africa.—The *South African Engineering and Mining Journal* in its issue for February 26th, 1921, says:—Dealers report that business in electrical goods is improving, and that orders are coming in from all parts of the country, East Rand, Kimberley, &c. Electrical materials, with the exception of half-watt lamps, which are still anxiously awaited, are arriving regularly, and nearly all the more important lines are now fairly well stocked. Prices generally are very firm, and show no present indication to fall.

THE UNITED STATES SUPERPOWER SURVEY.

The complete report on the superpower survey of the Atlantic seaboard now being made by the Geological Survey will not be ready before the end of June, but a brief statement showing the progress made so far was made recently by the Secretary of the Interior, Mr. J. B. Payne, to President Wilson, and was published in the *Electrical World* of March 5th. An abstract of it follows.

An organisation was effected under the Geological Survey with Mr. William S. Murray as chairman of the engineering staff, which has been aided by an advisory board of business and professional men. [See Electrical Review, June 18th, 1920, p. 797.]

Having in mind the objects of the Superpower Survey, namely, (1) allocation of the amount of waste in labour, coal and other materials due to the improper form of power generation and distribution within the Boston-Washington zone, and (2) recommendations regarding a regional power system by means of which these wastes may be eliminated, the superpower report naturally divides into three divisions—(1) physical, (2) legal and (3) financial.

With regard to the physical aspect the investigation has been concerned with power necessary to (*a*) railroads, (*b*) industries, (*c*) utilities, and (*d*) a system of centralised electric generation and transmission to supply their power requirements through 1930.

Railroads.—It is found that twenty Class 1 railways are included in the superpower zone; total trackage (including yards and sidings), 36,000 miles. There are 10,000 steam locomotives, of which 44 per cent. are freight, 29 per cent. passenger and 27 per cent. switching. The total annual railroad coal consumption for 1919 was 19,000,000 tons.

Apparently one-third of this mileage can be economically electrified. Owing to lack of traffic density upon the branch lines, these cannot be profitably electrified. The above 33 per cent. of mileage will carry more than 50 per cent. of the traffic, and by preferential arrangement of routes probably 60 per cent. of the total traffic could be put over this mileage. Through the electrification of the above mileage a fuel saving of 6,000,000 tons, or $40,000,000 yearly, would be effected. Added to this saving will be $50,000,000 annually in favour of electric *v.* steam engine repairs and maintenance.

The total unit cost of electrification will be approximately $40,000 per mile of main-line track, which with 12,600 miles to be electrified would cost $500,000,000. In addition, yard and siding trackage would call for $300,000,000, or a total of $800,000,000. This sum will cover the necessary construction and equipment for the railways.

The electrification above outlined will displace approximately 7,000 steam locomotives, which at a salvage value of $22,500 each will credit the electrification estimate with approximately $150,000,000, leaving a net investment of $650,000,000, which taken in connection with aforementioned savings of $90,000,000 per annum would return approximately 14 per cent. on the investment.

Industries.—There are approximately 50,000 industrial plants in the zone which either purchase or generate power. The Bureau of the Census is at present compiling the statistics of the 1919 Census of Manufactures. From the data at hand a saving of between 6,000,000 and 8,000,000 tons of coal is indicated. In the anthracite coal mines of Pennsylvania, by means of electrification and the supply of superpower, a conservative estimate based on actual tests shows a saving of 6,500,000 gross tons of anthracite. The Survey is preparing estimates for completely electrifying the anthracite mines.

Utilities.—A large saving of coal can be effected through the more efficient generation of power by the new superpower stations. It is found that the average rate of consumption for present central-station output is 2¾ lb. per kWh. Power can be produced in the superpower system at an average rate of 1¾ lb. per kWh. The present central-station output of coal-generated power within the zone is 8,000,000,000 kWh. Therefore one pound saved per kWh will conserve 4,000,000 tons of coal annually.

Electric Power Generation and Transmission.—The location of the large superpower stations and their attendant transmission lines is related to the establishment of load centres throughout the superpower zone to which power will be transmitted from them at minimum distance. To date it is indicated that some twenty load centres will be established. By March 1st sufficient data were expected to be at hand to establish these load centres, after which the location of new superpower stations and their interlinking transmission systems could be promptly determined in the zone.

The development of power outside of but for transmission to the zone is being most carefully considered, having relation to the St. Lawrence River, other hydro-electric powers and the bituminous coal mines. It has been agreed among the experts of the country that 250,000 volts will be an acceptable voltage for the transmission of power over distances greater than 200 miles and about half that value for the zone itself.

A conference with the coal authorities indicates that a fair figure to take for the average price of coal during 1919 was $2.90 per ton at the mine, and during the period from that date to 1930, $3.50 per ton.

With regard to water power for the zone, a summation of the possible outputs indicates that for an average year there will be available 12,000,000,000 kWh and for a minimum year 8,360,000,000 kWh, the plant capacity being 2,300,000 kW to furnish this amount of energy. It is of interest at this point to state that in 1930 the total power requirement in the superpower zone indicated by projected growth curves will be 48,000,000,000 kWh, of which amount the superpower system could supply 36,000,000,000 kWh. This, therefore, indicates that the water-power supply can be but from 20 to 25 per cent. of the total. This fact forces the conclusion that most careful consideration must be given to the efficient development of power from coal.

The report will contain a chronology indicating time and location of superpower stations to be constructed in the order of their requirement, giving savings to be effected as their serial installation is made.

Through the unusual co-operation of the public utilities, the railways and the industries the completion of the work will be, after May 1st, substantially a matter of computation and tabulation.

Legislation.—Legislation should take the form of an Act permitting the formation of a corporation authorised to take by eminent domain lands or interests therein necessary or appropriate to the construction, maintenance and operation of lines for the transmission of electric energy. Such legislation may be by a separate Act or by an amendment to the Federal Power Commission law.

As a condition precedent to the formation of such a corporation the proposed incorporators should be required to apply to the Federal Power Commission for a certificate that the project is desirable and is justified in the public interest. This application should be followed by a hearing after due notice to the governors of the States through which condemnation rights are asked. If the certificate is granted, the incorporators should be permitted to form a corporation with the usual powers and in addition thereto (subject to the approval of the utility commission of the State where the power is to be exercised) the right to construct, maintain and operate power plants and transmission lines and the right to purchase electrical energy from and sell it to electrical power producing and distributing companies. All of these rights should be subject to the exercise by each State of its full police and taxing power.

It will be observed that herein no new right is created as against any State, except that of taking by eminent domain the location of a transmission line for the transportation of electrical energy in interstate or foreign commerce. Each State retains unimpaired power to fix rates, to determine the character of structures and to lay and collect taxes to the same extent as such authority is exercised over power producing and distributing corporations of its own creation.

Financial.—The plan of financing which has been suggested is based on the supposition that the superpower system is in its very nature an extension of present power supply systems whereby, combining several large plants with present relatively small plants, economy in generation and conservation of natural resources can be secured over that at present attained. Therefore the vested rights of existing public utility power generating and distributing companies should be protected.

Dependence must be placed on the incentive of private initiative to lower costs and on some form of public regulation of prices to the consumer. The power generated and distributed by the superpower system will finally be distributed to the public by means of existing companies, and the economies to the public utility companies which will result must ultimately be reflected in prices to the consumer through the action of the State regulating bodies.

The financial plan in bare outline provides for a superpower company with non-par stock as its only class of security. The public utilities within the Boston-Washington zone are to be entitled to subscribe for this stock, pro rata, based upon capacity demand and load factor, stock not taken by these customers of the superpower system to be offered to public subscription.

A contract between the superpower company and a local public service company would be a selling contract or a buying contract, while in many cases both buying and selling of electrical energy would be involved. These contracts, on which the State regulatory bodies would pass, would be adjusted from time to time to meet the progress of the art and changing conditions, whether favourable or unfavourable to costs of operation.

Returns upon the stock of the superpower company should be limited by specific provision to a fair division of the benefits derived from its operation between the investing public and the consumers that will make it possible for the superpower company to come into existence and at the same time be able to serve the public adequately. New capital is the keystone of the project, but the public demand is its foundation. This division of benefits would be attained by a rule under which the customer companies would participate equally with the stockholders in any distribution, at stated intervals, of net earnings in excess of a specified rate of return, which itself should be more liberal than is commonly contained in the idea of public regulation. Thus efficiency in management would be rewarded and the public interest directly served. To secure the participation of the ultimate consumer in this division of benefits, provision should be made that the superpower stock held by any public service company be regarded as representing an extension to its existing station capacity rather than an outside investment security.

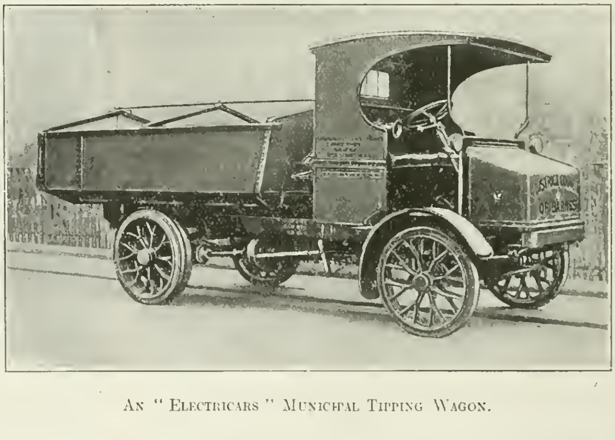
Absolute publicity of the superpower company's operations will be an essential condition. Freedom of action should, however, be also sought for this company in order to promote the free flow of capital to this enterprise, whose requirements will be large and continually increasing.

The prime object of the superpower plan is a larger supply of cheaper power. The superpower survey looks to the full utilisation of all resources, and conservation of the country's fuel cannot be attained except with the aid of large capital investment. Neither the nation, by coal conservation, nor the individual consumer, by lower rates, can profit by the project, however sound in its engineering and economic phases, unless the conditions of financing are sufficiently attractive to warrant the use of the country's financial resources.

ELECTRIC VEHICLE PROGRESS.

A New "Electricar."

During the past year Messrs. Electricars, Ltd., have been engaged in very considerable experimental and research work in connection with the needs of the municipal engineer and surveyor. One of the results of their activity is depicted in the accompanying illustration. It is considered by its makers that this electric vehicle is the nearest approach that has yet been made to the ideal municipal wagon. Perhaps two of the most difficult requirements of the refuse-collecting wagon are: Adequate carrying capacity, and the keeping of the body sufficiently low to enable the filler to work without the use of a ladder. The first is a very difficult factor, owing to the different conditions which obtain in each town, but its importance is apparent when it is considered that no vehicle can be earning anything for its owner while it is standing idle being loaded. It is, therefore, essential to determine the correct carrying capacity of the vehicle in order to avoid wasting the time of the vehicle on the one hand, and wasting the time of the fillers on the other. In practice, it has been generally found that the 40 or 50-cwt. Edison accumulator wagon has been the most economical unit to employ for this class of work. With regard to the second requirement, it is almost unnecessary to say that while the old method of using a ladder to load the van with horse-drawn vehicles was tolerated, it is absolutely ruled out in the case of mechanically-propelled vehicles owing to the enormous waste of time involved. In the case of the wagon under consideration, Messrs. Electricars, Ltd., have endeavoured to keep the loading line sufficiently low; in this instance it is 5 ft. from the ground, which means loading from the kerb at a height of 4 ft. 8 in.



An "Electricars" Municipal Tipping Wagon.

B.E.V. "Super Giant" Trucks.

Messrs. British Electric Vehicles, Ltd., several types of whose trucks have been described in our pages from time to time, have received instructions from the Port of London Authority to supply 31 of their "Super Giant" electric industrial trucks. We are informed that the order was placed after exhaustive tests had been carried out on various types of vehicle, including trucks made by the leading American manufacturers, not so much from the point of view of price, as from that of actual performance, accessibility, and simplicity. As an example, the following facts may be mentioned: The motor can be replaced with a new one in under ten minutes; the countershaft can be taken out and replaced in the same time, and the controller can be removed without disconnecting any of the wiring and without taking out any bolts, the time required being under five minutes.

All other parts of the truck are also easily accessible for either repair or adjustment, and the electrical equipment consists of one of the firm's standard motors to run at 40 volts, 1,200 r.p.m., 1 b.h.p., constant rating. The battery consists of 20 cells, Chloride Exide-ironclad, I.M.V.5 type, rated at 161 Ah. The efficiency of the motor under normal running conditions with the truck fully loaded, running on a hard level track, is 80 per cent., the current consumption being from 30 to 32 amps. All running parts are fitted with ball or roller bearings, Skefko bearings being used for the motor, differential gear and countershaft, and British Timken roller bearings for the wheels.

The controller is of the firm's standard pattern, fixed under the platform of the truck in a dust-tight case, and embodies a number of special features, namely: The drum can be taken out without dismantling any parts; the fingers are adjustable and are held in contact by springs; the trip gear, which is interlocked with the brake, interrupts the main circuit when the brake is applied, and the controller can be taken out without disconnecting any of the wiring.

It is particularly pleasing that in this instance the order has been kept at home instead of going to America, not as a question of sentiment, but on results.

A New "D. P." Vehicle Battery.

Storage batteries used to propel electric vehicles are required to withstand the most trying conditions that are met with in battery practice—overcharging, under-charging, standing discharged, discharging at excessive rates, neglect, rough handling, and, above all and worst of all, incessant vibration when in use—and it is marvellous that batteries have been produced which can successfully endure such treatment. As a matter of fact, the list of types which have made good is exceedingly short. The announcement of the D. P. Battery Co., Ltd., that it has developed and put on the market a new traction battery is therefore of exceptional interest, and we have taken an early opportunity of visiting the company's offices to inspect the newcomer. It is a lead-plate battery, of the pasted type, and has been subjected to prolonged trials in actual service, as a result of which the makers confidently put forward for it some remarkable claims, chief of which is that the cells never require cleaning out. That implies, of course, that the active material never falls to the bottom of the cell, for which reason the clearance space beneath the plates is greatly reduced. The plates are of high capacity but very strong construction, and the separators are of a special material applied in such a way that the active material is permanently retained in position. The capacity of the cells is therefore maintained longer than would otherwise be the case, and the important advantage is gained that the plates, during their whole life, never need be removed from the boxes and exposed to the air, a process which is well known to be very detrimental to them. The cells are generally similar in appearance to other lead batteries, and are made to the dimensions standardised for electric vehicles. We are informed that the watt-hour capacity of the cells per pound of battery is exceptionally high, implying that the internal resistance is low. The cells are capable of withstanding high rates of charging and discharging, and the British Electric Vehicle Co. has furnished particulars of a trial run of 80 miles with a battery of 42 "TR" 13 type "D. P." cells, rated at 145 Ah at the 5-hour rate of discharge. At the start the specific gravity of 1.265; on the outward journey of 40 miles, 110 Ah was taken out of the battery, which was then put on charge at constant voltage, for three hours, starting at 40 amperes (sp. gr. 1.200) and finishing at 20 (sp. gr. 1.250). On the return trip 100 Ah was taken out, the specific gravity falling to 1.175. The B.E.V. Co. considered these results "somewhat in the way of a record."

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A "Universal" Ceiling Rose and Connector Box.

Messrs. Edward Wilcox & Co., Broadway Corner, Trafford Road, Salford, have sent us particulars of a "universal" ceiling rose, connector box, &c., for any situation, and suitable for any wiring system.

The device consists of a base of porcelain or other suitable insulating material (fig. 1), having four openings leading from a central hole, each opening being provided with a tapped (or square dovetailed) blind hole into which are inserted as many terminals (fig. 2) as are required to make a two, three, or four-plate ceiling rose or junction box. The circuit cables are led through a central hole in the usual hardwood pattress, and the base is slipped over and secured to the wood block by three screws. The cables are bared in the usual way and the conductor is bent round the castellated terminal centre screw, a sound mechanical and electrical connection being effected, also ensuring that the conductor is insulated right up to the terminal. The flexibles for the pendant are secured to the same terminal screw, under the top washer. The design of the terminal leaves no back connections or screws to corrode and no side screws to tempt the wireman to leave to chance, all connections are at the front and straight. With the use of "cab tire" sheathed cables and a cover as shown in fig. 3, filled with suitable compound to cover terminals and a rubber ring to cover fixing screws, the device may be used for wet or corrosive situations in chemical and similar works. The ordinary type of ceiling rose cover may be used for ordinary situations, but the one illustrated is suitable for either with the addition of the compound filling only for special situations. A plain cover may be used to convert the device into a junction box for either wet or dry situations.

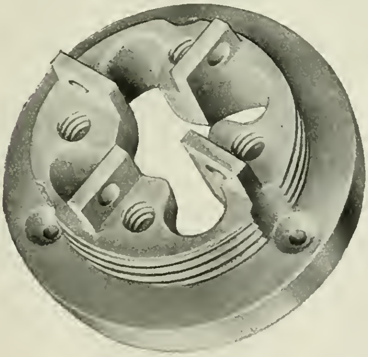


Fig. 1.—Universal Base.

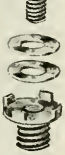


Fig. 2.—Terminal.

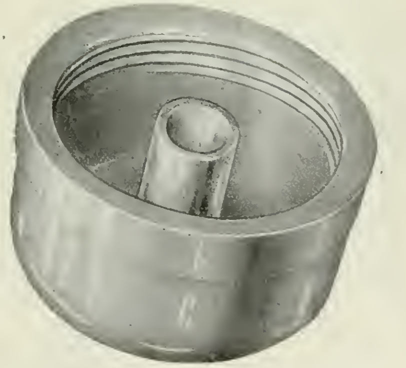
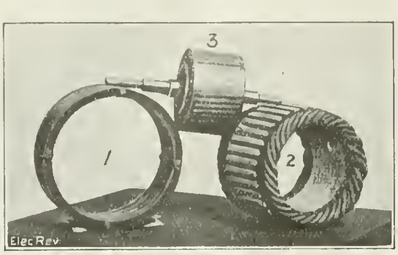


Fig. 3.—Cover for Base.

A New Stator Construction.

Mr. Alexander Zarky, 930, W. Temple Street, Los Angeles, Cal., U.S.A., has sent us particulars of a new design of stator for a.c. machines for which patents are pending. The chief aim of the design is to simplify winding or, better still, rewinding, especially in the case of fractional h.p. machines where limited space makes the work very difficult. It will be noticed from fig. 4, p. 408, that the finished product has the effect of a closed channel type of stator, a type which, although ideal electrically, is a rarity, owing to the commercial impossibility of winding such types for voltages requiring numerous inductors.

In this device, instead of a one-piece core stator with inner teeth, a two-piece stator of concentric ring construction is used. No. 1 in the illustration is the outer ring fixed to the frame. No. 2 is the inner ring with an inner web at the bottom of the outer teeth giving it the appearance of a d.c. armature. After winding the slots, the inner ring is pushed into position in No. 1, and a mechanical and magnetic contact is effected by having the bore of the outer ring and the outer diameter of No. 2 slightly tapered. The rotor can be of the usual types.



(1) Outer Ring. (2) Toothed Core. (3) Rotor.

Fig. 4.—A New Stator Construction.

Electric Starting on Crude Oil.

Messrs. Vickers-Petters, Ltd., the pioneers of semi-Diesel crude oil engines, have perfected an electric starting device, which can be supplied with all sizes of oil engines manufactured by them. It enables the engine to be started instantly on crude oil without external heating, and dispenses with the need for paraffin. The device consists of a patented electric torch, to which current is supplied through a battery charged by a dynamo attached to the engine. As soon as the engine is started, the current is switched off and ignition maintained by the heat of combustion. The torch is only exposed to the heat of combustion for a few minutes, and is not liable to be burnt out. The equipment includes two storage batteries for 100 ampere-hours, one being a spare, one spare heating element, and a complete generating set with switchboard and instruments for charging the battery from the engine. A lamp switch is also provided, enabling one or two electric lights in the engine room or elsewhere, to be connected to the battery.

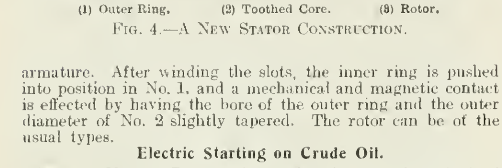


Fig. 5.—Crude Oil Engine Starter.

Keeping Wires straight when being Pulled into Conduit.

Where a number of conductors are being pulled into a conduit, such as the connections between a controller and its resistance or motor, from a field-rheostat dial and operating mechanism on the switchboard to the resistance some distance away, &c., the problem of keeping the wires straight and properly laid up during the pulling-in process is always present. The scheme illustrated in the figure solves the problem very nicely.

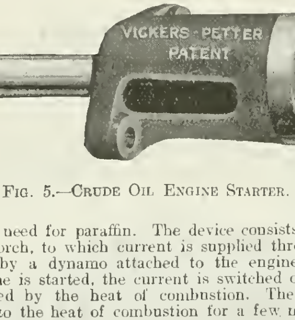


Fig. 6.—Arrangement of Conductors when being Pulled into a Conduit.

In a piece of board a number of holes are bored, and through these the wires are passed and then connected to the pull-in line (fig. 6). When the wires are connected the board can be held away from the end of the conduit by a man while the wires are being pulled. Since the holes in the board hold the conductors in a given position on entering the conduit they will maintain this position throughout the latter's length. This greatly facilitates cabling up, as the wires occupy practically the same relative position in each end of the conduit. When they are tested out, the top conductors at one end will be found on top at the other and the bottom conductors at one end on the bottom at the other, which is seldom the case excepting where some means is provided to hold each wire in a given position in the cable.—W. A. Harris in *Power.*

CORRESPONDENCE.

Letters received by us after* 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The North-East Coast Power Companies.

It may readily be conceded that the primary object of your leading article in the Electrical Review of March 11th, 1921, is synonymous with the aim of the writer of this letter, viz., to help to secure to the national industries the cheapest possible supply of electric power to enable home industries to compete in the markets of the world. But your commendation of the North-East Coast electric power companies is unfortunate, in view of the methods of that combination, and of the misuse of Parliamentary powers it has acquired and has exercised without the sanction of Parliament in a manner inimical to public interests. It is also somewhat unfair to your readers in so far as your comments give the impression of successful development, the genuineness of which is at least open to doubt. Should not the performances of the Newcastle group of power companies rather be regarded as a public danger than held up as an example? Surely you have not fallen into the common error of mistaking a goliath growth for a healthy development.

It is puzzling to know the data on which business experts of your experience repeat the claim of successful electrical development in the North of England, which claims up to now have always proved to be but an echo of the vaunting voice of the combination itself. Where are the independently verified figures obtainable? The statistics of the North-East Coast companies are not to be found in the directors' reports, and they are not to be found side by side with those of the other companies and all the municipal electrical authorities in the kingdom, in the published tables of the electrical Press. Is it not rather a fact that properly audited figures and independently verified statistics of the Newcastle group of power companies do not exist, and that the combination is a law unto itself in spite of the statistics prescribed by the Board of Trade to other undertakings, who readily and freely publish their figures, as all the owners of State-granted powers ought to do?

If the successful development you commend means the lowest possible price of electric power to the national industries and a fair return to the private investor, then success has not been achieved under the holding company system practised by the Newcastle group of power companies on the North-East Coast. On the contrary, it has meant the ruin of certain sets of investors on the one hand, and extravagant rewards to another section, while the consumer can only receive such portion of the benefit of reduced costs or improvements in working as the combination "ex gratia" chooses to bestow. The introduction of intervening and holding companies which have been depleting the revenues of Parliamentary undertakings for no adequate service, supplying plant at enormous prices far above cost, vending at the holding company's own price all the electricity required by a Parliamentary undertaking, is a most unsatisfactory condition of the affairs of a State-granted monopoly.

I recognise that you are seeking, as I am also endeavouring to seek, to be of service to the well-being of the national industries. With such knowledge as I have, the lowest possible prices of electric power seem to be impossible of attainment under the existing methods of the Newcastle group of power companies. How is the effect of past abuses of Parliamentary powers to be remedied and proper safeguards imposed, except in the first place by the impartial and independent investigation advocated in my pamphlet, a copy of which is enclosed for your information?

The fact of the Newcastle group having done useful pioneer work, which must be admitted, ought not to be a justification for continuing their methods. I would be pleased to hear from you, especially as you are more in touch than I am with the new conditions under the Electricity Commissioners. It does not appear that they have the power to investigate past performances of the North-East Coast companies in the manner they ought to be sifted before the operation of so important an area is entrusted to them under the 1919 Act. Any information that would modify my views would be acceptable. I am open to conviction if shown to be wrong. I would only be too pleased to rectify any apparent injustice my present attitude may be doing to the combination or to industrial interests. My aim has been to help electrical progress in the right direction, although shareholders whom I have addressed from time to time, have never been able to see it, the subject is so complex.

With the one exception I think your article is most useful and instructive.

Andrew Gemmell.

Ovingham-on-Tyne.
March 16th, 1921.

[We print with some reluctance Mr. Gemmell's letter (which we rather expected to receive)—reluctance, because of the pressure on our space; but it were better to risk misapplying the space than to risk the suppression of truth or the perpetuation of injustice. If our correspondent is mistaken, the companies are too well established to suffer injury; if he is in the right, the facts should be known. It seems that the "short point" of his complaint is simply that the companies do not publish the details of their business; this does not strike us as a very reprehensible procedure. On the other hand, while we hold no brief for the companies, we are impressed by the fact that Mr. Gemmell's campaign, extending over many years, has elicited no support from any quarter, and the companies appear to be in good standing and repute with their consumers, amongst whom are numbered many of the largest manufacturing concerns on the North-East Coast, and many municipal authorities. It would, no doubt, be a very good thing if the companies would meet Mr. Gemmell's charges once for all, and settle a question which is becoming somewhat time-worn; but the fact that they are silent by no means presumes their guilt. Our own view of the companies' activities has already been expressed: it is, in fact, the item with which Mr. Gemmell disagrees.—Eds. Elec. Rev.]

The Life of Metal-filament Lamps.

Holding a, perhaps, unique position in the lamp industry, and having read with much interest the correspondence on the above subject, and closely examined many thousands of the "dear departed," I would like to suggest that one real reason for the short life of the vacuum-type lamp is that of rough and unsuitable usage, for it should always be remembered that a m.f. lamp cannot be handled with the same freedom as a carbon type. This fact alone would appear to be responsible for more than half the complaints of short life.

With regard to the "gasfilled" lamp, the case is perhaps a little different, for there is here a very real defect which, no doubt, will be eliminated in the course of time by the manufacturers and no doubt your correspondents will find the life of "gasfilled" lamps increase beyond that of the vacuum type—if they will exercise their patience a little longer and not forget that the manufacturers' and consumers' interests, after all, are almost identical.

Ita Est.

March 22nd, 1921.

Payment According to Ability.

When I wrote you my idea of low production and payment by ability I meant just what I said. By ability I mean doing a fair day's work, and doing it well. I don't believe in scamped work, though I've seen plenty of it done.

There is no doubt that "Another Regular Reader" was the best man on the job he got sacked over.

I still hold that the average man after serving his apprenticeship and having 15 years' experience is a better man than the average man of 21. If he is no good then, I should give him a broom, and let him sweep the shop up. I don't care whether a man is married and has children or not, if he applies for a job and expects the same wage as other men he should be capable of doing his work. What is technical training? It is only one way of gaining experience. He says, himself, that he failed to pass a test; well, he failed through want of experience.

To my idea, fear of unemployment through more production is utter nonsense. Can't a man be quick at his work and do it well at the same time? Is "Another Regular Reader" one of those that think a man is too old at 40?

If a foreman or manager cannot tell which are his best workmen he must either be silly or blind.

Regular Reader.

March 20th, 1921.

The Training of Kinema Operators.

Apropos of your note *re* kinema operators and their ability as electricians (in your issue of March 18th), I should like to say that I think most of the fault lies with the tuition at some of the institutions where operating is taught. I myself had tuition at one of these, and I must say that had I not possessed a thorough knowledge of electrical and mechanical engineering already, I should now have been considerably at sea.

I certainly agree with your correspondent's remark that so long as they can turn the handle or switch on and thread up the projector they think they are first-rate operators.

For instance, at the institution attended by me they had in the theatre a petrol generating set. Many pupils who came down would say: "What is that?" and the only satisfaction they received was to be told: "It is a generator." They were not told of its construction, or its working, or instructed in any way as to its care, and during the period of my attendance it was not even run, but I noticed that one of the operator instructors spent much time in cleaning it.

Also I might say a few words in connection with the working of the arc and gear with which it is controlled.

In the school theatre in question there were (as is the case in most kinemas) two projectors, but unlike the commercial units, no change-over switch was fitted—there being a double-pole two-way knife switch only. Consequently none of the pupils received instruction in the management of this, and the necessity of cutting down the current to the required level while the two arcs are momentarily burning together. This, of course, is done automatically in the case of the change-over resistance and switch combined, but all kinemas are not necessarily fitted with this type.

The only opportunity given to the pupil to grasp all these technicalities is one evening's actual experience in the operating box of some kinema to which he is sent by the school.

Therefore, I do not see how these men can be necessarily described as electrical engineers unless they have taken the greatest interest in their work, and augmented their electrical knowledge during their spare time.

Could not this be done in the same way as some of the apprentice engineers are doing it—by attending a course at the polytechnics in the mornings? or, better still, kinema proprietors should insist that the schools teaching the would-be operators should give them a thorough technical and practical course of electricity and its application to the kinema.

F. C. Dreler.

Thornton Heath.
March 24th, 1921.

An Electrostatic Phenomenon.

In reply to Mr. F. Cooper, many years ago I experienced the same phenomenon. A number of 100-V carbon filament lamps had become charged in the manner described by being in close proximity to a quick-running dry leather belt of a Robey engine and dynamo. On a lamp being touched by hand on the brass collar, one had a nasty shock when the lamp discharged to earth. If a lamp was held by the bulb and placed close to the belt, but not touching it, a lightning display was noticed all over the outside of the bulb, and the filament of the lamp lashed up against the sides of the bulb. It was possible to light a gas jet when the brass collar was brought near the gas burner with the gas on.

I have many times tried since to charge lamps up in a similar manner, but so far have failed. Whether it was the dryness of the belt, or the combination of fastening studs in it, I cannot say.

P. E. Davenport.

London.
March 26th, 1921.

City and Guilds Examinations.

Referring to my letter of January 31st, 1921 (which, so far, you have apparently not found space enough in your columns to publish), I should like to call your attention to the paragraph referring to the closing-down of City and Guilds Examinations in *all* technical subjects, except as regards the Final (Honours) Grade.

From my personal knowledge I know this cancellation has proved disastrous, as far as electrical classes are concerned, and apparently gas engineering and gas supply also.

The difference is, however, that "our friends the enemy" are not inclined to allow their business interests to be handicapped in this manner, and it is interesting to know that the result of their agitation is that the cancelled examinations have been reinstated in the subjects of gas engineering and gas supply.

If, Sir, this can be done by our gas competitors, surely our own Institution ought to be capable of similar action on behalf of those who are so anxious to qualify in the branch of the industry they have entered.

It is important to note that these gas examinations will be held *next month*, and had my letter been brought to the notice of our profession, it is quite possible that pressure would have been brought to bear on the Board of Education, with the same satisfactory result as regards electrical examinations.

Of course it is impossible now, as far as this session is concerned, but I trust that some steps will be taken to ensure their reinstatement for the session 1921-1922.

It is quite beyond my comprehension to understand why such indifference is shown to educational matters, they being more generally pushed into the background, instead of being allowed to take their proper position in our profession.

Undoubtedly a well-educated body of workers is more contented and valuable to the general community than the reverse.

Gus. C. Lundberg, M.I.E.E.

London.
March 22nd, 1921.

Wiring in Ferro-concrete Factories.

With reference to the correspondence that has appeared lately on the subject of wiring in concrete buildings, the letter of Mr. J. H. C. Brooking in your current issue raises a very important point regarding the right of users to criticise any material offered for sale. While I am not immediately concerned in the question of the merits or otherwise of cables for a certain class of work, I am in common with other engineers and users of electrical material very much concerned with the attitude taken up by Mr. Brooking, as it unfortunately represents the views of several of the large manufacturers at present. Mr. Brooking makes three suggestions as to how you should deal with letters similar to the one which has annoyed him, suggestions to which you will no doubt attach the value they deserve, but I think they should not pass unnoticed by your readers, especially the last one: That correspondents' letters should be submitted to the firms affected so that they could answer the *libellous* statements contained therein. While it may be the case that Mr. Brooking's firm deal satisfactorily with any complaints they may receive, this is not the case with a number of firms. Any engineer who has had to deal with firms regarding defective or unsuitable material knows the usual type of reply that is given in these cases—either an impossible "explanation" or an attempt at bluff, which is an insult to the complainant's intelligence. Mr. Brooking talks glibly about "libellous" statements as though every criticism of a manufacturer's products were libellous; no doubt there are certain firms who do make an honest effort to investigate users' complaints, and give help where it is required, but the point I wish to emphasise is that letters such as that written by Mr. Brooking are likely to do more harm to the industry than good, as it is really saying in effect to the user that So-and-So's manufactures are "IT," and you must not criticise. The technical Press should be open to all discussions on, and criticisms of, goods offered for sale; it is only by that means that results of use can be circulated, and really reliable information obtained. As one who has found the "Correspondence" columns of the Review a mine of practical information during the past 17 years, I hope it will be a long time, if ever, before you adopt Mr. Brooking's suggestions.

Phase.

Synchronous Induction Motors and Power Factor.

In the *Electrical World* for November 20th, 1920, a very interesting series of tests carried out at the Yale University, U.S.A., on an ordinary induction motor, supplied with continuous current to the slip-rings, was published. Messrs. Warner and Knowlton, who carried out these tests, are to be congratulated on the intelligent way in which they have appreciated the difficulties which prevent supply engineers from doing anything on a large scale to improve the power factor of their stations, and on the manner in which they have in their paper expressed these difficulties; but unfortunately there is still a lot of valuable information which they have not given, and possibly cannot give.

Surely, Sir, here is an opportunity where some of our many British University and other laboratories might do something to help the supply engineers of our own country? For instance—

(1) The tests were only carried out on a 10-h.p. motor; how would they show up on a 100-h.p. motor, and with what result if the rotor were delta-wound?

(2) The constant excitation at which the tests were carried out, using only two limbs of the star, appears to have been fixed too low, apparently with the object either of improving the overall efficiency or of reducing the leading current at the lightest loads; but it is not made clear what is the exact load at which the motors become unstable, in regular running, with this particular current and with the *rotor* used as field.

(3) Similar information is wanted with respect to the load limits at synchronising; in other words, how much extra exciting current is required for additional load during this operation?

(4) What are the absolute limits to the exciting current which are fixed by the heating of the rotor windings?

It would surely well repay our Universities, &c., to ascertain further particulars regarding these, and many other, points of interest to supply engineers and to publish them.

A. M. Taylor,
Hon. Major, S.O.2, W.B.A.M.

Birmingham.
March 22nd, 1921.

Heating of Buried Cables Report.

I understand that in the discussion at Liverpool upon the above report, Mr. J. A. Morton referred to some results which I gave at Birmingham as to the relative heating with continuous currents and three-phase, 25-period, currents in the same bit of cable, and suggested that the results given, namely, a 50 per cent. sheath loss in the three-phase cable, as compared with the copper losses of the same cable when traversed by continuous current, in the experiments quoted by me, were incorrect and were due to the fact that a current of 400 amperes (d.c.) was passed through one core instead of a current of 230 amperes d.c. through each core.

I beg to say that Mr. Morton is wrong in his assumption, and that, as a matter of fact, experiments were tried in which 230 amperes d.c. was actually passed through each core and, so far from the temperature rise with direct currents coming out higher in this case, as Mr. Morton expected, the actual temperature rise was 12½ per cent. less.

The three-phase (25-periods) tests were, however, repeated later, and it was found that, instead of 50 per cent. loss in the sheathing and armouring, there was only 33 per cent. if compared with 400 amperes d.c. in a single core, but that there was 50 per cent. if compared with 230 amperes d.c. in three cores. The results given, therefore, substantially stand for 25 periods.

On the other hand, more recent experiments carried out at 50 periods showed that the losses were considerably less with 50 periods than with 25 periods, except in the case of single-phase currents.

Has Mr. Morton seen *La Revue Générale de l'Electricité* for August 7th, 1920, in which (I am told) Monsieur Capelville demonstrates, and quotes experiments to prove, that the loss in the lead sheathing converts into a drop in the copper conductor of 30 volts per mile? Now, the drop in the copper conductor due to a continuous current at 1,000 amperes per square inch would only be 50 volts per mile; therefore, according to M. Capelville, the loss in the copper due to a continuous current would be increased by 60 per cent., when traversed by an equal alternating current, due to the losses in the lead sheathing. This seems fully to bear out my contention, assuming that his experiments were made at 25 periods.

I believe I have the correct explanation of the losses (contrary to my expectation) being less with 50 periods than with 25 periods, but will not trespass upon your space at the present time to give my reasons. I may say, however, that I have tests to show that the losses with single-phase, 50-period, currents in armoured cables are greatly in excess of those with 25 periods.

As it is probable that in the near future we shall work with single-phase conductors and specially high voltages (see Clark and Shanklin's paper, Am.I.E.E.), the fact of the reduced lead sheath losses with three-phase cables at 50 periods will not help us very much.

A. M. Taylor,
Hon. Major.

Birmingham.
March 23rd, 1921.

LEGAL.

Walker v. Tipler and Another.

At Marylebone County Court on March 23rd, Judge Sir Walworth H. Roberts had before him a case in which Frank Walker (trading as Sowerbutts & Rodgers), of 122, High Street, Kilburn, electrical engineers, sued A. V. W. Tipler, a schoolmaster, of "Ballater," Harrow Road, Sudbury, and a Mr. Moseley for £29 8s. for supplying electric wiring to Mr. Tipler's house, including pendants, switches and fuses complete at £2 2s. per point, and also supplying a dozen Osram lamps at 3s. 6d. each.

The case for the plaintiff was that Mr. Moseley told Mr. Walker of the job, and he sent a man to make arrangements with Mr. Tipler to carry out the work of wiring. The work was done, and plaintiff sent the account to Mr. Moseley, who replied that the account ought to be forwarded to Mr. Tipler himself. This plaintiff did, but the money had not been found.

Plaintiff, in giving evidence, said in cross-examination that he would be surprised to hear that the account should not be paid until the question of commission was settled between him and Mr. Moseley.

Mr. Tipler, giving evidence, said that Mr. Moseley and he were in the Army together. Witness was mess officer and Mr. Moseley was sergeant cook. They became very friendly, and witness thought so well of the capable way he did his work that he lent him £70 to set up in business, and he was able to engage him at decorating his house. Witness obtained from the North Metropolitan Electrical Company an estimate which worked out at 35s. a point. Mr. Moseley told him he could get the work done at 30s. a point, and that was how he came into contact with the plaintiff. No estimate was submitted by the plaintiff, and he had never received an account from him of any kind.

It transpired in further evidence that the account had been paid with the moneys given by Mr. Tipler to Mr. Moseley, and his Honour gave judgment for Mr. Tipler and for the plaintiff against Mr. Moseley for the amount claimed.

Damage to Street Lamps.

At Whitehaven, last week, two youths named Samuel Skillen and Samuel George were fined 20s. each for wilful damage to electric street lamps. The town clerk told the magistrates that the total damage suffered last year amounted to nearly £400, and it was time an example was made of some culprits.

The damage done in the particular case under consideration amounted to £3 4s. 8d., the youths having thrown stones at the lamps.

Oldham, Ashton & Hyde Electric Tramway, Ltd. v. Corporation of Ashton-under-Lyne and Others. Judgment.

The Court of Appeal, consisting of Lords Justices Bankes, Warrington, and Atkin, on March 22nd, dismissed the appeal of the Oldham, Ashton & Hyde Electric Tramway Co. from the judgment of Mr. Justice Rowlatt on its appeal from the award of the arbitrator in the arbitration as to the purchase price to be paid to the appellant company by the Ashton and Hyde Corporations and the Audenshaw and Denton Urban District Councils.

The arbitrator awarded the company £142,000, and its case was that Mr. Justice Rowlatt ought not to have: (1) Depreciated the item as to engineering fees; (2) allowed nothing for the item as to the cost of raising capital; (3) should not have remitted to the arbitrator for reconsideration the item as to interest on capital during construction, and (4) that the learned judge should not have disallowed wholly the item with regard to the expenditure the company incurred in respect of the alterations to the Guide Bridge.

Apprentice Fined.

At Bridlington, last week, an electrical apprentice named Major Dodgson (19) was fined 20s. for having connected a private wire to the Corporation electricity main. He admitted that he had done it against his employer's instructions.

Ballinrobe (Co. Mayo) Electric Company.

Mr. Justice Powell, in the King's Bench Division, Dublin, granted permission to the Ballinrobe (Co. Mayo) Electric Co. to enlarge its operations by the manufacture of woollens and textiles.

BUSINESS NOTES.

Bankruptcy Proceedings.—Albert Lord, 33, Westgate, Burnley, Lancashire, electrical contractor. The following are creditors :—

Electric Lamp Factors	£20	Metallic Electric Engineering Co.	£22
Greenhalgh	186	Royal Sovereign Lamp Works ..	15
Green & Co.	22	St. Helens Cable Co.	34
Hale, Kearn & Co..	20	Thornton, W. R.	131
Hasland Engineering Co. ..	31	Tucker, J. H., & Co.	42
Johnson & Phillips	80	Weyden Lamp Co.	63
Kippex, Wm., ...	200	Whitaker, J., & Sons	11
Mason & Co.	15		

John Vincent Bell, 21, North Bar Within. Beverley. East Riding, Yorkshire, electrical engineer. The following are creditors herein :—

Briggs & Powell	£26	Siemens Bros. & Co , Ltd. ..	£80
General Electric Co., Ltd. ..	211	Ward & Goldstone, Ltd. ..	37
Pottage Bros.	11		

L. P. Howse and G. H. B. Snell (Howse & Snell), electrical engineers, 6 and 8. Duke Street, Margate.—Receiving order made March 21st, on debtors' own petition.

C. P. Stanton (Southern Electric Engineering Co.), electrical engineer, 25. Beckenham Grove, and 5, Laurel Grove, Penge.—Receiving order made March 22nd on debtor's own petition. First meeting April 4th at 132. York Road, Westminster, S.E. Public examination, April 21st. at the City Court. Croydon.

E. S. Elam and J. Walton (Elam Walton & Co). electricians, 63, King Edward Street, Kingston-upon-Hull —Last day for proofs for dividend. April 13th. Mr. G. H. Acheson. Official Receiver, trustee, York City Bank Chambers, Lowgate, Hull.

Company Liquidations.—Improved Solidite Co., Ltd.—Mr. H. W. McLaren, of Bnller. Viney & Co., of 68. Coleman Street, E.C., has been appointed receiver on behalf of the debenture holders.

Stols Electrophone Co. (1914), Ltd. — Winding-up order made March 22nd.

Our contemporary. *Electrical Industries*. asks us to state that it has no connection with a company entitled Electrical Industries, Ltd., a trading concern registered in May, 1920, and now in liquidation.

Dissolutions of Partnership.—Sunbeam Electric Co., electrical factors, 63. Lancaster Avenue, Manchester.—Mr. A. E. Outhwaite and Mr. A. G. Hartley have dissolved partnership. Debts will be attended to by Mr. A. G. Hartley, who will continue the business.

J. A. Frost and J. W. Frost, electrical engineers. 70. Old Compton Street, W.—By order of the Westminster County Court, of February 18th. the partnership between Mr. J. A. Frost and Mr. J. W. Frost was dissolved as from May 22nd, 1920. Debts due to the said firm should be paid to Mr. J. A. Frost (the Receiver appointed by the Court) at 70, Old Compton Street, W.; particulars of debts owing should be sent to Mr. J. A. Frost by April 23rd.

Catalogues and Lists.—The Austin Motor Co., Ltd., Longbridge Works. Northfield, Birmingham.—An illustrated and fully-detailed pamphlet dealing with the "Austin" 0·75-kW auto-plant for country house lighting, &c. Also a similar pamphlet of the "Austin No. 4" lighting set.

Messrs. Phillips & Turner. 115, Edmund Street, Birmingham.—Leaflet showing galleries, ceiling plates, &c., for electric light fittings.

Messrs. Geo. M'Cartney & Co., Bnrnside Works, Cumnock, Scotland.—An illustrated and priced booklet of "Orb" switch and fuse gear of many types.

Messrs. Jones & Pordes, 8, Crawford Passage, Farringdon Road, E.C. 1.—An illustrated and priced leaflet dealing with "Elba" dry cells, accumulators. portable bell sets, hand lamps. &c

Messrs. L. G. Hawkins & Co.. 116, Charing Cross Road, W.C. 2.—An illustrated and priced leaflet advertising the "Universal" electric washer.

Messrs. Brotschi Freres & Cie, S.A., Grenchen.—M. Leon Wnlliman, of 4, Water Lane. Brixton Hill, S.W. 2, has sent us a leaflet relating to the screws, terminals and other such articles for the electrical industry made by this firm, which he represents here.

Messrs. Herbert Morris, Ltd., Loughborough, Leicestershire.—List 301 Z, giving details of Morris electric hoist blocks, with illustrations of actual installations, as well as sizes and prices. Also two leaflets dealing respectively with steel joists, channels, angles, &c., and vertical boilers (made by H. Coltman & Sons).

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—P Section (13th edition), an illustrated and fully detailed list of "G.E.C Witton" engine- and turbine-driven a c. generators. The types shown are constructed to give supplies at 25, 40 and 50 cycles, and range from 30 to 1,000 kW.

The Globe Engineering Co., Ltd., Perseverance Works, Huddersfield Road Brighouse.—List No. 2. A leaflet giving illustrations and specification of small d.c. motors of 1 and 2 b.h p.

Messrs. Edward J. Goodwin, Ltd., 508. Mansion House Chambers, Queen Victoria Street. E.C. 4.—An illustrated booklet dealing with "Eastman" electrically-operated cloth-cutting machines.

Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Catalogue Section "J." an illustrated and priced booklet, giving full details of the "Simplex" colliery lighting system, describing many types of small junction or connector boxes.

Trade Announcements. — Messrs. Jones & Pordes announce that Mr. D. J. Esterson. of Glasgow, is not now representing them and that they have appointed Messrs. Macdonald and Shaw, of 116, Hope Street, Glasgow, and Mr Mason Alcock, of Windsor Buildings, North Street. Belfast, and Dublin, to be their sole selling agents for Scotland and Ireland respectively.

Messrs. H. W. Smith & Co. (1920). Ltd., have appointed Mr. C. H Spafford, 20, Falmouth Road. Bishopston, Bristol (who was with Messrs Simplex Conduits, Ltd.). as their representative for the West of England; and Mr. W. J. Davies, Dydraw, Porthcawl, as their representative for South Wales. His telephone number is "65 Porthcawl."

Messrs. McClure & Whitfield. of Stockport, have appointed the City Electrical Co., 1, Emerald Street, Theobald's Road, London. W.C. 1, their sole export selling agents, also their sole agents for the following districts :—London and the South-East Coast—1. Emerald Street, Theobald's Road, London. W C. 1; Lincolnshire—High Street, Scunthorpe; the East Riding of Yorkshire—Jameson Street, Hull; the North-East Coast—67, Grey Street. Newcastle-upon-Tyne; South Wales—16, Charles Street, Cardiff.

Messrs. J. Culkin & Co., of Skinner Lane, Leeds, wish to receive catalogues, price lists, &c., of electrical goods, particularly motors, dynamos, switchgear, and power accessories.

The Tividale Foundry and Engineering Co. have opened an office and saleroom at 2a, Merton Road, Watford, Herts., and they wish to receive catalogues and lists of electrical supplies.

Copper and Lead Prices.—Messrs. F. Smith & Co. report March 29th :—Copper (electrolytic) bars, £73, £2 increase; ditto sheets, £145. £2 increase; ditto wire rods, £89, £2 increase; ditto h.c. wire, 11¾d., ¼d. increase.

Messrs. James & Shakespeare report March 29th :—Copper bars (best selected), sheets and rods. no change. English pig lead, £21 10s., 25s. increase on last week's price.

Australia and Trade with Germany.—Mr. Hughes, the Prime Minister. has confirmed a report that sales of wheat have been made to Germany, and has stated that the question of the resumption of general trade with Germany will shortly be submitted to Parliament.—*Reuter* (Sydney).

The G.E.C. Removal.—The new premises of the General Electric Co., Ltd., Magnet House, Kingsway. W.C. 2, the erection of which was commenced some years ago, being subsequently held up by the war, will from Monday next, April 4th, become the head office, sales department and stores of the company. The new telephone number will be "Regent 7050" (50 lines). The goods entrance will be in Keeley Street. Until further notice the showrooms of the company will remain at 67, Queen Victoria Street, London, E.C. 4.

For Sale.—By direction of the Disposal Board, Messrs. Eadon & Lockwood will offer by auction on April 19th, 20th and 21st at the National Ordnance and Filling Factory, Chilwell, Notts., plant and machinery, including many electrical items: Messrs. King & King, on April 19th, at 46, Commercial Road, Portsmouth, will sell by auction machinery, electrical and other plant, &c.

Messrs. A. Dobell & Co. are offering by auction at Liverpool, on April 7th, a quantity of spruce deals and other timber, stored in Liverpool and Manchester. For further particulars see our advertisement pages to-day.

Book Notices.—"Employé Training." By J. V. L. Morris. Pp. xxiv + 312. Price 18s. "Connecting Induction Motors." By A. M. Dudley. Pp. xii + 252; 289 figs. Price 15s. London: McGraw-Hill Publishing Co., Ltd.

"*Journal* of the American Institute of Electrical Engineers." Vol. XL, No. 3. March, 1921. New York: The Institute. Price $1.

"The Electrical Power Engineer." Vol. II, No. 9. March, 1921. London: E.P.E.A. Price 4d.—The present issue contains a portrait of Mr. J. F. Heslop, A.M.I.E.E., who is President of the Association for 1921. Reports of proceedings at various branches and a number of interesting notes also appear.

"Coil Ignition for Motor-Cars." By C. Sylvester. Pp. xii + 228; 106 figs. London: Sir I. Pitman & Sons. Price 10s. 6d. net.

"Artificial Light." By M. Luckiesh. Pp. xiv + 366; 41 illustrations. London: From the University of London Press, Ltd. Published by Hodder & Stoughton. Price 12s. 6d. net.

Fuel Research Board. Technical Paper, No. 2. "Report on the Simmance Total Heat-recording Calorimeter." By Thomas Gray, D.Sc., Ph.D., and Alfred Blackie, M.A. London: H.M. Stationery Office. Price 9d. (by post 10½d.)—This is the second paper in the series of Technical Papers of the Fuel Research Board of the Department of Scientific and Industrial Research. The report contains the record of the operations of the Simmance total heat-recording calorimeter for two periods. In the first of these the instrument was left to operate on town gas for five months with occasional adjustment, the readings of the recorder being compared with the results of determinations of the calorific value carried out with the calorimeter which forms part of the instrument. During the second period the instrument was supplied with mixtures of coal gas and water gas in order to check the accuracy of the gravity governor when subjected to rapid and extreme changes of density and calorific value. Tables and results of curves illustrating the experiments are also included.

"Electro-Deposition of Copper." By C. W. Denny. Pp. xii + 108; 29 figs. London: Sir I. Pitman & Sons. Price 2s. 6d. net.

Social Events.—Tredegars, Ltd.—On Tuesday, last week, an inaugural dinner was given to the staff of Messrs. Tredegars, Ltd., by Mr. Alex. Maclean and Mr. H. H. Millett, directors, at the Florence Restaurant, in honour of Mr. N. E. Bartlett, chairman and governing director. In proposing the toast of "The Queen and the rest of the Royal Family," the chairman, Mr. Maclean, said that the Queen had long been a most valued client of the firm and had visited Tredegars on several occasions. He then proposed "Tredegars," offering a most cordial welcome to the new head of the firm, Mr. Norman Bartlett. The business was founded by Sir Herbert Bartlett (who was present at the dinner) and was placed under Mr. Arthur Bartlett, whose loss they lamented; his brother had returned from the war and assumed the leadership. They were all out for success, and it was to their common interest to pull together with that object in view. Mr. Norman Bartlett, in responding, expressed his pleasure at meeting the staff under such happy auspices, and said that the company had established a reputation for good work, which they were all keen to maintain and increase. Co-operation won the war, and was the key to success in their joint purpose; with that in view, he asked for their help and friendship. Mr. Dudley Bartlett also briefly responded on behalf of Sir Herbert and the parent firm (Perry and Co. (Bow), Ltd.). Mr. H. H. Millett proposed the toast of "The Visitors, including the Press and the Artistes," and endorsed the chairman's remarks, adding that he hoped the dinner would become an annual event. Mr. Johnson responded. An excellent musical entertainment followed, the artistes being Misses Sybil Elliott, Jean Butt, Joan Bonrsot, Eva Scott-Thompson, and Nora Morris, and Messrs. W. K. Haselden and Morland Hay, who gave of their best to make the evening memorable.

The Scottish Electricians' Strike.—At a meeting of the Electrical Contractors' Association of Scotland, at Edinburgh, to consider the strike of electricians, it was stated that of the entire Scottish membership only two firms were reported as not having given notice of the reduction in wages. Their action, while affecting but a small number of employés, was strongly condemned as tending to prolong the strike. It was resolved to bring the names of the two firms before the Central Board of the Association for consideration. It was stated that men were beginning to come in and ask for work at the new rate. It was noted that some effort had been made by the Trade Union to call out selected men from firms affiliated to the Engineering Federation. In view of the fact that the standard rate of wages paid by that Federation was less than the rate now offered by the Electrical Contractors' Association, the employers' representatives at the meeting were of opinion that further immediate steps should be taken towards the equalisation of all wage rates of electricians in Scotland, and the introduction of one flat rate.

The men declare that they are resisting the wage reduction because it will mean the lowering of the level of subsistence for the workers not only in one, but in all occupations. It is pointed out that the result of the acceptance of lower wages in the electrical trade in Scotland will mean that the same will take place in England, where the employers are said to be awaiting the result of the dispute before putting forward reduction proposals on their own behalf.

The Industrial Situation in Austria.—Speaking on the trade results of 1920, and the prospects of 1921, at the yearly meeting of the Metal, Iron and Machine Trades Union of Austria, the president, Herr Hugo Noot, remarked on the severe struggle for existence which all the trades included in the Union had experienced in 1920. Hindrances on all sides were encountered. Heavy taxation had created wage disturbances. Austrian industries had withstood the test, but the almost unbearable tax burdens filled the future with forebodings. Passing the various trades in detailed review, that of water turbines had been fully employed. The lack of coal and petroleum had compelled, where possible, the development of unused water power for the generation of electric light and power. The electrotechnical trades, with a greatly lessened output, were comparatively busy. As in Austria only a small part of the production was consumed inland, outlets abroad had to be held and new ones opened; and there, especially in their old market, Czecho-Slovakia, the greatest customs obstacles were met with, notwithstanding that a great demand existed there, which the home industry was unable to satisfy. Efforts to supply the home demand were also observable in Poland, where a number of new factories had already been started. In Poland, Rumania and some parts of Jugo-Slavia, the Austrian industries had had to face foreign competition, especially German, French, Italian and English, which, on account of the currency obstacle, was very difficult to meet. With Bulgaria and Turkey, for political reasons, no effective trade relations were possible. Trade with Greece was only of small dimensions. Sales in the western lands fell through, owing to the lack of commercial relations. Extraordinarily burdensome to the electrotechnical industry were felt to be the transit limitations, and the export formalities which prevented the prompt forwarding of goods, the long storage of which represented a serious loss to all factories. Earnestly to be wished for were the regulation of traffic business, and a comprehensive reduction of the intolerable export formalities. The steady rise in wages and salaries, and the consequent increase in price of raw and half-wrought materials, the depreciation of the currency, the lack of raw and half-wrought materials which the electrotechnical industry had to procure from abroad, were bringing that industry into a daily worsening condition, leading to overstocking at home and the increase of the already formidable competition from abroad. Lack of coal lay at the root of Austria's industrial difficulties, affecting all her industries alike. The schemes to develop the country's water resources as a mitigation of this situation could not be carried out during the past year on account of the unexampled increase of building costs and the indisposition shown by foreign capitalists to adventure into such undoubtedly paying investments. The State Railway Department had drafted a big building programme, which the representative bodies had sanctioned, but its realisation was put off by the Finance Minister owing to lack of means, whereby their cost was still further increased. It was earnestly to be wished, in the interest of the popular welfare, that the greatest readiness should be shown in granting water-right concessions required for the furthering of home industries. Favourable concessions must likewise be granted to foreign capitalists, so that they might interest themselves in these businesses. In this matter, unfortunately, the existing provincial administrations had hitherto maintained a complete reserve, as they wished to develop the water resources themselves; but it was to be feared that for a considerable time they would be unable to command the needful means, and thus all efforts to benefit Austria's economic position would be frustrated. Sales of electric colliery and foundry machinery had not varied much from the total of the foregoing year. Investments in colliery property in the past half-year had occurred only in Poland, as the Polish Government had agreed to the free sale of coal in exchange for machinery equipment. As the delivery of such coal could only be made to Austria, considerable orders, as a result, had been secured by Austrian industries. No disposition for big investments had been shown in the Galician oil region. The Rumanian oilfields before the war placed the greatest part of their orders in Germany, and repairs and new orders for the most part had fallen again to that country's industries. There could be no doubt that the colliery and foundry industries had large orders to place, but these would not be issued until after the political and economic situation had become consolidated.

The New Customs Tariff in Spain.—The manufacturers of electrical material are protesting against the prolongation of the treaties of commerce. In order to avoid the retention for several months longer of the Customs surtaxes which came into force in November, the Government, it appears, has decided to negotiate with each country separately with a view to arranging partial exceptions to the present tariff in exchange for concessions to be made in favour of Spain regarding articles exported by her to the various countries.—*Reuter's Trade Service* (Madrid, March 20th).

South African Representation.—The Premier Engineering Co., of 4, Stella Buildings, Rissik Street, Johannesburg, asks us to announce that it is open to represent makers of disk and rotary-type water meters, steam and crude oil engine generator sets, and steam wagons.

Motor-Car Batteries.—One of the latest products of Messrs. C. A. Vandervell & Co. is an entirely new battery which as its name, "C.A.V.-Willard," implies, has been produced as the result of an interchange of ideas between Messrs. C. A. V. & Co., and T. A. Willard, U.S.A.; instead of the usual grooved wood separators Willard threaded rubber separators have been adopted. Messrs. Vandervell have acquired the patent rights for Great Britain and the Colonies, with the exception of Canada, for the Willard rubber threaded separator and have undertaken to act as service representatives for the Willard Storage Battery Co., in this country. Mr. Irvin Kuhn, of the Willard organisation, has recently been in England consulting with the C. A. V. Co. on the new undertaking. The company is organising a complete chain of service stations throughout the country, and the organiser and manager of the C.A.V. service station scheme is Mr. George Gregory. The service is primarily intended to educate the car owner to appreciate the value and purpose of the battery, and by so doing create more battery satisfaction than has hitherto existed. Motor car manufacturers standardising "C.A.V.-Willard" batteries will supply with each car a battery registration card, upon which will be recorded every 14 days the condition of the battery during the 90 days' guarantee. Another feature of the scheme is a service station pass, in season ticket form, which enables the holder to obtain distilled water, testing, and advice free of charge at any of the company's service stations, which will carry stocks of new batteries and spare parts for repair work, also batteries which can be hired out to users at a standard uniform rate throughout the country. The scheme is planned to be everywhere operated by entirely independent traders in preference to branch premises owned and staffed by the company, so as to give greater value to the user, inasmuch as the service trader is in a position to regard all transactions from an entirely independent and different view-point from that of the manufacturer, consequently in the wider application of business he possesses that freedom of action which secures the confidence of the customer in his purchases. *Motor Commerce* also announces that Mr. S. W. Windeler, of the Mack Storage Battery Co., Toronto, Canada, is now in this country for the purpose of placing "Mack" batteries on the English market, and at the request of Sales, Ltd., will take care of the sales side of the business. A company is being formed and it has been decided to manufacture a full range of all types of batteries, including those for motor car starting and lighting. *Motor Commerce* states that its representative has witnessed interesting demonstrations of the abuse that the "Mack" battery will withstand without adverse effect, among them being welding together 6 in. iron nails, and melting steel files by connecting them across heavy cables connected to the battery terminals. In another instance, a heavy car was towed by a much smaller vehicle driven by the standard starting motor, the current for which was supplied by a Mack battery, 140 yards being covered before the battery was totally discharged. A final test was to place a Mack battery on a charging bench, giving it a reverse charge at 10 amperes for 12 hours, the charge afterwards being made in the right direction. Such abuse far exceeds the average ill-treatment a battery receives in actual practice, yet the battery was opened afterwards for inspection with two cells in a charged condition and the other cell in a discharged state, and the plates were found to be in excellent condition.

Cancellation of Orders in the United States.—According to a statement issued on March 8th by the Fabricated Production Department of the Chamber of Commerce of the United States, cancellation of contracts is one of the contributory causes for the present slump in business. This conclusion was reached by the Department after a six months' study of the cancellation evil. The influence of early repudiation of orders, it is pointed out, spread rapidly, and brought about a creeping paralysis of industry. In a number of lines, partly because of cancellations, plants were reduced from overtime production schedule to three days a week, and, in some instances, to a complete shut-down. Legal remedies have been of little avail, for the ailment has shaken confidence, confidence, which must be restored before better times can be looked for. The investigation of cancellations showed that there were plenty of cancellations mutually arranged which were beneficial to both parties, but there were many others which caused hardship to either the buyer or the seller. Of the latter type, the number of sellers who violated their contracts were about equal to the number of buyers who cancelled orders. The investigation also disclosed that a large number of business men bore losses rather than repudiate contracts.—*Reuter's Trade Service* (Washington).

Chilian Copper Production.—There is to be a radical curtailment of operation in some of the large copper mines of Chile. The output of one mine will be reduced from 3,000 to 1,000 tons per month, and other companies will also greatly restrict production. These mining camps absorb a large quantity of American products, and their partial suspension, pending recovery of the copper business, will further restrict Chile's imports from the United States.—*Reuter's Trade Service.*

E.D.A. Activities.—The British Electrical Development Association, Hampden House, Kingsway W.C. 2, has just issued a pamphlet exhorting its readers to "Use the electric vacuum sweeper, and you will not fear the sunshine," and extolling this method of "spring cleaning."

Trade with Denmark.—The extended application of electric power in Denmark is hindered by circumstances over which that country has little control. Its territory is flat and possesses no sources of cheap water power which might be utilised for the generation of electricity. Equally important in its bearing on this matter is the fact that Denmark has to import all her supplies of coal. It is stated that for her import of some 2,400,000 tons of coal, coke and briquettes in 1919, Denmark had to pay between 400 and 500 million kroner, compared with the 60 or 70 million kroner which she spent previously on an import of 3,600,000 tons. (This partly explains why the coal miner is about the only worker who can afford Danish butter.) Electricity's future in Denmark is linked with the import of energy from Norway or Sweden, where spare hydraulic power is available. Plans are in progress for an extension of this source of supply to Denmark

Proposed Tour of Danish Engineers.—It was reported recently in Copenhagen that a party of electrical engineers proposed visiting the United Kingdom with a view to an inspection of the latest practice in electricity production and electrical manufacture. Such visits were formerly paid to Germany. No doubt Danish engineers in such a tour would see a great deal to incline them to add to their connections with our manufacturers. In the opinion of H.M. Commercial Secretary at Copenhagen, under normal conditions there should be a market in Denmark for practically all classes of British goods, and that even if there is at present little prospect of immediate business, British firms should not lose touch with their Danish connections. On the whole, the Danish market may be said to be readily receptive of British goods as regards style and quality, and provided British exporters pay attention to the requirements of the market, and, where possible, visit the country from time to time to become personally acquainted with their agents and their customers, there would appear to be no reason why a considerable share of Danish imports of manufactured goods should not come from the United Kingdom. For the present, however, British exporters of commodities which come under the category of articles of luxury should not expect any considerable trade.

On the whole the Danish metal industry was well employed during 1919, and the number of hands engaged was considerably increased. Certain branches of the industry suffered not a little from foreign competition, and particularly from Germany. The electrical industry was busily engaged during the year, as there was a considerable shortage of lighting material, which led to a general desire to introduce electric plant. The number of employés in the installation industry rose from 2,500 to 3,200 during 1919, and could have been increased further had sufficient trained labour been available.

Forthcoming Exhibitions.—The following exhibitions are being organised :—

LONDON. — April 1st to 30th, Building Trades' Exhibition ; April 30th to May 14th, Printing, Stationery and Allied Trades' Exhibition ; June 3rd to 17th, Rubber Trades' Exhibition ; July 4th to 15th, London Fair and Market ; September 7th to 28th, Shipping, Engineering, and Machinery Exhibition ; October, Society of Motor Manufacturers and Traders ; November 17th to 25th, Public Works, Roads, and Transport Exhibition. 1923—British Empire Exhibition.

BRITISH DOMINIONS.—June, 1921, Dominions Touring Exhibition (*South Africa, Canada, Australia, and New Zealand*).

FRANCE.—(*Bordeaux*) June 15th to 30th, International Samples Exhibition.

BELGIUM.—(*Brussels*) April 4th to 20th, International Commercial Fair. (*Ghent*) April 16th to June 14th, International Exhibition of Architecture, Building, and Kindred Industries.

SWITZERLAND.—(*Basle*) April 16th to 26th, Swiss Industries Fair ; May 28th to June 8th, International Automobile Exhibition.

HOLLAND.—(*Utrecht*) September 6th to 16th, International Fair.

ITALY.—(*Milan*) April 12th to 27th, International General Manufacturers' Fair.

SPAIN.—(*Barcelona*) April 1st to 10th, International Samples Fair.

ICELAND.—(*Reykjavik*) June, World's Fair.

PERU.—(*Lima*) June 1st to October 31st, International Industrial Exhibition.

ARGENTINA.—(*Buenos Aires*) 1922, International Exhibition.

BRAZIL.—(*Rio de Janeiro*), 1922, International Centenary Exhibition.

MEXICO.—September, Commercial and Industrial Fair.

JAVA.—(*Bandoeng*) September 19th to October 9th, Netherlands East Indies Fair.

CZECHO-SLOVAKIA.—(*Prague*) May 28th to June 5th, Automobile Exhibition. (*Reichenberg*), August 13th to 21st, International Fair.

POLAND.—(*Warsaw*) May, Building and Fire Protection Exhibition.

Institute of Cost and Works Accountants.—Miss M. S. Neale, chief cost accountant to Messrs. Allen & Hanbury, Ltd., of Bethnal Green, E., has been admitted as a "Fellow" of the Institute of Cost and Works Accountants. The next examinations of the Institute will be held during the first week in June in London, Birmingham, Manchester, Glasgow, Sheffield, and Bristol. Forms of application and full particulars may be obtained from the Secretary at 30, Grosvenor Gardens, S.W. I.

German Reparation (Recovery) Act: Committee Appointed.—Under Sec. 5 of this Act, which takes effect on Thursday, March 31st, the Board of Trade may by order take certain action, as indicated below :—

(*a*) Under Sec. 1 of the Act, importers of German goods are to pay to the Customs a prescribed proportion of the value of the goods, not exceeding 50 per cent. The Board of Trade may reduce the prescribed proportion as respects articles of any class, make or description, or may exempt such articles from all the provisions of the Act.

(*b*) Sec. 2 excludes from the provisions of the Act goods partially manufactured or produced in Germany which are not first consigned from that country, and in which 25 per cent. or more of their value is attributable to processes of manufacture undergone since they last left Germany. The Board of Trade may vary this percentage as respects articles of any class, make, or description.

(*c*) Under Sec. 1 the Act shall not apply to goods imported before April 15th, if it is proved to the satisfaction of the Customs that the goods are imported in pursuance of a contract entered into before March 8th. The Board may, as respects articles of any make, class, or description, substitute some later date for April 15th.

(*d*) Sec. 4 provides that where any person is liable, under a contract entered into before March 8th, to accept bills of exchange or make advances in connection with the importation of any goods, he may apply to the High Court; and the Court, if satisfied that by reason of the provisions of this Act, the enforcement of the contract would result in serious hardship to him, may suspend or annul, or with the consent of the parties amend the contract as from such date as the Court may think fit, or stay any proceedings for the enforcement of the contract or any term thereof, or any rights arising under it. on such conditions (if any) as the Court may think fit. The Board of Trade may extend the classes of contract to which the Section relates.

The Board is not. however, to make any order under any of the above provisions except on the recommendation of a Committee which it is to appoint, consisting mainly of persons of financial, commercial, or industrial experience.

The following Committee has accordingly been appointed by the Board of Trade, under Sec. 5 of the Act :—

Mr. H. A. Trotter, Deputy Governor of the Bank of England (chairman)

Mr. H. B. Betterton, M.P., C.B E.

Mr. F. R. Davenport, managing director of Messrs. Willans and Robinson, Ltd., Rugby.

Mr. Stanley Machin, President of the London Chamber of Commerce.

Mr. D. Withers, manager, Foreign Branch, London County, Westminster, and Parr's Bank.

Captain G. W. Duncan (secretary).

Applications to the Board of Trade to make any order under any of the provisions referred to should be addressed to the Secretary, Board of Trade, Great George Street, Westminster, and both the letter and envelope should be marked "German Reparation."

Wages Reduction in Sweden.—The L.M. Ericsson Telephone Co. has reduced the wages of its staff by 10 per cent. with a view to enabling the company to compete with foreign manufacturers.—*Reuter's Trade Service* (Stockholm).

Italian Industrial Revival.—The mechanical industry throughout Italy is showing sustained evidence of revival, the iron, shipbuilding and mechanical workshops at such centres as Genoa, Savona, Terni, Naples, Sampierdarena, Pozzuoli, &c., having already almost attained pre-war activity. A surprisingly rapid transformation from the production of war material to the supplying of many needs was made some months ago, and, but for the political unrest, the majority of the factories would have been in full operation ere now. Equipment, indeed, has increased in some instances faster than the supply of skilled labour. while wages have risen until a first-class mechanic now asks as much as 20 and 22 lire per diem. Before the war the rate was seldom above 10 lire. The most important engineering products now being turned out are railway material and agricultural implements. If Italy succeeds in maintaining a steady flow of raw materials (and some substantial contracts have been made abroad of late in this direction), the majority of the iron and steelworks in the districts mentioned should soon be in full operation. Steel is particularly in request, a large number of cars having been compulsorily laid aside in certain of the shops, owing to the lack of steel for the frames. Wherever possible, wood has been substituted for steel; but even the requisite lumber is wanting in sufficient quantities. Owing to the lack of coal, some of the larger establishments during the war installed electrically-driven machinery, and this is being found very serviceable to-day. Steam plant is being retained as a standby for periods of breakdown or increased demand. Notwithstanding the difficulties created by the exchange situation, several large orders are being placed by Italian factories for new machinery, such as hydraulic presses, foundry equipment, textile machinery, and general labour-saving devices.—*Reuter's Trade Service* (Savona).

The A.E.G. in Luxemburg.—The Société Luxembourgeoise pour Entreprises Electriques has been formed at Luxemburg, with a share capital of 3,000,000 fr., divided into 6,000 shares of 500 fr., of which the A.E.G. has subscribed 5,944 shares.

Prices Reduced.—Substantial reductions in the price of the "Electrolux" suction cleaner are announced by the Z Electric Lamp and Supplies Co., Ltd., owing to increased demand and increased production leading to reduced cost.

Electricity District Schemes.—When a scheme for improving the organisation of electricity supply in a district has been submitted to the Electricity Commissioners, it has to be put on sale by the promoters and thus made accessible to the public. The London County Council is now advertising the scheme and technical report prepared under its auspices. Particulars of the publishers and prices of other schemes that we have reviewed have been given in each case in connection with our abstracts.

A Belgian Dividend.—The Ateliers des Constructions Electriques de Charleroi propose to pay a total amount of 87.50 fr. per share on the ordinary shares, comprising arrears of dividend for the past seven years, including 1914.

Inquiries.—The names and addresses of makers of "Sun" bonding pliers, and "Puralite" fittings No. F. 56, are asked for.

The Bitterfeld Chemical Works.—The undertaking of the Electrochemical Works Co., of Bitterfeld-Rheinfelden, whose shares are held by the Berlin Electricity Works Co. and the Zurich Bank for Electrical Undertakings has been sold to the German aniline dye group, represented by the Griesheim-Elektron Chemical Works Co., which has held a lease of most of the plant for a number of years. The works were originally started in 1893 by Herr Walter Rathenau, and the value of the present transaction is estimated at over 100,000,000 marks.

LIGHTING AND POWER NOTES.

Aberdeen.—Details of Proposed Extensions.—In our last issue we announced that the Town Council had under consideration extensions to the Ferryhill electricity works, estimated to cost £210,540. This amount is made up of the following items :—A 10,000-kW, 6,600-V, 50-cycle turbo-alternator, with condenser, pumps, foundations, &c., £77,000; two 36,000-lb. boilers, with superheaters, economisers, forced and induced draught apparatus, steel chimney, boiler-house building, foundations, piping, valves, &c., £60,000; engine-room and switch-room extensions, £20,000; one 1,500-kW and one 1,000-kW motor converters, £18,000. e.h.p. and l p. switchgear, £10 000; one 60-ton electrically-driven crane for the engine room. £6,400; contingencies (10 per cent.), £19,140. The expenditure would be spread over a period of two years. In a recently-presented report the electrical engineer (Mr. J. Alex. Bell) justifies this outlay by giving details of the rapid development and the remunerative nature of the municipal undertaking.

Aylesbury.—Loan Sanctioned.—The Town Council has received sanction to a loan of £6,074 for electricity purposes connected with the housing scheme.

Ayr.—New Plant Proposed.—At a meeting of the Town Council, there was submitted for approval a draft agreement with Kilmarnock for the supply of electricity in bulk by that authority to Ayr. The agreement was severely criticised, and it was stated by members that a supply from Kilmarnock would involve a heavy cost, although the Town Council would have very little to say in the matter. It was eventually decided that the member of Parliament for Ayr Burghs should be asked to urge the Electricity Commissioners to permit the purchase and installation of a 1,500-kW turbo-generator, for which accommodation already exists at the Council's station.

Bedford.—Price Reduction.—The Town Council has decided to reduce the charges for electricity for lighting from the next quarterly readings of the meters from 10d., less 2½ per cent., to 9½d., less ½d. per uint; and for power by ½d. per unit.

Belfast.—Protest against Award of Contract.—The Secretary of the Belfast Builders' Association has written to each member of the Corporation protesting against the action of the Electricity Committee in recommending the awarding of the contract for the Harbour power station to a certain firm, as it is maintained that the prices tendered by members of the Association were considerably below those specified in the recommended tender. The reasons given by the Committee for its refusal to accept the tenders of Association firms were that members of the Association refused to accept the city surveyor's conditions of contract, and that their tenders were based on a proposed wage increase, allowing for fluctuations. The recommended tender was based on existing wage rates. The Secretary of the Association states that responsible members of the Association tendered at figures about £12,000 below the figure recommended for acceptance by the Committee, and even when the tenders of members of the Association were adjusted to the basis on which the recommended tender was calculated they were still £5,000 below it. The secretary asks, therefore, that consideration of the tenders may be postponed until the wages question is settled when fresh tenders could be invited and given on a fresh basis.

Extensions.—At a special meeting of the Corporation Electricity Committee a report was received relative to the interview which Councillor O. Jamison, Councillor W. Addis, and Councillor T. E M'Connell, J.P., and the city electrical engineer had with consultants in London regarding the installation of the second 6,000-kW set temporarily at the auxiliary power station at Musgrave Channel Road and the provision of the necessary converting plant at the East Bridge station. Already the Council had sanctioned £24,000 for this purpose, but an additional £14,000 was required. The Committee decided to recommend the Council to approve of this expenditure.

Canada. — Hydro-electric Extensions in Manitoba.—The Manitoba Provincial Government proposes to expend a million dollars on the extension of hydro-electric power mains to rural points during this year.—*Reuter's Trade Service* (Winnipeg).

Ceylon. — Hydro-electric Developments. — The Government of Ceylon has approved the recommendations of Mr. J. W. Meares, electrical adviser to the Indian Government, relative to the development of the Laxapana-Aberdeen hydro-electric scheme, and has ordered detailed surveys to be made. The scheme advocated involves diverting by canals the waters of the Kehelgomu Oya and the Maskeli Oya above their junction to a point where an effective head of approximately 2,000 ft. can be obtained. The scheme also involves building storage reservoirs to equalise the flow. The consumers of the power would be the hill country, the Colombo suburban railways, the towns of Colombo and Kandy, tea and other factories, sewage-treatment works, and water-pumping plant for city flushing. As there is not at present sufficient demand for the full 100,000 h.p. which will become available, it is proposed to make an initial development of only 24,000 h.p., leaving future extensions to be performed in three additional developments as the demand for power increases. When the detailed survey is completed, the plans and estimates will be forwarded by the Local Government to the consulting engineer in England, who will draw up conditions of contract and call for tenders.—*Commerce Reports.*

Chester.—Power from the River Dee.—The Board of Trade has inquired of the Electricity Committee whether the Corporation has any reasons to advance why the Board should not now ask for the early removal of the curb from the weir on the river Dee. Instructions were given for the town clerk to explain that the removal of the curb would mean a reduction in the amount of electricity generated, and a consequent reduction in the supplies to industries, many of which already were curtailed considerably, and that such a reduction could not be made good by the steam station, which was already overtaxed, and permission to extend could not be obtained.

Finance.—The city accountant has reported on the expectations of the Electricity Committee. Last year, he stated, there was a net profit of only £164, this year a net profit of £3,873 was expected. There was a probable increase in the charges for light and power, although one increase was made last year. He was told that an increase was likely by reason of the Committee having applied revenue for capital charges, necessitating an overdraft at the bank of about £7,000. The present charge of 5d. was not high, and the average charge for 82 county boroughs was 7d. The tramways had had a bad year on account of the high charges for materials, high wages, and the cost of the permanent way. There was no balance available for transfer to the reserve fund.

Continental.—Switzerland.—The special correspondent at Vevey of the *Daily Mail* gives some details of the effects of the prolonged drought upon the hydro-electric works and connected industries which play such a prominent part in the economic life of modern Switzerland. The large station at Muhleberg, near Berne, which normally produces about 64,000 h.p., was for a time able to supply only 5,000 h.p. The effect of the loss of power upon industry was counteracted to a great extent by the existing trade depression.

Dundee.—Temporary Stoppage.—An exceptionally low tide in the estuary of the river Tay led to an hour's suspension of the supply of electricity on March 23rd. The water required at the station at Carolina Port is drawn from the river by means of a large pipe, the water gaining entrance to the pipe *via* a screened dam. On Wednesday the water receded so far that only a very small portion of the screen was submerged, and a quantity of silt gathered at the bottom of the screen, with the result that water in sufficient quantity could not force a passage ; the condenser vacuum was lost, and the turbines stopped running.

Dutch East Indies.—Electrical Developments.—There are indications of a great development in the generation and use of electricity throughout the Dutch East Indies. Extensive investigations are being made into the water power of the various rivers with a view to the electrification of the railway and tramway systems. Housing and building schemes in all the large towns and seaports in Java and Sumatra call for supplies of electrical apparatus of various types.—*Reuter's Trade Service* (Bombay).

Electricity District.—North-West Midlands.—The Electricity Commissioners give notice that the time within which objections and representations may be made, and schemes submitted in connection with the above-named district, has been further extended from the last day of March until July 30th, 1921.

Hastings. — Plant Extensions. — The Town Council has approved a scheme for extending the electrical plant, at an estimated cost of £51,429. The extensions have been rendered necessary by the great increase in the number of consumers.

India.—Punjab Developments.—The development of schemes for electrical power in the chief centres of the Punjab has lately made considerable progress. Lahore and Amritsar are already provided with electricity, and arrangements are in train for supplying electricity to Rawalpindi, Multan, and Lyallpur.—*Indian Engineering.*

Isle of Man.—Electric Light for Douglas.—In the Legislative Council, on March 8th, the Douglas Corporation Electric Light and Power Bill was read a second time, and the Committee stage of the Bill postponed in order that several amendments suggested by the Postmaster-General, the Manx Electric Railway Co., the Douglas Gas Co., and the original promoters of the Electric Light Bill might be circulated.—*Isle of Man Times.*

Kilrush (Co. Clare).—Electric Lighting.—The Urban Council has decided to ask Messrs. Glynn, owners of an electrical plant with surplus power, to undertake the lighting of the town at a price to be fixed. A member stated that the cost would be about £2,000 or £3,000—or one-half what an outside company would charge.

Mansfield.—Price Increase.—The Town Council has decided to increase the charge for electricity to 10d. per unit, as from the end of the March quarter. The pre-war charge was 4d. per unit.

Newark.—Electricity Scheme.—The Town Council determined, at its meeting on March 21st, to proceed, at an estimated cost of £100,000, with a new scheme of electricity supply. Mr. Wordingham had prepared a project for the establishment of a 1,500-kW plant, with a stand-by plant of similar capacity, it being recommended that, in the event of a provisional order being obtained, his services should be secured to carry out the work. An amendment, which was defeated, was moved in favour of delay and further consideration of the matter by the Committee. Alderman Patrick urged that the Council should not delay any longer a scheme which already had been under discussion for 20 years, and that view was generally acquiesced in, the chairman of the Committee (Alderman Priestley) explaining that it was proposed to deal with Newark and the rural district, and if the East Midland authority was unable to supply Southwell and Farnsfield, to include those places also, together with others *en route*. To ensure a reliable supply, the plant should be duplicated, and with 3,000-kW capacity available they could produce 4,000,000 units per annum. The estimated cost of buildings to house the machinery was £55,000. The average cost per unit would work out at 2·29d.

New Zealand. — Ashburton County Electrical Scheme.—An electrical scheme for the County, at an estimated cost of £230,000, has been decided upon. The plans provide for the distribution of electricity throughout Ashburton County, serving an estimated total of 2,500 consumers, from a supply at 11,000 volts taken in at two points—Ashburton and Methven. The scheme will be entirely self-supporting, the estimate allowing a loss of approximately £2,000 upon the first year's operations. It also provides for the purchase by the proposed Power Board of the plant of the Ashburton Electric Supply Co. Arrangements have been made for the presentation of a petition to the Government asking that a power district be created. The Public Works Department will also be asked to set aside 700 kW from the sixth set at Lake Coleridge for the use of the county.—*Reuter's Trade Service* (Melbourne).

Oldham.—No New Mains.—The Corporation Electricity Committee has decided that for the present new supplies shall only be given along the routes of existing mains, owing to the prohibitive cost of new mains. Similar action has been taken at Blackpool.

Salvador.—Electric Light Company Authorised.—The municipality of Santiago de Maria, Department of Usulutan, has granted a contract for the establishment of an electric light company, which is to furnish light to that city and also to the city of Berlin, in the same department. The United States Vice-Consul there estimates the populations of the two cities at 10,000 and 9,000 inhabitants respectively.—*Commerce Reports.*

St. Helens.—Maximum Charges.—On March 22nd the St. Helens Corporation Bill was again considered by the Local Legislation Committee of the House of Commons. One clause of the Bill was to confer upon the Corporation powers to increase the maximum charges for electricity, and the borough electrical engineer gave evidence in support of this clause. Eventually the Committee decided that the clause should be altered as the Minister of Transport was the appropriate authority to sanction such increases.

Stoke-on-Trent.—Land for Sub-Station.—In response to an application by the Corporation for permission to borrow £2,467 for the purchase of a site for a new sub-station, the Electricity Commissioners have written asking the Corporation to apply in the first place for sanction to hold more than five acres for electricity purposes. This is being acceded to.

Tamworth. — Proposed Mains Extensions. — The Midland Electric Light and Power Co. has applied for an order to lay cables in the parishes of Amington, Bolehall, Glascote, Shuttington, and Wilnecote.

Torquay.—An Alternative Scheme.—Following upon the decision of the Town Council to delay further action with regard to the erection of the proposed station at Newton Abbot, on account of the expense involved, a syndicate has placed before the Electricity Committee another scheme which it is claimed will prove more advantageous and cheaper in first cost. This syndicate is about to engage in the production of oil from the lignite beds of the district, and works are to be erected at Heathfield for this purpose. It is stated that a large amount of surplus power will be available, and the syndicate offers to transmit this in bulk to the Corporation's present station, or to a station erected for the purpose. The cost of the necessary cables will be between 50 and 70 thousand pounds. The Council is making further investigations into the matter.

United States.—Large New York Station.—The *Electrical Review*, of Chicago, states that the United Electric Light and Power Co., New York City, has under construction a new generating plant known as the Hell Gate station. This station, when completed, will be one of the largest generating stations in the world, with a rated capacity of 280,000 kW. The foundations, water-front improvements, &c., are now well under way, and steel erection is about to begin. The plant will be unique in many respects. The turbine room will be parallel and adjacent to the river, so that it will be possible to eliminate the suction tunnel, individual suction pipes being carried through the east foundation wall into the screen basins behind the bulkhead line. The boiler house will be next to the turbine room, between the electrical galleries and the turbine room, and will be separated from the electrical galleries by a narrow passage. The initial installation of generating equipment will consist of two 35,000-kW 25-cycle, three-phase, 11,000-volt General Electric turbo-generators and two 35,000-kW, 60-cycle, three-phase, 15,200-volt Westinghouse turbo-generators.

Waterford.—Extensions Postponed.—The Corporation has decided to postpone consideration of the proposed extension of the city electric lighting, pending the receipt of estimates, &c., as to the lighting of the Ferrybank district.

Watford. — Price Increase. — The Urban District Council has increased the charge for electricity supplied through slot meters from 5½d. to 8d. per unit.

Woking.—Inquiry.—An inquiry was held on March 22nd relative to the application of the Electric Supply Co., Ltd., for power to increase the maximum charge for electricity from 9d. to 1s. 2d. per unit. The application was opposed by the Urban District Council, and it was stated by the company that it was intended to charge only 10d. per unit, unless circumstances rendered it necessary, but the Council declined to agree to this.

York.— Electricity for Sewage Works. — At a meeting of the Flaxton Rural District Council, near York, last week, it was decided to authorise the installation of electric power at the Strensall sewage works, and an agreement with the York Corporation is to be entered into. At present the power is provided by oil engines.

TRAMWAY AND RAILWAY NOTES.

Aberdeen.—Opposition to Order.—The Caledonian, North British, and the Great Northern of Scotland Railway Companies have lodged a petition of protest against certain clauses in the Aberdeen Corporation Provisional Order which seeks, *inter alia*, to obtain powers for the Corporation to construct a railway from Market Street to the electricity works.

Blackpool.—Proposed Fare Increase.—The Corporation is endeavouring to obtain powers to increase the tramway fares. The profits on the undertaking have dropped from £30,000 a few years ago, to barely £5,000.

Continental. — France. — The work of electrifying certain French railroads, which started in 1920, has made rapid progress. The Midi Co. has 150 km. of double-track electric line in operation, and the work of electrifying 3,000 km. in addition is actually in progress. The reconstruction of two hydro-electric plants, which will furnish 150,000 h.p. each to this road, is nearly completed. The road has placed orders for 50 new electric locomotives of the type used by the Chicago, Milwaukee, and St. Paul Railway. Two other French railroads have undertaken the electrification of sections of their lines—the Orléans, which is electrifying 3,000 km., and the "P.L.M.," which is electrifying the same extent of track. The power for the Orléans road will be furnished by the waterfalls of the Upper Dordogne, and that for the "P.L.M." by the falls of the French Alps. The cost of electrifying these railroads will be in the neighbourhood of 5,000,000,000 fr. The saving in coal will exceed 3,200,000 tons per annum, which, supposing the price of coal per ton to be above or equal to 100 fr., will, at the current rate at which money may be borrowed in France for such work, more than pay the interest on electrification bonds issued.—*Electrical World.*

Paris Municipal Council has decided that women tramcar conductors are to go, though an endeavour will be made to find employment in the depôts for such of them as wish to remain in the tramway service.—*The Times.*

Exeter.—Proposed Sale of Undertaking.—In view of heavy losses incurred by the Corporation tramway undertaking, the City Council, at a meeting on March 22nd, discussed future proposals. It was suggested that the service should be greatly restricted, or that the tramways should be given up, or that the whole business should be sold to a company. The decision is to be made at a later meeting. Provision is made in the coming year for an estimated loss of £1,000. The Tramway Committee attributes the position to advances in wages and the high cost of materials. It was stated that the tramway staff was discontented. Pending a final determination as to the future of the tramways, approval has been given by the Council to the sale of surplus stores, amounting to £1,320.

Keighley.—Increased Charge for Power. — The Electricity Committee has recommend that the price of electricity supplied to the tramway department be increased to a flat rate of 1·75d. per unit. The present charge is 1·5d. per unit for the first 250,000 units, and 1d. per unit above this amount. The increased charge, it is recommended, should be placed in force upon April 1st, and retained for a period of one year.

London.—Extension of Suburban Services.—The London County Council has completed the track on Eltham Road, Lee, and in a few days' time will extend service 46—Southwark Bridge and Eltham—to Beresford Square, Woolwich. This will afford at least three advantages :—A through route from Beresford Square to Lewisham, a quicker route from Shooter's Hill to Lewisham (by avoiding the journey *via* Woolwich Road), an alternative route, for the major part rural, from Bereford Square to Forest Hill, Catford or Beckenham Lane by a change at Lewisham Obelisk. The new tramway will serve the housing estate of the Woolwich Borough Council as well as the older portion of Eltham, where some property has been pulled down and the road widened. —*Kentish Mercury.*

Train Mishap.—On March 28th, as a train left the Farringdon Street Station of the Metropolitan Railway, a sudden access of speed caused some couplings in the middle of the train to break. The rear carriages remained in the station, and the front portion of the train proceeded some distance before it could be stopped. The passengers were transferred to other coaches.

Leyton.—Proposal to L.C.C.—In the hope of turning losses into profits, the Leyton (Essex) Council is asking the London County Council to take over its tramway system under a partnership scheme for 10 years.—*Daily Mail.*

Liverpool.—Report on Accident.—Major A. Mount, R.E., has presented a report to the Ministry of Transport upon an accident which occurred at the James Street Station on the Liverpool Overhead Railway, on January 25th. Two electric trains were involved ; one was standing at a platform when the other ran into its rear, causing shock and minor injuries to about 37 persons. The inspector states that this was a simple, but serious, case of misunderstanding and slack working under normal conditions, and he is satisfied that the signals and block instruments concerned were in working order. It appears that a ticket collector, who was responsible for the block instruments, displayed a green light, stating that he took the starting signal to be "off." After the train had proceeded, he discovered that the James Street section was blocked. He tried to rectify his mistake by telephone, but the collision occurred almost immediately. The driver of the second train said that he noticed both the collector's green light and also that the starting signal was at "danger." He took the collector's signal to mean that the fixed signal was out of order, and so proceeded. This was against a definite rule on the subject of defective signals, and Major Mount, therefore, lays the blame equally on the collector and the driver. It is recommended that the practice of hand-signalling all non-stop trains should be discontinued, as it is misleading. The inspector also recommends the abolition of cut-out switches in cabs, and the installation of louder bells on the block telephones.

Railway Fusion.—L. & N.W. & Lancs. & Yorks. Companies.—A provisional agreement has recently been entered into for the acquisition of the Lancashire and Yorkshire Railway Co. by the London and North-Western Railway Co. The "London and North-Western" title will cover both systems, which will be governed by one board of directors. The L. & N.W. Co.'s mileage is 2,338, and the L. & Y. Co. operates 2,262 miles of line.

Wolverhampton.—Progress of Works.—The work of transferring the tramways from the Loraine to the overhead system is being pushed forward. On March 26th the Dudley Road route was completed, and a direct service from Wolverhampton to Dudley thus established.

TELEGRAPH AND TELEPHONE NOTES.

Ireland.—Telephone Service.—On the morning of Easter Monday Sinn Feiners raided a number of telephone exchanges in County Dublin, including those at Kingstown, Foxrock, Blackrock, and Dalkey, dismantling or carrying off all the instruments. At some places the complete switchboards were removed, and at Kingstown even the generator was removed.

Trans-Atlantic Amateur Wireless Telegraphy. — Result of Tests.—The *Wireless World* of March 19th reports the result of the competition which took place on February 2nd, 4th and 6th. No competitor succeeded in receiving the test signals from the United States, but a prize offered by Messrs. Burnham and Co. for the best description of the apparatus used, was won by Mr. W. R. Wade, of Clifton, Bristol.

United States.—A Wireless Record.—The world's long-distance record was broken by the U.S. Navy, on March 8th, by the sending of messages within three minutes from Gavite, Philippine Islands, to Washington, a distance of 10,000 miles. The Gavite station sent test messages 7,000 miles to the Goat Island station; the message was then forwarded to San Diego, and thence to Washington. Naval officials are said to attach considerable importance to the record, because it indicates the possibility of abolishing the present system of sending messages by cable *via* Midway Islands, Guam and Honolulu. It was also said that a new automatic control, which was used in making the record, eliminated all handling of messages between originating and receiving points. This would give American warships direct communication with Washington from any point within 3,000 miles of a shore station. —*Reuter's Trade Service* (San Francisco).

West Indies.—Cable Service.—*The Times* reports that in the House of Commons on March 21st, Mr. Baldwin moved:—"That the agreement, dated March 16th, 1921, between His Majesty's Government and the West India and Panama Telegraph Co., Ltd., supplemental to the Agreement, dated August 10th, 1914, entered into between His Majesty's Government, the Government of the Dominion of Canada, the Crown Agents for the Colonies, and the West India and Panama Telegraph Co., Ltd. (H.C. 447, of 1914), be approved." Mr. Pike Pease, Assistant Postmaster-General, in reply to questions, said that the company was actually in a very bad way at the present moment, and its increased expenses had more than absorbed the increased revenue. The need for the whole of the State subsidy was greater than it was in 1914. The company had been obliged to sell practically all its investments, and if the refundments due under Clause 14 of the Agreement were insisted upon it would probably have to cease working almost at once. The whole question of the West Indian telegraph communication was being fully considered by a sub-committee of the Imperial Communications Committee, and it would not be possible at present to bring into operation an alternative service, whether cable or wireless. Therefore it was absolutely necessary to take the course which they had pursued. The Canadian Government had paid its portion of the subsidy up to December 31st last, and he hoped that it might be possible to arrange with it to take the same course which the Government was asking the House to pursue. Lieut.-Col. Amery, Under-Secretary for the Colonies, in answer to Mr. Hurd, said that the West Indies hoped to secure a direct cable service through Bermuda, but he did not think it possible to get such a service within the next year or two. The motion was agreed to.

A White Paper was issued on March 21st containing a copy of the agreement under which His Majesty's Government is entitled to a refund of part of the subsidy paid for the year ended September 30th, 1919. Having regard to the importance of maintaining the service, the present agreement provides for a modification of Clause 14, as a result of which, in any year as from and after the fourth anniversary of the date on which the original agreement came into force, the provision for the refund of subsidy to the Imperial Government, in the contingency stated, is cancelled.

Wireless Telephony.—Lightship's Installation.—The first installation of wireless telephony for commercial purposes in the United Kingdom was inaugurated at Liverpool on March 21st, says *The Times*, between the head offices of the Mersey Docks and Harbour Board and the Mersey bar lightship, 12 miles away. The other two lightships guarding the Mersey entrance are connected with the shore by telegraph cables, but that is impracticable in the case of the bar lightship owing to the heavy currents. The apparatus is the Marconi Co.'s portable set of 100-W power with a 35 miles range. The wave length used is 400 metres, to minimise the possibility of interference with other wireless stations. The apparatus is worked by the ordinary crew of the lightship and the Dock Board's shore staff, and will be used for communicating with ships, and for life saving purposes, as well as to enable Dock Board officials to speak with the lightship.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—April 27th. Victorian Railway Commissioners, Spencer Street. Caustic soda primary cells, complete (Contract No. 33,914).*

May 2nd. Victorian Railway Commissioners. Twelve miles of ·015 sq. in. two-core, lead-sheathed, wire-armoured, 2,200-V cable.*

June 22nd. Victorian Railway Commissioners. One electric lifting magnet (capacity ½ ton), one 440-V motor generator.

June 29th. Supply of 1-ton platform type industrial storage battery trucks, also battery charging equipment.—*Reuter's Trade Service* (Melbourne).

Belfast.—April 25th. Electricity Department. E.h.p. and l.p. switchgear. (March 18th.)

Belgium.—April 6th. The Société Nationale des Chemins de Fer Vicinaux, 14, Rue de la Science, Brussels. Laying of the underground armoured cables required in connection with the supply of electricity to the railways in the Louvain section. Particulars can be obtained for 3 francs from the Services Electriques, 48, Rue Montoyer, Brussels.

April 11th. The municipal authorities of Schaerbeek, Brussels. Supply of a quantity of electric cable. Particulars can be obtained from the Service d'Electricité, Hotel Communale, Schaerbeek.

April 25th. Deputation Permanente du Limburg. For the establishment of an electricity supply in the Genck-Hasselt-St. Trond district. Copies of the specification and plans can be obtained on application to 99, Rue des Flamands, Louvain, while tenders, on special forms, are to be sent by registered post to Le Gouverneur de la Province de Limburg, Hasselt, Belgium.

Bridgend.—April 12th. Urban District Council. Electricity Department. One 400-kW triple expansion steam engine, direct-coupled to an alternator. (See this issue.)

Canary Islands.—April 7th. The Cabildo Insular de Teneriffe, at Teneriffe, Canary Islands. For the establishment of a telephone service between Santa Cruz de Teneriffe and Guimar.

Cardiff.—April 11th. Welsh National Memorial Association. Electric lighting plant for the Glan Ely Sanatorium. Two 20 kW internal-combustion engine-driven generator sets, battery charging booster, switchboard, and battery of accumulators. (March 25th.)

East Ham.—April 2nd. Electricity Department. L.p. paper-insulated, lead-covered, armoured concentric cable, with necessary joint boxes, &c.; also two c.i. lighting feeder pillars. (March 18th.)

France.—April 5th. The French State Railway authorities, 43, Rue de Rome, Paris. Supply of four 8-ton electric travelling cranes for the new railway workshops at Sotteville-Quatre-Mares, Rens. Particulars may be obtained from the Services Electriques (1st Division) at the above address.

Glasgow.—April 2nd. Corporation Electricity Department. Works required in connection with erection of sub station in Buchanan Street. Corporation Electrical Engineer.

Holmfirth.—April 8th. Urban District Council. Electricity Department. Erection of additional overhead mains (approximately four miles). (See this issue.)

Jugo-Slavia.—May 1st. The Serb, Croat, and Slovene Ministry of Public Works. Erection of a power-station, main conductors and transforming stations in connection with an electrical scheme at Kostolac for the supply of energy to Belgrade, Semlin, &c.*

The Commercial Secretary to H.M. Legation at Belgrade reports that a prominent business man and proprietor of flour mills in Serbia is contemplating the installation of a complete electric lighting and power station, and is asking for tenders for the necessary plant, which includes one steam engine of 150-h.p., generators, &c., for power for 4,000 to 5,000 lamps (about 90-kW), and overhead cables and conductors for 60 kilometres of circuits (to provide lighting for about 1,400 houses). The name and address of the inquirer may be obtained by United Kingdom firms interested, on application to the Department of Overseas Trade in London.

London.—H.M. Office of Works. April 12th. Supply of electrical labour-in-daywork in the Leeds district. (March 18th.)

L.C.C. April 18th. 5,500 tons of standard steel girder tramway track rails, lipless track rails and renewable guard rails with fastenings. Chief Engineer, County Hall, Spring Gardens, S.W. 1.

New Zealand.—April 19th. Public Works Department. H.M. Trade Commissioner has forwarded particulars of a call for tenders for 6 000 pin insulators, suitable for a line operating at 66,000 volts between phases. Tenders (accompanied by deposit of £100) to the Secretary, Public Works Tenders Board, Government Buildings, Wellington. Specifications may be seen at the Department of Overseas Trade, 35, Old Queen Street (Room 59), Westminster, S.W.1.

South Africa.—Pretoria.—May 10th. Municipality. Switchgear. Tenders, marked "Electric Light and Power Department, 1920 Extensions, Contract No. 5," to Deputy Town Clerk, Municipal Offices, Pretoria, on May 10th. Deposit, five guineas. Further particulars may be obtained from the general manager of the Electric Light and Power Department, or from the consulting engineer, Mr. G. M. Clark, 40-42, Meischkel's Buildings, Johannesburg.

Johannesburg.—June 22nd South African Railways and Harbours. Electrification of Capetown and Simonstown and Durban-Maritzburg lines: Overhead equipment of permanent way and overhead transmission line, switchgear and accessories, and trackbonds. (See this issue.)

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* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—New South Wales.—P.M.G.'s Department. Accepted :—

One additional primary-line switch unit for automatic exchange, Balmain, £862.—Automatic Telephones (Aust.), Ltd.
Automatic switchboard material, £180.—Automatic Telephones (Aust.), Ltd,

Victorian Railways Department. Accepted :—

Impregnating plant, spare parts and humidity gauge, for impregnating electrical apparatus with insulating varnishes and solid compounds, £4,461 each.—Gibson Battle (Melbourne), Pty., Ltd.
400-kW transformer, £983.—General Trading Co. —*Tenders*.

Government Contracts. — The following Government contracts were placed during February, 1921 :—

ADMIRALTY : CONTRACT AND PURCHASE DEPARTMENT.

Automatic telephone exchange equipment.—Relay Automatic Telephone Co., Ltd.
Electrically-operated jib crane.—Armstrong & Main, Ltd.
Electrical condenser.—W. A. Hole.
Electric lighting, &c.—G. E. Taylor & Co., Ltd.
Electric fans.—General Electric Co., Ltd.

WAR OFFICE.

Distributing boards.—General Electric Co., Ltd.; W. Sanders & Co.
Bridge meggers.—Evershed & Vignoles, Ltd.
Electric cells.—Fuller's United Electric Co., Ltd.; Siemens Bros. & Co., Ltd.

AIR MINISTRY.

Electric wiring.—T. Clarke & Co.
Magnetos.—British Thomson-Houston Co., Ltd.
Magneto spares.—North & Sons.

POST OFFICE.

Protective apparatus.—British L.M. Ericsson Manufacturing Co., Ltd.
Telephone apparatus.—British L.M. Ericsson Manufacturing Co., Ltd.; Phœnix Telephone & Electric Works, Ltd.; Siemens Bros. & Co., Ltd.
Terminal blocks.—General Electric Co., Ltd.; Phœnix Telephone & Electric Works, Ltd.
Telegraph and telephone cable.—British Insulated & Helsby Cables, Ltd.; Glover & Co.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.
Cords for telephones.—London Electric Wire Co. & Smiths, Ltd.; Phœnix Telephone & Electric Works, Ltd.
Cable drums.—Macintosh Cable Co., Ltd.
Ducts.—Exors. of the late H. R. Mansfield; Sharp, Jones & Co.
Laying conduits.—Birmingham-Worcester (Section III) and Birmingham-Worcester and Droitwich (Section II): E. E. Jeavons & Co., Ltd. Canterbury-Ramsgate-Margate, Colchester-Ipswich (Sections I and II), Hampstead (Belsize Park) and Purley-New Oxted (Section II): O. C. Summers. Ealing (Castlebar) and London-Bristol-Newport (S.-W., Section 5): Whittaker Ellis. London-Dorking (Section I): J. Mowlem & Co., Ltd. London-Uxbridge-High Wycombe (Hyde Park, &c.): G. J. Anderson. Newcastle-Durham (Section Ia): W. Turner (Ardwick), Ltd. Portsmouth-Ryde: H. Linington. St. Pancras: A. Thomson & Co. Wembley (N. & N.W.) area: J. A. Ewart, Ltd. Widnes-Runcorn: Hodge Bros. (Contractors), Ltd.
Manufacture, supply, drawing-in, and jointing cable.—Chester-Hawarden: British Insulated & Helsby Cables, Ltd. Derby-Sheffield and Sheffield-Leeds: Western Electric Co., Ltd.
Distribution cable plugs.—British Insulated & Helsby Cables Ltd.
Insulator rings.—Avon India-Rubber Co., Ltd.
Solder.—British Insulated & Helsby Cables Ltd.; E. Cowles.
Telephone exchange equipment.—Cambridge: Western Electric Co., Ltd.
Wallboards.—Thornton-Pickard Manufacturing Co., Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.; British Insulated & Helsby Cables, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co., incorporated in the London Electric Wire Co. & Smiths, Ltd.
Copper binding wire.—F. Smith & Co., incorporated in the London Electric Wire Co. & Smiths, Ltd.
Enamelled and silk covered and copper wire.—Phœnix Telephone and Electric Works, Ltd.
Tinned copper wire.—Richard Johnson & Nephew, Ltd.

HIGH COMMISSIONER FOR INDIA.

Cable.—British Insulated & Helsby Cables, Ltd.; W. T. Glover & Co., Ltd.; Pirelli General Cable Works, Ltd.; Siemens Bros. & Co., Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. & Smiths, Ltd.); Union Cable Co., Ltd.; Western Electric Co., Ltd.
Inert cells.—Fuller's United Electric Works, Ltd.
Crucibles.—Morgan Crucible Co., Ltd.
Insulator cups.—T. De la Rue & Co., Ltd.
Generating sets.—Lancs. Dynamo & Motor Co., Ltd.
Electric lamps.—General Electric Co., Ltd.
Meters.—Ferranti, Ltd.
Electric motors.—Lancs. Dynamo & Motor Co., Ltd.; Veritys, Ltd.
Stator, &c.—British Thomson-Houston Co., Ltd.
Switchboard.—Erskine Heap & Co., Ltd.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.
Electric wire.—Derby & Co., Ltd.
Galvanised wire.—R. Johnson & Nephew, Ltd.; Rylands Bros., Ltd.
Iron wire.—Dorman, Long & Co., Ltd.
Steel wire.—Shropshire Iron Co., Ltd.; Siemens Bros. & Co., Ltd.; Whitecross Co., Ltd.

CROWN AGENTS FOR THE COLONIES.

Alternator and condensing plant.—C. A. Parsons & Co., Ltd.
Battery.—Tudor Accumulator Co., Ltd.
Cable.—Western Electric Co., Ltd.; W. T. Glover & Co., Ltd.
Cables.—Callender's Cable & Construction Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.
Ceiling fans.—General Electric Co., Ltd.
G.I. wire.—Rylands Bros., Ltd.
Insulator cups.—Bullers, Ltd.
Pole distribution boxes.—British Insulated & Helsby Cables, Ltd.
Porcelain grids, &c.—Chloride Electrical Storage Co., Ltd.; Telegraph Iron Works; Bullers, Ltd.
Telegraph line material.—Siemens Bros. & Co., Ltd.; Bullers, Ltd.
Telephone, &c.—British L.M. Ericsson Manufacturing Co., Ltd.
Wire.—R. Johnson & Nephew, Ltd.
Bronze and copper wire.—T. Bolton & Sons, Ltd.

H.M. OFFICE OF WORKS.

Engineering services, Royal Mint switchboard: Drake & Gorham, Ltd.
Miscellaneous cable.—Enfield Ediswan Cable Works, Ltd.
Electric cable and wire.—General Electric Co., Ltd.; H. W. Smith & Co. (1920), Ltd.; Hackbridge Cable Co.

Lurgan.—Urban District Council. Accepted :—

Cables for the electricity scheme, £3,156.—Enfield Ediswan Co., Ltd.

New Zealand.—Auckland.—The City Council has accepted the following principal tenders for the extension of the city's electricity system :—

Generator plant, £94,000.—British General Electric Co.
Remainder of machinery, £77,000.—British Thomson-Houston Co.
Boilers, £81,000.—Babcock & Wilcox, Ltd.
—*Reuter's Trade Service* (Melbourne).

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, April 1st. At 39, Victoria Street, S.W. At 7.30 p.m. Paper on "Pneumatic Conveyors," by Mr. M. Jennings.

Friday, April 8th. At the Caxton Hall. At 8 p.m. Questions and general discussion.

Institution of Production Engineers.—Saturday, April 2nd. At 2 and 4, Tudor Street, E.C. At 6 p.m. General meeting to approve articles of association and by-laws.

Society of Engineers (Incorp.).—Monday, April 4th. At Burlington House, Piccadilly, W. At 5.30 p.m. Ordinary meeting.

Manchester Wireless Society. — Tuesday, April 5th. At the Albert Hall, Albion Hotel. At 7.30 p.m. Paper on "The History of the Telephone," by Mr. A. Marr.

Paisley Association of Electrical Engineers.—Wednesday, April 6th. At the Y.M.C.A., 25, High Street. At 7.30 p.m. Annual business meeting

Faraday Society—Joint Meeting with the Institution of Mechanical Engineers, and other Institutions.—Wednesday, April 6th. At the Institution of Mechanical Engineers. At 2.30, 5, and 8 p.m. Discussion on "The Failure of Metals under Internal or Prolonged Stress."

Royal Society of Arts.—Wednesday, April 6th. At John Street, Adelphi, W.C. At 8 pm. Paper on "The Octophone," by Mr. A. Barr.

Chemical Society.—Thursday, April 7th. At Burlington House, Piccadilly. At 8 p.m. Lecture by Dr. F. W. Aston.

Institution of Electrical Engineers.—Thursday, April 7th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Paper on "Some Recent Developments in Steam Turbine Practice," by Mr. K. Baumann.

Western Centre. — Monday, April 4th. At the Public Library, Swansea. At 6 p.m. Paper on "The Commercial Application of Variable Speed Motors," by Dr. S. Parker Smith.

North-Western Centre.—Wednesday, April 6th. At the College of Technology, Manchester. At 7.30 p.m. Lecture on "Developments in Wireless Telegraphy and Telephony," by Prof. E. W. Marchant.

South-Midland Centre. — Wednesday, April 6th. At the University, Birmingham. Ordinary meeting.

Physical Society of London.—Friday, April 8th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary scientific meeting.

Edinburgh Electrical Society.—Friday, April 8th. At the Philosophical Institute. At 8 p.m. Electrical questions and answers.

Salford Technical and Engineering Society.—Saturday, April 9th. At the Royal Technical College. At 7 p.m. Paper on "Correct Lubrication," by Mr. A. B. Smith.

NOTES.

Bogus Electricity Inspectors.—The *Manchester Guardian* warns its readers that recently many instances have occurred in Manchester of men calling at houses and representing themselves to be employés of the Corporation Electricity Department, obviously with the intention of theft. The genuine inspectors are always in uniform, and bear a written authority, the exhibition of which should be demanded.

Educational.—Birmingham University.—The Council of the Birmingham University is taking steps to bring members of the staple trades of Birmingham and the Midlands into closer relationship with the University by making them acquainted with the opportunities for training of students at the new buildings at Edgbaston. Last Thursday the leading members of the iron and steel trades paid a visit, and they were conducted over the technical departments by Prof. T. Turner. Considerable interest was shown in the electrical engineering, mechanical engineering, and metallurgical departments.

Radium for Paris.—The Municipality of Paris has voted a sum of £100,000 for the purchase of 2 grammes of radium for use in public hospitals.

E.T.B.I. Concert.—A smoking concert has been organised by the Manchester and District Local Advisory Committee of the Electrical Trades Benevolent Institution, which will take place at the Albion Hotel, Piccadilly, Manchester, this evening.

The Batti-Wallahs' Society.—The annual general meeting was held at the Holborn Restaurant on the 21st ult., following the luncheon that this lively Association holds monthly. Among the guests was Mr. Beresford ("Tendency Beresford"), President of the American Institute of Electrical Engineers, and a complimentary reference to his presence brought from him a capital little speech in reply.

The retiring President, Mr. W. Wyld, was in the chair until such time as he gracefully handed it over to the newly-elected President, Mr. W. F. Ireland.

The hon. secretary, Mr. F. Pooley, reported sound progress in 1920, both in numbers and in finance, and the meeting registered a resolve to make the Society still more comprehensive in 1921. Mr. Pooley was presented with a most handsome silver bowl, which was inscribed as a small tribute of esteem and gratitude for his long and splendid services to the Society.

The following is the list of officers elected at the meeting :—President : W. F. Ireland. Vice-Presidents : E. Barralet, C. Newton Russell, E. P. Barfield, R. W. Hughman. Committee : A. W. Blake, H. Foulds, L. S. Richardson, J. P. Maginnis, A. F. Harmer, M. R. Gardener. Hon. Sec. and Treasurer : F. Pooley. Hon. Entertainment Secretary : A. J. Greenly.

Educational Kinemas.—When the Lycées of Paris obtain the kinema sets, which the Minister of Education intends shortly to distribute, they will be applied, in the first instance, says the *Daily Mail*, to the teaching of natural history.

Football.—In a football match at Wigan, between the employés of the Southport Corporation Electric Tramway and the Wigan Corporation Electric Tramway employés, the latter were the victors by 2 to 1.

Service Notes.—Capt. E. B. Hunter, A.M.I.E.E., from the London Electrical Engineers, has been gazetted a major in the Territorial Reserve of Officers, from March 23rd last. Lieut. R G. Burton, from the London Electrical Engineers, has been similarly appointed to the Territorial Reserve of Officers. Lieut. R. G. Smith, who was in the Territorial Reserve of Officers for some time, has been re-appointed to the Lancashire Fortress Engineers, Territorial Force (Electric Lights Company). Recruiting for the electrical departments of the Navy and Army is very good just now, and a good type of men is being obtained for both Services.

It is officially announced that the Admiralty Experimental Station at Shandon, Dumbartonshire, set up during the war for scientific, experimental, and research work, was to be completely closed down by March 31st. On this date the appointment of Senior Naval Officer, Shandon, held since June, 1919, by Capt. George L. Massey, who in the war was Assistant Director of Paravanes, was to be terminated. The naval part of the Shandon base has been known as H.M.S. *Crescent III*, the *Crescent* being the depôt ship at Rosyth for the Scottish Command, and this unit was also to be paid off on March 31st, says *The Times*. Research work for the Navy will in future be chiefly carried on at the Naval Research Institute at Teddington, which, it is hoped, will be complete by the end of the present financial year. The reason for the abandonment of Shandon was on account of its distance from the open sea and from the experimental schools at the ports, the various scientific institutions, and the Admiralty.

The Consumption of Electricity by Domestic Appliances.—The following figures indicate the value of a steady propaganda in favour of the subsidiary uses of electricity in the home. As most of the appliances named use electricity at lighting rates, we have assumed a price of 6d. per unit :—

	Watts capacity.	Use, hours per annum.	Units, per annum.
100 fans	100	100	1,000
100 irons	300	150	4,500
100 table hot-plates... ...	200	100	2,000
100 kettles	500	100	5,000
100 water or milk-heaters ...	250	50	1,250
100 toasters...	200	60	1,200
100 vacuum cleaners ...	250	300	7,500
100 washing machines ...	250	150	3,750
800 pieces.			26,200

26,200 units at 6d. = £655 per annum.

If the peak load is not increased by the use of these devices, the cost of the energy is only that ascribed to "running costs," so that the bulk of the revenue is net profit.

Appointments Vacant.—Tramway overhead linesmen (78s. 8d.), for the Borough of Wigan Tramways Department; shift engineer, for the Rawtenstall Corporation Electricity Department. See our advertisement pages to-day.

A Municipal Exhibition.—To educate the public up to the advantages conferred by the use of electricity should be one of the first considerations of a municipality owning an electricity undertaking. We are pleased to see that Aylesbury set an excellent example in this direction by the organisation of an electrical exhibition, last week. The show, which was formally opened by the Mayor, Alderman James Robinson, on March 21st, was arranged by the borough electrical engineer (Mr. W. A. Turnbull) and his staff, and their efforts were amply rewarded by the keen interest shown by the visitors. The exhibition covered both domestic and agricultural appliances, and these were shown in working. The best way of all was chosen for the display of the domestic side of the show—*i.e.*, by arranging the exhibits in their correct surroundings, in a bedroom, drawing room, dining room, and kitchen. Each room presented an example of correct and scientific lighting and heating. Local firms carried out the decoration and furnishing. Among the devices which appeared were "Carola" heating pads in the bedroom, a "Lightning" oven in the kitchen, and "Aqua" and "Stanton" water-heaters supplying hot water to a bath. The Western Electric Co., Ltd., was very much to the fore, its stand bearing examples of many of its appliances, including a washing machine, a dish washer, a sewing machine, and vacuum cleaners. The stand was illuminated by means of flood lighting. Mr. Gowan, an enterprising local contractor, was responsible for a most imposing display in the centre of the hall. Assisted by demonstrators. Mr. Gowan showed washing machines, cookers, and smaller apparatus under working conditions. A number of lighting sets were exhibited by various firms, these including "Lalley Light," "Austin," and "Aster" sets. The Jackson Electric Stove Co. had an excellent range of its products, and cooking was carried on continuously.

Upon the agricultural side were gravel crushers, fodder slicers, milk separators, and centrifugal pumps, automatically controlled, the principal manufacturers represented being Messrs. Brown and Sons, of Leighton Buzzard. A 2½-ton electric vehicle, built by Messrs. Ransomes, Sims & Jefferies, Ltd., was driven round the district by Messrs. Messey & Co., Ltd., to advertise the exhibition. Other exhibitors included the General Electric Co., Ltd., the Hot Point Co., the Bastian Co., the British Electric Transformer Co., Ltd., &c.

The latest aid to publicity—the kinematograph—was made full use of, both the Western Electric Co. and the Hoover Suction Cleaner Co. loaning films for the purpose.

Many useful lectures were given to appreciative audiences, among the speakers being Mr. J. W. Beauchamp, of the British Electrical Development Association; Mr. Napier Prentice, of Felixstowe; Mr. Borlase Matthews, A.M.I.C.E., and Mr. W. T. Kerr, borough electrical engineer, Hereford, who lectured on the applications of electricity to agriculture. Mr. W. A. Turnbull also lectured, and Mr. Ll. B. Atkinson, President I.E.E., was present on March 24th.

It is to be hoped that the exhibition will be followed by a tremendous rush for electricity and electrical appliances. Much of the success was due to Mrs. W. A. Turnbull, who rendered valuable assistance in demonstrating for and instructing lady visitors.

After the close of the show the staff was entertained to supper by Mr. Turnbull, when they were thanked for their good work.

The Metric System in Japan.—The Director of the International Bureau of Weights and Measures has informed the Academy of Sciences that the Japanese Parliament has passed an Act for the compulsory adoption of the metric system.

Electrical Apprentices.—In reply to an advertisement for three apprentices at Burnley electricity works, the Corporation has received 100 applications.

Empire Naval Policy.—The Memorandum supplementing Lord Lee's statement reviewing the history of the past year states, says the *Times*, that it is hoped that the Naval Research Institution at Teddington close to the National Physical Laboratory will be complete by the end of the present financial year. Referring to "the very economical arrangements made with regard to optical research and experiment," the memorandum says:—"It was arranged earlier in the year that the requirements of the fighting services could best be met by co-operation, and it has been decided that the Admiralty shall maintain an Optical Section at the Naval Research Institution which shall carry out research and experiment for both the Navy and Army. Until the Admiralty building at Teddington is complete the Optical Section will be housed by the National Physical Laboratory. In a somewhat similar way it has been possible to centralise research work in gyroscopes, it having been decided to continue such research work at the Royal Naval College, Greenwich."

A Division of the Naval Staff has been made responsible for formulating proposals for the commercial application of scientific devices, originally developed for naval purposes, which may be suitable for commercial application. The Admiralty proposes to lay a leader cable in a position where its commercial application can be fully demonstrated, in order that the Mercantile Marine may have every opportunity of investigating the practical commercial value of the device. It is believed that the adoption of leader gear off the entrances to some of our commercial ports will prevent considerable losses both of time and material.

Many directional wireless telegraphy stations were set up on the coasts of the United Kingdom during the war, and several of these, since the Armistice, have been placed at the disposal of ships of the Mercantile Marine. As the stations are not required in peace time for naval work, they are being turned over to the Post Office, except one which will be employed on development and research work.

The policy with regard to deck and engineer officers set out last year has been continued, and it is proposed to introduce certain modifications in the present system of engineering training. The time has arrived for arranging gradually to transfer the duties in connection with the electrical installations of H.M. ships from the charge of the torpedo lieutenant, a deck officer, with whom it is vested at present, to the engineering side. The maintenance in an efficient condition of electrical machinery is a similar function to that of the maintenance of other machinery on board ships; the proposals, therefore, for the future training of officers for the engineering branch make provision for a proportion of those officers to become electrical engineering specialists. It has been deemed desirable to arrange for the separation of deck and engineering branches to take place earlier than has hitherto been the case. Those on the engineering side require, before proceeding to sea, to receive a thorough grounding in engineering and electricity, and to undergo a period of practical work in the workshops. For this purpose they will first proceed for three years' training at the Engineering College at Keyham, and will undergo a course similar to the one which all engineer officers in H.M. Navy formerly underwent, and which gave us the splendid body of officers to whom we owe the engineering efficiency of the fleet during the war. On completion of this course they will then proceed to sea to carry out engineering duties afloat. Specially selected officers will be given the appropriate advanced courses at Greenwich as may be necessary. Those officers who have qualified in the advanced marine engineering course will be eligible as at present for the higher posts; those who have qualified in the advanced electrical course will be employed in ships requiring them and will be eligible for selection for the higher electrical positions. As specialist electrical officers become available the electrical installations in the more important ships now in charge of torpedo lieutenants will be transferred to them, and in the less important ships the electrical installations will be in charge of an engineer officer.

Electricity (Supply) (No. 2) Bill.—A special committee appointed by the Council of the Association of Municipal Corporations had an interview with Mr. Arthur Neal, Parliamentary Secretary of the Ministry of Transport, and the Electricity Commissioners, on January 21st, and recently issued a report on the No. 2 Bill, suggesting various modifications. The report has been adopted by the Council. The Committee suggests that a joint authority shall not be restricted in borrowing for working capital to a period of three years, as laid down in Clause 1, since it may require no capital during that period, but may need it later. With regard to Clause 2, the Committee would extend the permission to suspend sinking-fund payments to cover all moneys borrowed for the purposes of the Electricity (Supply) Acts, and not only loans raised subsequently to the passing of No. 2 Bill; it would also add power to capitalise interest during construction. By the Act of 1919, the expenses of the Electricity Commissioners are placed upon the shoulders of the joint electricity authorities and authorised undertakers of the United Kingdom; as they are, in effect, a Government department, objection is raised to the provision, and it is urged that Sec. 29 of the Act of 1919 should not be amended but repealed. Clause 8 authorises the Minister to transfer to a joint authority the whole or part of the undertaking of an authorised undertaker who is unable to supply electricity, or to empower the joint authority to supply electricity within the area: it is proposed that this power to supply in default shall extend only to that part of the area within which the authorised undertaker is unable to give the supply. Clause 13 provides that deficiencies in the accounts of a joint authority may be met by contributions levied from the constituent bodies represented on the joint authority, objection is taken to the provisions of the clause so far as they are compulsory.

Clause 15 extends the period for repayment of sums advanced by the Treasury for urgent works from two to five years; the Committee desires that the period shall be further extended to 15 years, but Mr. Neal, at the interview, pointed out that the intention was not to finance the joint electricity authority, but to save time by providing money for urgent works while the authority was being established and got into working order. Directly the works were handed over to the authority, the latter should provide the money. The clause was intended to ease the burden by extending the time and providing for payment by instalments.

Radio-Activity and Plant Growth.—According to an article by Prof. G. Petit, in *La Nature*, experiments have shown conclusively that radio-active substances have an important effect on the growth of plants, provided that too great a quantity of the substance is not employed. Researches are in progress to determine the best conditions and methods of application, and the manner in which the improved results are brought about.

INSTITUTION NOTES.

The Institution of Electrical Engineers.—Liverpool Sub-Centre.—Mr. Mallinson read his paper on "Electric Driving in the Paper Mill on Heat economy Lines" before the Liverpool Sub-Centre, on March 21st. Mr. T. D. Clothier, in opening the discussion, remarked on the low speeds referred to, and questioned whether these could not be boosted up. He also referred to the high percentage of energy required to drive the machinery required for paper-making against that actually used for the manufacture. Mr. Rattenbury offered some useful suggestions that he thought might overcome the switchgear difficulties enumerated by Mr. Mallinson. Mr. Malpas referred to the heating of paper mills, and asked several questions dealing with the technical manufacture of paper. Messrs. Cooper and Wilson also took part in the discussion.

Western Centre.—An ordinary general meeting will be held at Swansea on Monday, April 4th, when Dr. S. Parker Smith, of the City and Guilds Engineering College, London, will deliver a a lecture on "The Commercial Application of Variable-Speed Motors."

Previous to the meeting at Bristol on May 2nd, when the Centre will be addressed by the President, Mr. Llewelyn B. Atkinson, it is proposed to hold a dinner if a sufficient number of members are willing. Early application for tickets should be made to Mr. A. J. Ostler, Electricity Department, The Exchange, Corn Street, Bristol.

The annual report for the 1919-1920 Session of this Centre states that the session (the eighth) has been an important one, following upon the extension of the area referred to in the last annual report. Seven meetings—four in Cardiff two in Bristol, and one in Swansea—were held. The latter was the first held by the Western Centre in Swansea, and it was most successful.

The attendance at all the meetings has been such as to encourage the Committee in increasing the scope of its operations, and it will no doubt further consider the junior members of the Centre, and provide means whereby they will be able to take a greater part in the discussions.

The membership of the Centre for 1920 was as follows:—Members, 75; associate members, 218; associates, 15; graduates, 34; students, 73; total, 415.

The Faraday Society and Engineering Institutions.—A joint general discussion on "The Failure of Metals under Internal and Prolonged Stress" will be held in the Hall of the Institution of Mechanical Engineers, on Wednesday, April 6th, from 2.30 to 10.30 p.m., by the Faraday Society, the Institution of Mechanical Engineers, the Iron and Steel Institute, the Institute of Metals, the North East Coast Institution of Engineers and Shipbuilders, the West of Scotland Iron and Steel Institute, and the Institution of Engineers and Shipbuilders in Scotland.

An introductory address will be read by Dr. W. Rosenhain, F.R.S., giving a general survey of the subject. Papers of a general character will occupy the rest of the afternoon, and the second session, 5 to 6.30 p.m., will be devoted to a general discussion. After dinner there will follow papers and discussions dealing with "Causes of Failure of Brass and Steel." Amongst the papers to be presented are the following:—L. Archbutt: "Failure of the Lead Sheathing of Telegraph Cables"; H. S. Rawdon: "The Presence of Internal Fractures in Steel Rails, and their Relation to the Behaviour of the Material under Service Stresses."

Royal Institution.—The "Tyndall Lectures" will be delivered by Mr. C. T. R. Wilson, who will speak on "Thunderstorms," beginning on Thursday, April 7th.

Edinburgh Electrical Society.—At a meeting held on March 25th, Mr. W. Leithead delivered a lecture on "Automatic Telephones." After a brief reference to the history and varieties of automatic exchanges, the lecturer gave a very full and detailed description of the Strowger apparatus. He showed how preliminary difficulties had been overcome and the modern gear perfected. The lecture was illustrated by lantern slides and diagrams. In the course of the discussion, Mr. J. Plucknett submitted some particulars of the "Relay" automatic system, and strongly supported its claims for wider adoption on the grounds of simplicity.

Institution of Civil Engineers.—In a recent circular to members the Council referred to the proposed legislation to regulate the qualifications of civil engineers and to define and limit the use of the title "civil engineer," and remarked that the original proposal to effect this object by means of a private Bill was found to be impossible; the Council had considered whether the desired object could be satisfactorily secured by means of a public Bill, and discussed the subject with other engineering Institutions, but decided not to follow that course. The adoption of a descriptive title to be used exclusively by those who possess, in the words of the Institution's original Charter, "the knowledge which constitutes the profession of a civil engineer," was then considered, and it was decided that the most appropriate professional designation which could be effectively limited in its use in the way desired was "chartered civil engineer." The Council, acting under legal advice, has decided to apply to the Privy Council for the grant of a supplemental Royal Charter to confer the use of the professional description "chartered civil engineer" upon corporate members of the Institution.

Liverpool Engineering Society.—At a meeting of the Society on March 30th, Mr. F. W. Macaulay, M.Inst.C.E., read a paper on "Some Considerations on the Choice of Materials for Pressure Aqueducts." In the course of his paper the author stated that water engineers who had charge of cast-iron mains laid within the last 30 or 40 years were faced to-day with very serious difficulties and problems owing to the more or less rapid deterioration of the discharging capacity of their mains. As an instance, it had been found that the three cast-iron mains on Manchester's Thirlmere aqueduct lost 35 per cent. of their original capacity in 15 years, and 40 per cent. in 20 years. The deterioration of large mains of the Leeds Waterworks was said to be still higher.

The problem before manufacturers was to find a method whereby the theoretical quantity of steel necessary to withstand internal working pressures might be formed economically into a pipe which, while stiff and rigid to prevent deformation by external pressure, would be protected against corrosion and bacterial action. The author dealt at some length with reinforced concrete pipes mentioning that devised by M. Bonna, consisting of a steel cylinder between internal and external steel helices of cruciform section, the whole embedded in concrete. The "Hume" pipe was described. This is made by a centrifugal process, the concrete being reinforced with steel wire. This type of pipe has proved of great value, and the author described a number of examples which he had seen. A patent recently had been taken out by a South African, for lining metal tubes with unreinforced concrete, and pipes of from 3 to 24 in. in diameter already had been dealt with by this method. The author saw no reason why equal results could not be obtained with tubes of much larger diameter.

The annual general meeting will be held on April 27th, when the business will include the announcement of election of Council and officers, and announcement of awards of the Derby Gold Medal, the Society's Premium, and presentation of Diploma Certificates to those elected during the session.

Chelmsford Engineering Society.—The first annual conversazione was held on March 18th, at the Arc Works' Club Rooms (by kind permission of Messrs. Crompton & Co., Ltd.). Many prominent engineers were present, and the Mayor, Alderman J. O. Thompson, O.B.E., also attended. The President, Mr. T. E. Dann, in a brief address, welcomed the guests. The first half of an excellent concert followed, and refreshments were then served.

During the interval a number of working models and subjects of scientific interest were on view (under the supervision of Mr H. Church). They proved of great interest, and included a demonstration of wireless telephony by the Marconi W.T. Co., exhibits of soap bubble formation, microscopic slides, colour photographs, a demonstration by Messrs. Crompton & Co. of the "Robertson" stroboscopic vibrator, and various electrical apparatus manufactured in Chelmsford about 35 years ago. The President, in an interesting speech, laid stress on the important part played by engineers in the development and every-day life of the community, and pointed out the need for such a Society as this in the town, by means of which engineers were able to meet and enjoy the advantages of discussion The secretary, Mr. H. Spencer, gave a brief history of the Society, followed by a pleasing address from the Mayor on behalf of the guests. The second half of the concert programme was then proceeded with.

Stoke-on-Trent Association of Engineers.—The members of the Association were recently conducted over the Burslem Electricity Works by the Stoke-on-Trent chief electrical engineer (Mr. C. H. Yeaman). Mr. Yeaman outlined the history of electricity supply in the district, and an interesting afternoon was spent. In the evening a students' competition was held, each participant being desired to describe the construction and uses of various locomotive parts.

Iron and Steel Institute.—The annual meeting of the Institute will be held at the Institution of Civil Engineers, Great George Street, Westminster, on May 5th and 6th, commencing each day at 10 a.m. The programme of proceedings includes on May 5th a general meeting of members and annual dinner at the Connaught Rooms; on May 6th the following papers (among others) will be read:—"Notes on the Cleaning of Blast-furnace Gas," by S. H. Fowles; "Slip-lines and Twinning in Electro-deposited Iron," by W. E. Hughes; "Röntgen Spectographic Investigations of Iron and Steel," by A. Westgren.

An invitation has been received from the Comité des Forges de France for the Institute to hold its autumn meeting in Paris early in September. After the meeting, arrangements will be made to enable members attending to visit works in Lorraine, Creusot, and Normandy.

Association of Mining Electrical Engineers.—A meeting of the Midland Branch of the Association was held on March 19th, at Derby. Mr. A. W. Williams read a paper on "Insulators: Their Duties, and the Maintenance of Insulation." Of course, the paper was directed chiefly to the use of insulators in mines; an instructive discussion followed the reading of the paper.

Institution of Engineers, India.—The inaugural meeting of the Institution was to take place on February 23rd. The Viceroy and the Governor of Bengal were to be present, and the presidential address was to be delivered by Sir Rajendra Nath Mookerjee. Amongst the papers read during the meeting were:—"Development of Electrochemical Industries in India," by Dr. Fermor, of the Geographical Survey of India; "Electricity in the Jute Mill," by Dr. Crowley; "Driving Belts as a Source of Waste in Factories," by Mr. T. C. Weston, Deputy Director of Industries, Bengal. The first annual dinner was to be held on February 24th, when the Governor of Bengal and other distinguished guests were expected to attend. The address of the Secretary is Post-box 669, Calcutta.—*Indian Engineering.*

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Mr. R. McGregor, who has for some years past been chief mechanical engineer to Messrs. J. G. White & Co., Ltd., London, electrical, mechanical, and civil engineers, and who in this capacity has been responsible for the design, erection, and putting to work of large power stations all over the world, is relinquishing this position to become engineer and manager of Messrs. Clayton and Shuttleworth, Ltd., Lincoln, where he will be more particularly responsible for the development of their water-tube boiler business. This firm possesses one of the finest boiler works in the country, and for some time past has been manufacturing water-tube boilers on a design which is claimed to represent a marked advance on existing construction. It is intended to develop the manufacture and sale of these boilers as the principal activity of the firm.

Mr. E. T. Newborn, shift engineer at the Doncaster Corporation electricity works, who is leaving to take up a position in London, has been presented by the staff with a leather suit case.

Keighley Town Council renewed a debate, last week, on the subject of the salary of the newly-appointed electrical engineer (Mr. Webber, who recently relinquished his position as tramway manager, on the separation of the two posts). A previous recommendation by a Committee had been referred back by the Council, and the Committee now introduced alternative proposals that the salary for this new post be £750 per annum, or that it be £750 per annum from the time of relinquishing the tramway duties to March 31st, 1921, and for one year from April 1st, £600, plus 5 per cent. of any net profits made by the electricity department. In discussion, it was pointed out that the latter proposal would need a profit of £3,000 to make the salary reach £750. Eventually it was decided that the salary should be £750, including war bonus.

At a meeting of the Blackpool Salaries Committee it was decided to recommend an increase in the salary of the electrical engineer and tramways manager from £1,250 to £1,500 a year. Mr. Furness was receiving £900 per year for these dual positions up to August, 1919, when his salary was increased by £350, bringing the total up to £1,250.

Obituary.—Mr. M. B. Kenworthy.—The death is announced at Stafford of Mr. Marchand B. Kenworthy, chief engineer at the English Electric Co.'s (late Siemens') works, Stafford, at the age of 41 years. He was a native of Saddleworth, Lancs., and came to Stafford about 17 years ago to take up a position as draughtsman at Messrs. Siemens Bros.' works, rising to the position of chief engineer. For many years he had been instructor in machine construction and drawing at the Stafford Municipal Technical School.

Mr. J. G. Hancox.—The death is announced, at Rhyl, of Mr. J. G. Hancox, engineer, of Darlaston. For some time he occupied a position of responsibility with the Bradford Corporation electricity undertaking, and in 1915 he became assistant works engineer at the Metropolitan Carriage Works, Saltley, near Birmingham.

The death was announced, last week, of Dr. Ironside Bruce, radiologist to Charing Cross Hospital. This gentleman is another of a long line of X-ray workers who have given their lives in humanity's service. Dr. Bruce's continual exposure to unscreened rays led to the development of an acute form of anæmia, which ultimately caused his death at the early age of 45. Dr. Bruce was educated at Aberdeen, and saw service during the South African War.

Dr. A. Leray.—French science had a parallel loss on March 26th to that caused to England by the recent death of Dr. Ironside Bruce. The latest victim in France to the dangers of X-ray research is Dr. Adolphe Leray, for 25 years director of the Radiographical Laboratory at the St. Antoine Hospital, at Paris. Dr. Leray made 35,000 radiographic examinations during the war, refusing to take any rest until after the armistice.

Mr. Edward Campbell.—We regret to record the death, which occurred at Edinburgh on March 25th, of Mr. Edward Campbell, who was superintending engineer, Telegraph Department, G.P.O., Edinburgh, from January, 1902, to April, 1905. The deceased gentleman was nearing his 77th birthday.

NEW COMPANIES REGISTERED.

Armstrong Sparking Plug Co., Ltd. (173,762).—Private company. Registered March 18th. Capital, £6,030 in 6,000 ordinary shares of £1 each and 600 deferred shares of 1s. each. To carry on the business of dealers in sparking plugs, carburettors, magnetos, engines, wings, radiators, and other components for the construction and repair of motor vehicles, &c., and to adopt an agreement with A. W. Armstrong. The subscribers (each with one share) are: C. D. Im Thurn, Springle House, Harley, near Hertford, gentleman; and F. F. Day, 56, Norfolk Square, Hyde Park, W.2, gentleman. The subscribers are to appoint the first directors. Qualification: £200. Secretary: J. H. Im Thurn. Registered office: 22, Broadway, Westminster, S.W. 1.

Regan, Bennett & Co., Ltd. (173,779).—Private company. Registered March 18th. Capital, £5,000 in 2,000 10 per cent. cumulative preference shares of £1 each and 60,000 ordinary shares of 1s. each. To carry on the business of electrical and mechanical engineers, electricians, manufacturers of, dealers in, and agents for metal filament and gasfilled electric lamps, &c. The first directors are: J. W. Regan, 32, Charing Cross, Whitehall, S.W. 1; W. H. Bennett, 32, Charing Cross, Whitehall, S.W. 1; A. L. Martin, 32, Charing Choss, Whitehall, S.W. 1. Registered office: 32, Charing Cross, Whitehall, S.W. 1.

Rely-a-Bell Burglar & Fire Alarm Co., Ltd. (173,780).—Private company. Registered March 18th. Capital, £1,000 in £1 shares. To adopt an agreement with Thomas Gunn, Ltd., and H. J. Tibbles, for the purchase of certain patents for burglar and fire alarms, &c. The first directors are: F. V. Gunn, 8, Livingstone Mansions, West Kensington (director of Thomas Gunn, Ltd.); M. Gunn, Caroline House, Heath Street, Hampstead (director of Thomas Gunn, Ltd.); H. J. Tibbles, Oakdene, Leigh Beck, Canvey Island. Registered office: 80a, Coleman Street, E.C. 2.

Aqua Electric Co., Ltd. (173,740).—Private company. Registered March 17th. Capital, £8,000 in £1 shares. To carry on the business of electrical, gas and water engineers, machinists, fitters, millwrights, &c. The first directors are: A. S. Dorsey, 168, Regent Street, W.; A. S. Haxton, 168, Regent Street, W.; E. F. Spencer, 37, Park Mansions, Vauxhall Park, S.W. Registered office: 168, Regent Street, W.

Gilbert Gilkes & Co., Ltd. (173,768).—Private company. Registered March 18th. Capital, £36,200 in £1 shares. To take over the business of civil, mechanical, and electrical engineers carried on at the Canal Iron Works, Kendal, Westmorland, and to adopt an agreement with Gilbert Gilkes & Co., Ltd., and L. L. Samuels, the liquidator thereof. The first directors are: N. F. Wilson, Elmhurst, Kendal; E. Crewdson, Low Slack, Kendal; R. W. Pennington, 4, Wood Lea, Kendal; W. M. Harris, Holmfield, Kendal. Registered office: Canal Iron Works, Kendal, Westmorland.

D. O. Williams & Co., Ltd. (173,806).—Private company. Registered March 21st. Capital, £2,000 in £1 shares. To take over the business of electrical engineers, installation and general contractors, &c., carried on at High Street, Clydach, Glam., as D. O. Williams & Co. The permanent directors are: J. T. Davies, 81, Wellfield Road, Cardiff; W. M. Wilson, 24, Pontygwyder Road, Swansea (managing director). Registered office: High Street, Clydach, Glam.

Guy V. Laycock, Ltd. (173,770).—Private company. Registered March 18th. Capital, £10,000 in £1 shares. To take over the business of an electrician and electrical engineer and merchant carried on by Beatrice S. Laycock at Cloth Hall Street, Huddersfield, as "Guy V. Laycock." The first directors are: Beatrice S. Laycock, Garrowby, Greenhead Road, Huddersfield; H. P. Ripley, 7, Regent Road, Edgerton, Huddersfield; W. H. Laycock, 22, Cecil Street, Huddersfield. Qualification, 100 shares. Remuneration as fixed by the company. Registered office: 12, Cloth Hall Street, Huddersfield.

M. E. C. Electrical Co., Ltd. (173,800).—Private company. Registered March 19th. Capital, £1,000 in £1 shares. To carry on the business of electrical and mechanical engineers, &c. The first directors are: H. F. Collier, 9, Stoney Lane, Birmingham; I. F. Milne, 9, Stoney Lane, Birmingham; F. Westwood, 9, Stoney Lane, Birmingham. Registered office: 9, Stoney Lane, Birmingham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lancashire United Tramways, Ltd.—Issues on various dates from April 6th, 1906, to March 1st, 1921, of £300,000 debentures, part of a series already registered.

Melvin Engineering Co., Ltd.—Debenture dated March 14th, 1921, to secure £1,150 charged on the company's undertaking and property, present and future, including uncalled capital. Holder: Lieut.-Commander J. W. Seddon, The Fosters, Hendon, N.W. 4.

Cambridge Electric Supply Co., Ltd.—Issue on March 7th, 1921, of £3,550 debentures, part of a series already registered.

Rapid Accumulator Co., Ltd.—Deposit on March 1st, 1921, of deeds of certain land in Mount Road, Hayes, Middlesex, to secure all moneys due or to become due from company to Barclays Bank, Ltd.

CITY NOTES.

British Aluminium Co., Ltd. The profits for 1920, after making provision for E.P.D. and corporation tax, amount to £428,157, plus £15,314 brought forward. Income tax, depreciation of investments, and proportion of profits payable to directors require £114,636; prior lien debenture service fund, £48,000; debenture stock service fund, £43,224; reserve for depreciation, £50,000; reserve account, £50,000. The 6 per cent. dividends on the preference shares (less tax) absorb £17,974. The total distribution on the ordinary shares is 10 per cent. for the year, less tax, requiring £100,103, and £19,534 is carried forward. The reserve account, after deducting the sum of £400,414 which was capitalised as at January 1st, 1920, and distributed to the ordinary shareholders, stood at £120,000, and there has been added out of the profits of the year £50,000, increasing the amount to £170,000. The depreciation reserve account has been increased by the sum of £50,000 out of the profits of the year, and now stands at £550,000. The buildings, works, and plant at the various factories have been fully maintained out of revenue. Considerable additions have been made at the Alumina works in Scotland, and at the rolling mills at Warrington, in order to provide increased capacity at those works. All the works of the company have been fully employed during the year. The demand for the metal during the first half of the year could not be met, but a sudden falling off was experienced in the autumn, in common with all other non-ferrous metals, and these conditions still continue. In consequence, it has been necessary since the close of the year to curtail seriously the output at the various works. It is hoped, however, that the general depression in the metal industry may soon be relieved. Meeting held yesterday, March 31st.

Newcastle-upon-Tyne Electric Supply Co., Ltd. The annual meeting was held in Newcastle on March 22nd. Mr. J. H. Armstrong, who presided, formally moved the adoption of the report, but, in view of his pending retirement, left it to his successor, Mr. R. P. Sloan, to deal with the accounts.

Mr. Sloan said the past year had been one of considerable progress, but it had been one of anxiety and difficulty. The miners' strike caused considerable disorganisation, but although their coal deliveries were entirely suspended, their stocks were sufficient for them to supply all demands upon their system. It had been expected that during the latter part of 1920 they would have derived some revenue benefit from the new generating plant on the Tees and at Dunston. In that hope they were disappointed. At Dunston they obtained no commercial use of the new plant until the beginning of this year, and the plant on the Tees was only brought into commercial operation some four days ago. This delay had caused them much anxiety, but the cause for that was now disappearing. Owing to the time taken in carrying out power station extensions, the directors had been handicapped by having to meet capital charges before any financial benefit accrued. The interest charges under that head had been particularly heavy, and were estimated on account of 1920 to have amounted to over £60,000. This had been met out of revenue, but the burden became greater as the business developed, and the directors had been considering whether they should to some extent modify that policy. The connections made to the system during the year totalled 25,203 h.p., and with those made in the Cleveland area, an additional 16,846 h.p., made a total of 42,049 h.p., which was a record. Their profit for the year, £392,643, was £144,449 in excess of 1919, and £50,249 over 1918. From the profits £30,000 had been transferred to reserve for plant renewals and improvements, which fund now stood at £372,241. Referring to the cost of labour, he pointed out that the salaries and wages bill amounted to £394,195, as compared with £296,124 in 1919, an increase of £98,071. The average remuneration per employé now represented an increase of 177 per cent. They were hoping there might be some relief in respect of this cost. The North-Eastern Railway main line electrification scheme, to which he had formerly referred, had not materialised, but he was glad to be able to state that after some considerable lapse of time, negotiations had been reopened by the Railway Co., and there was a reasonable hope that the scheme might be proceeded with, although on a somewhat smaller scale than was contemplated in the first instance. In the event of the scheme maturing, and proving a success, there was every likelihood of its leading to much larger developments. Having referred to legislative matters, the speaker said with regard to the prospects of the company during the current year, it was extremely difficult to make any forecast. Opinions differed very widely as to the probable duration of the slump in trade, and as to how long costs would remain at their present high level. Since the commencement of the year they had felt the effect of the great trade depression. Their output of electrical energy had, however, during the first eleven weeks of the year been increased by 5 per cent., compared with that of 1920. That was not a large figure, but it was encouraging in view of present circumstances, and indicated that they were benefiting to some extent as a result of the increased business obtained during the course of last year. They should during the year reap some considerable revenue benefit from the operation of the new generating plant on the Tees and at Dunston, and, further, they had on hand at present additional applications for connections to the system representing over 70,000 h.p.

The Hon. R. H. Brand thought shareholders could congratulate themselves on the position of the company. He hoped and believed they were through the era of strikes, and that the trouble so caused to their business would be diminished. Apart from the benefit they might derive from their new plant, the situation was more obscure than ever. The results of the company's working was bound to reflect the general industrial conditions on the North-East Coast, and it was impossible yet to say what its course would be. He thought it mainly depended on two things: first, a reduction in manufacturing costs by satisfactory arrangements between labour and capital; and, next, political peace. As to the latter, he regarded the result of the recent London Conference as a very serious blow to the revival of trade. In face of all this uncertainty they were bound to exercise care. They had determined to postpone all new capital expenditure as far as they safely could, but they had not yet completed the large programme they entered into before the end of the war, and which had been very much delayed. The cost, of course, had been considerably more than had been expected. Their issue 15 months ago of £1,500,000 7 per cent. preference shares had carried them through 1920. Recently it had been necessary to find more money by the sale of £500,000 nominal of their first debenture stock, and during the course of the year they should have to raise further capital, either by the sale of the first and second debentures still available, or in some other way. In view of the changing financial conditions, and the possibility of cheaper money towards the end of the year, they did not want to settle the actual methods they might adopt before it was necessary; but it was probable they might later in the year ask for sanction for the creation of more preference shares. They would prefer to have issued more ordinary shares, but that would not be possible until financial conditions improved. The company occupied a very special position. They were by far the largest electrical supply company in the kingdom, and their prosperity was absolutely essential to the whole industry of the North-East Coast, and if they were to serve that industry they must extend their operations with the expanding needs of the area they supplied. In fact, they had to anticipate the needs, incurring large expenditures of capital, which they had to raise from the public. This money they could not get unless their financial position was strong, which meant that they must have a reasonable return for their capital. They had come through a very difficult time and he looked forward to a much improved situation in the future.

The report and dividends were approved.

The chairman then referred to his retirement from the position of chairman of the company, and said Mr. R. P. Sloan, who had consented to act as his successor, would add the work of chairman to his present duties of manager, under the title of chairman and managing director. Mr. Sloan had acted as manager for 16 years, and had been a director for six years.

British Insulated and Helsby Cables, Ltd. The twenty-fifth annual meeting was held on March 21st in Liverpool. Mr. James Taylor (chairman) presided. He said that the profit for the year amounted to £340,713, an increase of £12,024 over the previous year. Such a result was very satisfactory, especially when taken in conjunction with the many and unusual difficulties that had to be contended with. Two stoppages occurred at the principal works at Prescot—one due to the coal strike and the other to certain unreasonable demands by workmen, which resulted in three weeks' work being lost. The workmen suffered a heavy loss in wages and the company in profits, in addition to which there were disorganising effects and an accumulation of costly raw materials. In addition men in the wire drawing department adopted the "ca' canny" policy in an effort to defeat the bonus system, which had been in operation for many years, and to bring about the substitution of a flat rate wage as high as the bonus system ensured. The company refused the demand, with the result that about 70 expert wire drawers who declined to continue on the old system had to leave the service. Some time was required to train fresh hands, but by persistent effort the difficulty was overcome, and now the new men were doing as much per week as the old and more experienced men were doing. These methods resulted eventually in the company being unable to turn out the usual and proper quantity of cable per week. Apart from these stoppages the works, both at Prescot and Helsby, had been busy throughout the year, and the present state of the order book was quite satisfactory. Present high costs of manufacture and inability to give certain delivery, owing to labour unrest, were preventing the company from taking orders, which were now being placed abroad. Foreign trade could only be retained by a reduction in the cost of production, and although a decrease in the present high rate of wages would have a most beneficial effect, another and very important element had to be considered, namely, increased efficiency in the mechanical means of production. The company therefore had carried out a reorganisation of the works. They had built what were practically three new factories, fitted with all the latest and most improved appliances, and had enlarged the power plant. They had also greatly improved and increased the facilities for handling raw material and finished products, besides making improvements in other departments, which should largely tend to cheapen production. The company had now been working under the improved conditions and additional facilities for the past two or three months, and while they were feeling the beneficial results of the changes generally, it was noteworthy that they could now turn out all the latest types of special high tension cables of very great lengths. It was believed that capital expenditure for some time would be relatively small, and the prices of raw material having fallen and the peak of the company's financial requirements passed, it would not be necessary to issue any of the new capital already authorised.

Clyde Valley Electrical Power Co.

At the annual general meeting held in Glasgow last week, Mr. Charles Ker, deputy chairman, who presided in the absence of the chairman, referred to the effect on the company's business of the high price of coal, which accounts for over 60 per cent. of the total cost of production. This does not affect the company directly so seriously as it might appear, as due to their sliding scale of charges, they are enabled to pass on a certain proportion of the increase to their customers, but the effect of the high price of coal on industry generally tends to restrict the output of electricity. In his opinion there can be no real prosperity in industry until the price of coal becomes more normal. He also referred to the heavy burden of taxation. In view of the high cost of production, the profit for the year was most satisfactory. Contracts for supply show an increase during the year of 11,307 h.p., and connections to mains an increase of 8,954 h.p.

The Bosch Co.

The report for 1919-20 of the Robert Bosch A.G., of Stuttgart, states that a considerable increase took place in the turnover, particularly through deliveries to other countries. Sales organisations were opened at Zurich and Prague; the sales office at Geneva suffered under the great difficulties of the automobile works in Switzerland; while the course of business at the sales office in Budapesth was very unsatisfactory. It had been possible to increase the number of workmen at Stuttgart and Feuerbach to 8,231, but at the end of the financial year the total had been reduced to 7,982, as restrictions in working had to be introduced in consequence of the increasing diminution in orders. Including the balance forward the accounts show net profits of 6,932,000 marks, as compared with 2,919,000 marks in 1918-19, and a dividend at the rate of 10 per cent. has been declared, as in the preceding year. The directors add that if the sale of the company's chief manufactures in other countries should meet with further difficulties preparations had been made for taking up the manufacture of other products.

The Italian Edison Co.—The Societa Generale Italiana Edison di Elettricite, of Milan, reports net profits of 10,315,000 lire for 1920, and a dividend of 36 lire on the 240,000 fully-paid shares and 13.13 lire on the 80,000 partly-paid shares. The share capital is being increased from 96,000,000 to 180,000,000 lire, and 10 per cent. of the augmentation is being allotted to the Compagnie Continentale Edison of Paris.

Tyneside Electrical Development Co.—The directors recommend a dividend at 6 per cent. per annum on the preferred ordinary shares, less tax, carrying forward £1,383. No dividend is to be paid on the deferred ordinary shares. No return has been received on the investment in the Tyne Electric Steel Foundries.

Metropolitan-Vickers Electrical Co., Ltd.—A notice appears in the *Financier* reminding preference shareholders that the option to convert their holdings into ordinary shares, at the rate of two ordinary shares of £1 for each preference share of £2, expires on April 14th next.

Bruce Peebles & Co., Ltd.—Shareholders who intend to accept the offer of two new shares for every nine held have to do so by April 30th. The issue is of 36,469 ordinary shares of £1 each at par.

Waste Heat & Gas Electrical Generating Stations, Ltd.—The report for the year ended January, 1921, shows that the profits, after deducting administration expenses, were £34,439, as against £39,626 in the previous year. £17,763 was brought forward. £14,000 is put to reserve. A dividend of 8 per cent. for the year requires £25,600, and £12,603 is to be carried forward. The amount standing to the credit of the reserve account is now £127,851. The redemption funds with respect to plant supplied on hire purchase terms amount to £18,505. Capital expenditure during the year was £25,939, mainly in connection with the new power station at Horden. The plant at this station was first operated in September last, but the full output has not yet been obtained due to non-delivery of certain parts of the plant and latterly due to reduced supplies of waste heat and gas. The delays in starting the new plant at both Horden and Weardale, together with higher costs, account for the reduction in profits. The aggregate output from all the generating stations has been maintained compared with the previous year. A further sum of £1,012 was expended during the year on experimental work.

Hadfields, Ltd.—After paying 5 per cent., free of tax, on the ordinary shares for 1920, £135,728 is to be carried forward. Operations were seriously affected by the moulders' strike, which caused reduction in profits earned and in reduction of the dividend. With the object of developing the use of the Hadfield system of manufacture and the sale of their special products in the U.S.A., the company have joined with the American Clay Machinery Co., of Bucyrus, in forming the Hadfield-Penfield Steel Co., in which Hadfields, Ltd., now hold a substantial interest. No immediate cash contribution from this company is necessary. The reconstruction of the company's war extensions to adapt them to post-war trade and the installation and equipment of the new steel foundry and rolling mills have involved a very large capital outlay to which has to be added the provision of additional working capital required to finance their output. An issue has been successfully made of one million pounds of 7½ per cent. debenture stock, redeemable in ten years.

Wycombe (Borough) Electric Light & Power Co., Ltd.—During the year 1920 the connections increased by 338 kW to 3,519 kW. Considerable repairs carried out and a new additional condenser installed. The new plant installed in 1919 has resulted in further generating economies. Cost of labour and fuel greatly increased. Including the balance from the contracting business there is a gross profit of £16,993, against £2,845 in the previous year. After paying debenture and loan interest, &c., and providing for income tax and adding the amount brought forward, £11,662 remains to be dealt with. A dividend of 7½ per cent. is to be paid, absorbing £3,750, £5,000 is to be put to reserve for renewals, and £2,500 to a general reserve fund, leaving £412 to be carried forward. The Electricity Commissioners increased the maximum price allowed to be charged as from July 1st, 1920, to 1s. per unit. The maximum authorised is not being charged.

Stewarts & Lloyds, Ltd.—According to the *Financial Times*, dividends are announced at the rate of 10 per cent. for the half-year on preferred ordinary shares, 2s. per share and bonus of 1s. per share on fully-paid deferred shares, 6d. per share and bonus of 3d. per share on deferred shares 10s. paid, and 1s. per share and bonus of 6d. per share on fully-paid deferred exchanged for shares in Alfred Hickman. Carried forward £114,356. Dividends on the preferred ordinary shares are less tax and on the deferred shares free of tax.

Browett Lindley & Co., Ltd.—Net profit for 1920, after deducting £2,399 debenture and bank interest, writing off £4,292 for depreciation upon buildings, machinery and patterns, and providing for income tax, was £8,694, plus £9,484 brought in, making £18,178. Directors propose further dividend of 6 per cent. on preference shares on account of arrears, of which 3 per cent. was paid September 30th, 1920, less tax; dividend of 8 per cent. on ordinary shares, of which 4 per cent. was paid on September 30th, less tax.—*Financial Times.*

Stock Exchange Notices.—The undermentioned have been ordered to be quoted officially:—

Globe Telegraph & Trust Co.—54,273 ordinary shares of £10 each, fully paid, Nos. 181,128 to 235,400.

Hastings & District Electric Tramways Co.—£104,450 4½ per cent. debenture stock.

Lanarkshire Tramways Co.—373,750 shares of £1 each, fully paid, Nos. 1 to 373,750.

Newmarket Electric Light Co., Ltd.—During 1920 3,241 (33-watt) lamps were connected to the mains, making the total 38,933. The gross profit was £2,953, against £2,351 for 1919. After providing for debenture interest £710, and adding £303 brought forward, a dividend of 3 per cent. is declared. £1,500 is carried to reserve for renewal of plant, and £249 is to be carried forward.

American Telephone & Telegraph Co.—A *Central News* dispatch from New York announces that the dividend is to be increased to 9 per cent., in order, under the new conditions resulting from the war, to make subscriptions to new stock issues attractive.

Mirrlees Watson Co., Ltd.—Dividend of 10 per cent. and bonus of 7½ per cent., both less tax. £25,000 to general reserve, carrying forward £14,409.

Vickers, Ltd.—The following final dividends for the half-year ended December, 1920, are announced: 2½ per cent. on preferred 5 per cent. stock (less income tax); 2½ per cent. on 5 per cent. preference shares (less income tax); 2½ per cent. on cumulative preference shares (free of income tax up to 6s. in the £). According to the financial Press, the books of the company for the year 1920 are practically complete as far as ordinary transactions are concerned, but there are still outstanding questions with Government departments of such importance that the directors regret it is not possible yet to present final accounts for the year, or even to state definitely when that will be done.

Torquay Tramways Co., Ltd.—Dividend 8 per cent. for the year 1920, free of tax. To reserve and renewals account £8,000; to reserve for equalisation of dividends £1,000. Carried forward subject to E.P.D. (1919 and 1920) and income tax, £10,302.

Belgium.—The report of the Société des Tramways Electriques de Gand, Ghent, for last year shows a profit of only 341,687 fr., as compared with 369,016 fr. in the preceding 12 months.

Metropolitan-Vickers Electrical Co., Ltd.—The directors have decided to recommend the payment of a dividend on the ordinary shares of 12½ per cent. for the year ended December, 1920.

Parker, Winder & Achurch, Ltd.—Total distribution on the ordinary shares for the year 10 per cent., less tax, carrying forward £4,207.

STOCKS AND SHARES.

TUESDAY EVENING.

THE principal event in those Stock Exchange markets with which we deal is a substantial rise in Underground Electric Railway Income Bonds. The price has been rising steadily on balance for some weeks past, and just before the holidays it gained 5½ points with an advance to 71½. This came about as the result of expectations of extraordinary holiday traffics, with a consequent favourable result upon the dividend. Most of the rise has been retained, and the 1s. shares rose a trifle in sympathy. Other stocks in the railway market are also better, Metropolitans putting on 30s. at 24 and Districts 10s. at 14. So far as the steam stocks are concerned, the market is puzzled by the outlook in the coal trade. Amalgamation of the London and North-Western and the Lancashire and Yorkshire lines is a significant move on the part of two of the "Heavy" Home Railway companies, and prices are good in consequence.

Holiday influences are still at work in most of the Stock Exchange markets. Evidently tempted by the spring-like weather, the attendance at business both on the part of clients and their Stock Exchange agents has been noticeably affected by the Easter recess.

Electricity supply markets are indifferent to the prospect of a coal strike occurring. Several of the principal shares are better on the week. There are rises, for instance, in Charing Cross, County, Metropolitan, St. James's, and Westminster ordinaries and in Metropolitan preference. Following upon the improvements of the last two weeks, the advance is noteworthy, more particularly in view of the fact, already quoted here, that several of the companies are known to be on the point of issuing fresh capital. The City of London will probably be in the field first. A good deal of interest attaches to the Central Electric borrowing. A Metropolitan issue is said to be at hand. Some of the others may put off their appearance until it becomes clear whether the Bank Rate is to be lowered. Anticipation runs high that the 7 per cent. will give place to 6 per cent. this week.

Manufacturing shares are better. Metropolitan-Vickers ordinary have risen to 19s. 6d., and the preference are 5s. up at 1⅞. English Electric hardened to 11s. 6d., General Electrics to 23s. 9d. Babcock & Wilcox are unchanged by the coal outlook. British Aluminium retain their strength at 17s. 6d. There is noticeable demand for all the best class preferences, and the majority of these are in short supply. Edisons are quiet at 10s., and Henley's at 27s. 6d. The new Henley's are about 1s. lower.

Movements amongst foreign issues are somewhat mixed. Montreal Light, Heat and Power Common shares at 90 are 7½ points down, whereas Canadian General preferred rose to 105½. Improvements of 2½ points lifted Mississippi Power Common to 17, the preferred to 100. Mexicans are still rather on the dull side, and in Argentines there is not much going on.

Metropolitan Electric Tramways 5 per cent. debenture stock eased off to 56½. The market for prior-charge stocks in the Home Railway list, however, is better. City & South London 4 per cent. debenture has advanced to 54. There has been a little demand for East London Third Debenture, rallying the price to 12½. The ordinary, it may be mentioned, stands at 3.

In the cable group, Eastern Extensions and Western Telegraphs are both ¼ higher at 16¼. Globe ordinary improved to 15¾ ex dividend. At the Exiles Club, where men of the Eastern group foregather when home on leave, the opinion is that arrears of work are steadily being overtaken, and that it should not take long, under to-day's conditions of working, for cabling to become normal as regards speed and reliability. The companies are scarcely recovered even yet from the effects of the war, but everything is being done to restore a satisfactory state of affairs to customers, staff and material alike. The competition of wireless continues to be a topic of lively debate, but the same opinion is held in Eastern Telegraph circles as in those of the Stock Exchange that plenty of room exists for both systems. Marconi's have risen to £2. The dividend time comes in June, and it may be recalled that the company paid only 1s. a share in December, as against 2s. in the previous corresponding period. Anticipation now runs that the dividend may be made up to 5s. for the year. Radio Common are better at 10s.; the preferred keep round about 11s. 6d.

The rubber market is singularly steady, having regard to the fact that there is so little improvement in the price of the raw material. Rubber shareholders take the philosophic view that the price of the produce has fallen so low that it cannot go much worse; consequently any change is almost sure to be for the better. In the armament market, Vickers are holding their improvement, and Armstrongs keep very steady at 18s. 3d. The recent excitement in Dunlops has given place to a more placid state of affairs. As stated above, there is not much business doing in Stock Exchange markets, but if the Bank Rate should go down on the Thursday in this week, this will prove an added stimulus to the present strength of gilt-edged stocks.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend 1919.	Dividend 1920.	Price March 23. 1921.	Rise or fall.	Yield p.c.
Brompton Ordinary	12	12	6¼	—	£9 12 0
Charing Cross Ordinary	7	8	3⅞	+ ⅛	10 6 6
do. do. do. 4½ Pref.	4½	4½	2⅝	—	8 8 8
Chelsea	4	6	3⅛	—	9 10 8
City of London	18	14	25/-	—	11 4 0
do. do. 6 per cent. Pref.	6	6	18/-	—	6 13 4
County of London	8	8	7⅞	+ ⅛	10 3 4
do. do. 6 per cent. Pref.	6	6	8¼	—	7 5 5
Kensington Ordinary	7	9	4¼	+ ⅛	10 11 10
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref.	6	6	9⅜	—	[illegible]
Metropolitan	6	7	3¼	+ ¼	10 15 4
do. 4½ per cent. Pref.	4½	4½	2 13/16	+ ⅛	7 19 2
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	5	—	2¾	—	9 2 10
South Metropolitan Pref.	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	5⅛	+ ⅛	9 15 2

TELEGRAPHS AND TELEPHONES.

	1918	1919			
Anglo-Am. Tel. Pref.	6	6	80¼	—	7 9 6
do. Def.	33/6	1¼	18	—	9 7 6
Chile Telephone	8	6	5⅛	—	*5 6 8
Cuba Sub. Ord.	7	7	6½	—	*10 15 4
Eastern Extension	10	10	16¼	+ ¼	*6 4 3
Eastern Tel. Ord.	8	10	160¼	—	*6 4 7
Globe Tel. and T. Ord.	8	10	15¾	+ ¼	*6 7 0
do. do. Pref.	6	6	9	—	6 13 4
Great Northern Tel.	22	22	20½	—	10 14 8
Indo-European	18	10	30	—	8 8 8
Marconi	25	25	2	+ 1/16	—
Oriental Telephone Ord.	10	12	2 3/16	—	*5 9 7
United R. Plate Tel.	8	8	8⅛	—	*8 10 8
West India and Panama	1/3	Nil	[illegible]	—	Nil
Western Telegraph	8	10	16¼	+ ¼	*6 4 3

HOME RAILS.

	1919	1920			
Central London Ord. Assented	4	4	48¾	—	8 4 0
Metropolitan	1½	1½	24	+ 2	6 5 0
do. District	Nil	Nil	14	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A"	Nil	Nil	5/6	—	Nil
do. do. Income	4	2	71½	+ 5½	2 16 0

FOREIGN TRAMS, &c.

	1918	1919			
Anglo-Arg. Trams, First Pref.	Nil	5½	2⅝	—	10 9 6
do. do. 2nd Pref.	Nil	Nil	¾	—	Nil
do. do. 5 % Deb.	5	5	59½	—	8 8 0
Brazil Tractions	Nil	Nil	37	—	Nil
British Columbia Elec. Rly. Pfce.	5	5	56	—	8 18 6
do. do. Preferred	2½	5	54½	—	*8 14 0
do. do. Deferred	Nil	8	51½	—	*11 17 6
o. do. Deb.	4½	4½	59¾xd	—	7 10 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	37	− 2	Nil
do. 6 per cent. Bonds	Nil	Nil	21½	−2	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	18	—	Nil
do. 1st Bonds	Nil	Nil	59	− 2	Nil

MANUFACTURING COMPANIES.

Babcock & Wilcox	16	16	2⅜	—	*6 8 4
British Aluminium Ord.	10	10	17/6	—	11 8 6
British Insulated Ord.	12½	16	1½	—	10 0 0
Callenders	25	15	1⅞	—	10 18 9
" 6½ Pref.	6½	6½	17/6	—	7 8 7
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	10	10/-	—	—
do. do. 5 per cent. Deb.	5	5	70	—	7 2 10
Electric Construction	10	10	16/9	—	12 14 0
English Electric	—	8	11/6	+ 6d.	13 18 4
Do. Pref.	—	6	13/6	—	8 17 10
Gen. Elec. Pref.	6½	6½	18/6	+ 6d.	7 0 5
do. Ord.	10	10	1 3/16	+ 9d.	*8 8 0
Henley	25	15	1⅜	—	10 18 2
do. 4½ Pref.	4½	4½	[illegible]	—	6 18 6
India-Rubber	10	10	2	—	—
Met.-Vickers Pref.	—	8	1⅞	+ ¼	8 10 8
Siemens Ord.	10	10	20/6	—	*9 15 2
Telegraph Con.	20	20	20½	—	*5 16 8

* £Dividends paid free of Income Tax.

THE LABOUR SITUATION AS IT AFFECTS THE ELECTRICITY SUPPLY INDUSTRY.

By T. W. COLE (Joint Secretary, Home Counties Industrial Council).

Industrial organisation is to-day one of the most important problems with which the electricity supply industry as a whole is faced. It is, in fact, not so much one problem as a series of problems, and, moreover, a series involving innumerable complex factors. Now, I suggest it might be useful to pass in review some of the chief elements of the situation. We shall certainly lose nothing by looking the facts squarely in the face.

We shall see best perhaps what we have to take into account by starting with the facts as they are at the moment. Let us take a bird's-eye view of the industry.

The industry consists of some 600 or so electric supply undertakings, covering between them the whole country, each undertaking separate and, broadly speaking, each without competition in its own area. The number of workpeople employed according to the Joint Industrial Council's figures is estimated at 29,000, and to this have to be added the technical and administrative staffs. Excepting a very small proportion, the whole of the foregoing are organised in some 20 or so trade unions. A proportion of the employés are highly skilled and absolutely indispensable. The majority are trained or have special knowledge, and only the residue are unskilled and readily replaceable. The whole (with the exception of the unskilled fringe, as it were) are permanently employed. It is an industry, indeed, where wholesale changes in workpeople are disadvantageous to the smooth running of any undertaking. Now, all this means that from the point of view of labour conditions the industry is in a very special position. Finally, no undertaking can afford to close down, one might say, even for a single hour, without serious public inconvenience. It can easily be seen that added together these factors constitute the elements of, at least, a preliminary problem. Then we have also to take into our view the Whitley system of industrial councils as at present at work in the industry, which introduces a profoundly modifying influence. Summarising the foregoing, we may say that there are three chief factors: the employers (covering the shareholders in the case of companies, and the ratepayers in the case of municipalities), the employés in the trade unions, and the Industrial Councils, and each of these factors is a variable. The problem for the industry as a whole is to effect an adjustment, and for this the utmost knowledge, foresight, and skill are required. Of these the most important at the moment certainly is knowledge, since nothing could be more disastrous than action based on a miscalculation of the constituent forces.

It is just these forces that I suggest it might be useful to bring under review, and which briefly are as follows:—

First, we have the trade unions' movement towards more and more effective organisation, and consequently increased power. This is, of course, a general movement affecting all trade unions alike in all industries.

Secondly, there is the rearrangement inside the trade union movement towards industrial unions instead of craft unions, and this has a special bearing on the electric supply industry.

Thirdly, there have to be taken into account various definite political movements which seek to realise themselves in and through industry, covering the whole range from State socialism to syndicalism.

Fourthly, there are the labour forces which impinge on the industry through the employers' side by way of municipal undertakings which are directed by labour municipal councils.

Fifthly, our consideration has to cover the directly shaping influences of legislation and Government direction dealing with labour, which tends to have on industry an effect which is little less than revolutionary as compared with the pre-war condition.

Finally, there is the interaction between the two sides of the Whitley Councils, the whole being itself modified by all the above influences.

Taking the foregoing *seriatim*, there is not much to say about the fuller organisation of the trade union movement so far as the workmen's unions are concerned, since this is already accomplished. For practical purposes we might consider that all workmen in the electric supply industry are now in one or another of the trade unions. There is no particular point to emphasise also with regard to the steady improvements which are taking place in the internal working of the separate trade unions which make them more coherent and an increasingly disciplined force. But when we come to the other section of employés, namely, the technical and clerical staff, we have a recent development which is most significant, and likely to play an increasingly important part in the future. There is now a fully-organised trade union covering practically the whole of the technical operating staffs of the important undertakings of the country. The clerical staffs are also organised in part, in other unions, although in a much more fragmentary and indefinite form; they do not, therefore, count as in any way an important factor industrially. The important fact is that the whole of the employés concerned in the effective working of the undertakings are in unions and, moreover, in unions which would admittedly act in concert. (The details of these separate unions and their relationships are somewhat complicated, and might perhaps be dealt with later on separately.) It is obvious from this that a return to pre-war conditions of industry is impossible, unless, indeed, the unions disintegrated of their own accord, which is not to be anticipated!

The second point mentioned, namely, the movement inside the trade unions towards industrial unionism instead of craft unionism, is a matter warranting the most serious study. An industrial union is one which is based on the inclusion of the whole of the personnel of a particular industry, so that all grades of workers engaged in the industry are associated in a single union. The craft union, on the other hand, in its simplest form covers only those of a particular trade, its members being dispersed in perhaps innumerable industries. There is a general tendency, however, for amalgamation of unions, and following this a possible reorganisation on an industrial basis. But coming more specifically to the case of the electric supply industry, there is one union, the Electrical Trades Union, which is confessedly ambitious to work out a programme of industrial unionism for the electric supply industry. The Electrical Trades Union is obviously the only union in the industry which could seemingly fulfil this rôle of an industrial union. The object, in the words of one of their own writers, is "the complete organisation of all employed in the electrical industry within the ranks of the E.T.U." An issue of the electrical workers' journal, the *Electron*, of February, contains an article on "Reorganisation," in which the writer deals with this proposal for complete organisation of all workmen employed in the industry, and with inducements which might be held out by the Electrical Trades Union so as to bring the whole of the workmen within the E.T.U. It is noteworthy that he includes supervisory grades up to charge engineers of power houses. If this is achieved the Electrical Trades Union will be, so far as the electric supply industry is concerned, practically an industrial union. The importance of such rearrangement of the unions lies mainly in its sociological aspect and its relationship with those revolutionary programmes which seek to work through industrial reorganisation. The most recent phase of socialism, namely, guild socialism, can indeed be realised only through industrial unions, since so far as individual works are concerned, the programme of guild socialism is that each works shall be run by the workers. The combination of all the workers in an individual industry is an essential in guild socialism; in fact, speaking of the present craft unions' state of unionism, the author of "Guild Socialism Restated" shows clearly that craft unions are recalcitrant factors to deal with in smoothing the way towards guild socialism, and points out that the present trade union "in all the regulations which it lays down still always remains a body external to the actual conduct of industry."

The ambition of the Electrical Trades Union in striving to become an industrial union has thus a special sociological significance. Indeed, at a Conference in Blackpool in May, 1919, a resolution pointedly embodied the whole matter in the following terms: "To take over the control of the electrical industry in the interests of the workers." It is a point that should be noted in connection with industrial unions that the Electrical Power Engineers' Association falls in line, as far as its own stratum is concerned, with this movement towards industrial unionism. This was not designedly so, of course, but lies in the nature of the case, and probably was not even thought of originally. But none the less, as will be seen when we consider guild unionism, it adds a most definite bias to the labour organisation of the industry. The importance of this tendency towards industrial unionism in the industry as replacing present craft unionism cannot be overestimated. The exact significance politically, so to speak, will be seen under our next consideration of the various political movements seeking to realise themselves in and through industry.

(*To be continued.*)

THERMAL CHARACTERISTICS OF ELECTRIC OVENS AND HOT-PLATES.

Discussion at Leeds.

At a meeting of members of the North-Midland Centre of the Institution of Electrical Engineers, held at Leeds on February 22nd last, when Mr. C. J. Jewell, chairman, presided over a large attendance of members, Dr. E. Griffiths's and Mr. F. H. Schofield's joint paper on the above subject, which was abstracted in our issue of February 18th, was read and discussed.

Mr. W. B. **Woodhouse** was particularly interested in the remark about the weakness of air insulation, because he knew that it was a very common delusion that air was quite a good insulator. The tests, however, showed quite definitely the danger of the movement of air. He would emphasise that there was not much object in packing tight. If they could keep the air from circulating the less solid the insulating material used the better. One striking point that Dr. Griffiths had brought out was that when one used a radiation heater a black pot was a very good thing to employ, and there was no particular point in polishing it.

Mr. **Allsopp** thought the authors should have conducted their tests with water or other fluid, and in connection with the oven tests he strongly considered that those tests were of no value whatever for cooking purposes. The results were so similar that one was led to understand that one did not differ very much from the other, but there would have been vastly different results had those ovens been loaded up with materials that would represent as near as possible the actual process of cooking. They had to provide cooking temperature for cooking various objects of various sizes, and he did not think that the experiments or the tests so taken would be of much use as a guide. In connection with the hot plates, they were told in the early days that it was necessary, and that it was the right thing, to have a vessel with a very thin bottom, but he found that by using a cooking vessel with a large section of wall, such as an aluminium saucepan, a pint of water could be boiled quicker on the same hot plate with the same amount of energy. He well remembered experiences with an electric oven which had appealed to everyone because the elements were, to all intents and purposes, concealed; the oven was loaded on the bottom side, and the elements were entirely out of sight. The oven could also be washed, which was an advantage, but the oven would not cook. The trouble was that the dispositions of the loading and the elements were wrong. Those experiences explained how some manufacturers threw ovens out on to the users and trusted to luck for their being satisfactory. That was a point that ought to be watched carefully. He recalled another oven which had side heating. His wife objected strongly to changing a loaf round six or seven times during the process of baking; she did not have to do that with a coal or gas oven, and it should not be necessary with an electric oven. They did, however, get a successful oven built, *i.e.*, having the elements at an angle on each side; it had been in use for seven years, baking bread daily. The elements were placed well out of sight, and out of harm, and could not be damaged by liquids or fats. They did get circulation which could not be obtained in any form of radiant heater; as they were put on the market and designed at the present time, too much heat was thrown into the oven. There was only one successful radiant heat oven that would actually bake bread. If an oven would bake bread it would do anything that it might be called upon to do in the ordinary kitchen.

Mr. **Hugh Gresley** (Doncaster) was not quite clear why there was much higher efficiency when dealing with a thick disk as compared with a thin plate. Why was the closed type of hot plate used at all if the open type was so much more efficient? In ordinary kitchens, whether in private houses or hotels, the care necessary to keep the kitchen utensils with their thin bottoms in that perfect state which was essential would probably be missing, the pans would get knocked about, and the efficiency would become low. If they had electric cooking they must have hot water, but heaters as a rule, he believed, were very inefficient. With regard to ovens, there seemed to be great objection to the heaters being disposed along the side or along the bottom on the ground of cleanliness. He did not believe any oven would find much favour unless it was one that could be cleaned easily, and the best form of oven, if it could be made efficient, was one in which the heat was hidden away behind the wall so that the whole of the interior could be thoroughly cleaned out.

Mr. **Jepson** (Sheffield) remarked that in his house everything was done electrically, even washing, &c. They had an emergency heater in the boiler which was absolutely successful; it was a copper tank, and was in the house when he took it. There were three kW on the top, two on the next, and half a kW on the lowest heat. Instead of fixing it as he was advised officially by his firm to do, he fixed it in the centre, the reason being that one wanted a comparatively small quantity of water sufficient for washing up, or even for one bath. He had had it fixed in the centre so that it boiled the upper half first and the bottom remained cold, but if when the upper half was boiled the heater was switched on to the lowest heat and left on, conduction (which was very slow) would heat up the whole of the water. That was so successful that by switching on the top heat of 3 kW and leaving it on they could get three baths of water following one another, as much as one wanted in the house. In his house he had 108 amperes total capacity of heating apparatus; the maximum which he used was something like 60 amperes. It would be a tremendous problem to install mains to tackle the matter, but the potential load was there, and it was a useful load, and it was needed mostly after the works were shut down, and at week-ends. Strange as it might seem, people said it was extremely extravagant, but it was not; if one went out of the house one switched the current off; it was not like a coal fire. In Sheffield they were fortunately placed for low-priced energy, which was an attractive feature. He did, however, think that they, as electrical engineers, were to blame for not pushing electrical apparatus more; no doubt the first cost of apparatus was heavy, but it saved itself in the long run. His advice to the builders had been to put one chimney in the house, and a kitchen fireplace. In many places, particularly round the Sheffield area, many miners got their coal for nothing, so that it would be absurd to supply them with electricity when coal cost them nothing. Dr. Griffiths's paper was an extremely useful one, but unfortunately it did not go far enough, and it should be up to the Institution to recommend that the tests should be carried much further than they had been. He was rather surprised at some tests he had made on the "bulb fire," which had a parabolical reflector with a small heating coil. An aluminium kettle took about half an hour to boil the water, but when the bottom had been painted black, the water boiled in something like 16 minutes. Another important matter to bear in mind was that if they used the kettle a second time immediately after they had emptied it, the efficiency rose to 85 or 90 per cent. easily. That was because they were using the heat they had put into the bottom of the kettle. The loss by radiation was very small; that was an efficient way of boiling water when once they had got their vessel hot. It had often occurred to him that they might find some much quicker way of boiling water by some improvement in parabolical reflectors so as to focus the heat on to a small surface, so that they could throw the heat right on the vessel. A solid body was not the right thing to use in making a test. When they were using water in a vessel the bottom of the vessel heated the water, which was immediately carried upward by convection, and cool water took its place. The greater the gradient they could get between the vessel temperature and the water the better and quicker the whole body would be heated up. In the case of a solid thing like a disk they did not get the cooling near the heater, they only got the effect of conduction. With regard to ovens, he had one in which the heaters were placed on the side and were circular in character. There were two circuits in each, an outer and an inner, and that oven worked admirably and was comparatively easy to clean. In cooking meat the best arrangement was to have a given radiating surface to strike on the meat, which closed the outer pores of the meat and kept the juices in. They had found this an easy matter with their electric oven in which there was a hook on which the meat placed inside was hung between two radiating plates; an even temperature was not so important. He agreed that the results obtained by the tests would have been far better if something had been placed inside the oven to absorb the heat which was given off; absorption in the oven affected matters seriously. It ought to be their first duty to try to develop electric heating, which unquestionably would become a thing of the future. It was only by installing it in their own homes and showing it to their friends that they could get people accustomed to it.

Mr. S. J. Jones (Batley) suggested that if Dr. Griffiths could get some ladies who were domestically inclined to go to his laboratory and talk things over with him, it would go a long way towards helping forward electric cooking. A gas oven could be used in a rough and ready manner, and until an electric cooker could be used in the same way he did not think they would meet with much success. Makers did not seem to show the necessary enterprise, and the first cost of electric cooking apparatus was so high.

Mr. Ingleby (Leeds), who spoke as a layman, suggested that the N.P.L. should take up the problem of producing a better heating element.

Mr. Wood (Bradford) described the Canadian house use of electricity. It was only a question of getting the apparatus in that country, because once the housewife got accustomed to an electric oven or iron she did not go back to the old style. English people when they first went out to Canada hesitated to use an electric iron, but they found out in the summer time that they were up against it, and one could see them going off to buy an electric iron. From one electrical appliance they quickly passed to others until their homes became fully electrically equipped.

Mr. Lovell (Leeds) emphasised the fact that they had to consider the practical point of view of the user, the housewife, and that very often seemed overlooked by the designer of apparatus at present on the market. The use of the word "efficiency" in the paper was unfortunate and open to misinterpretation.

Mr. Allsopp added that he felt certain that if it was left in the hands of a few salesmen to illustrate electric cooking to the housewife they would never get the electric cooker pushed forward. It must be done by the electricity supply undertakings; they must put their heart into the matter, and spend money upon its development. In Bradford at the present time they were seriously considering the further development of the electric iron. A scheme had been put forward to send out anything up to 1,000 irons on sale or return. Such a scheme had been developed in the States very successfully, and he thought that their Canadian friends owed a good deal of their development to working on the lines of sending the goods out on trial, and having faith that they would sell.

In replying to the discussion, Dr. Griffiths said he and his colleagues had found it extremely difficult to find anyone who had had actual experience of the matter. The word "efficiency," he agreed, was not a fair term to put into the paper, and it would be altered. He was very doubtful about using parabolic reflectors; it was surprising how difficult it was to concentrate heat on any object, a problem that needed solving. If he were using an enclosed plate he would go in for a thick bottom; they stood a better chance of retaining heat by this means than with a thin one.

Discussion at Birmingham.

On February 23rd the paper was discussed by the members of the South-Midland Centre of the Institution of Electrical Engineers.

Prof. W. Cramp, in opening the discussion, said that research of a scientific character upon electrical heating apparatus had for a long time been urgently needed. There were indeed few electrical matters about which so much nonsense had been talked as heating apparatus and its efficiency. The present paper attempted to deal with two aspects of the problem: One was the formulation of standard tests whereby apparatus could be compared and judged; the other was the efficiency of the apparatus. It was to be regretted that the word "efficiency" had been used in the paper to express the ratio of the heat absorbed by the proposed test block to the heat equivalent of the energy supplied to the plate, for that debited the plate with the heat energy emitted by the block. The results obtained had an interesting bearing upon similar apparatus heated by gas, for it would seem that gas rings constructed upon the radiant energy principle would be more efficient for boiling purposes than those of ordinary type.

Mr. N. B. Rosher welcomed the paper because he thought that if the use of electric cookers and heating apparatus was to become universal in the home there was much need for further research and practical experiment. One of the chief reasons, in his opinion, for the extensive use of gas cookers was the high cost of the electric cooker, which could be taken as about double the cost of a gas cooker of equal capacity. Another reason was that supply authorities had not followed the example of the gas authorities in providing cookers on the hire or hire-purchase system.

Mr. H. Joseph criticised the paper on the ground that the authors had departed radically from working conditions in their tests. He would like the authors to make it clearer why they had departed from the homely method of heating lagged vessels with specially prepared contact surfaces. With regard to oven experiments, the absence of working conditions appeared to leave room for further experiments. The thermometer was not an essential accessory; practice soon produced the requisite ability to judge the heat.

Mr. S. H. Holden mentioned that with some systems of domestic supply it was usual to fit a limit switch; that produced an objectionable intermittency of supply if the prearranged current was exceeded. Would that device be suitable as a safeguard for the supply authorities in the case of cooking apparatus, and what would be the effect of intermittency of current on the performance of a cooker?

THE NEW RAILWAY GOODS CLASSIFICATION.

The position with regard to the classification of goods carried on railways and the rates to be charged for them is beginning gradually to clear itself, as a result of the inquiry by the Rates Advisory Committee of the Ministry of Transport, although it will necessarily be a little while yet before a final conclusion is reached. It is a very intricate matter, and a solution can only be arrived at after the most careful consideration in which all parties concerned must endeavour with the greatest goodwill, to seek a just condition of affairs, both as regards classification and rates. It is not merely a question of carrying a certain weight of goods between two specified points. Many other considerations come into play, even to the extent of the effect of foreign competition. Any attempt to summarise the developments towards a more modern classification must be prefaced with the reminder that the existing railway goods classification was drawn up in 1888, and consists of classes A, B, and C, and numbers 1 to 5, but it must be recognised that much has happened since then which must of necessity modify the fundamental principles upon which the old classification was based. It was because of the prevarication to which the 1888 classification lent itself that traders welcomed the decision of the Ministry of Transport to hold a public inquiry prior to settling a new classification, not only because of the new circumstances after the war, but in the light of past irritating experience under the conditions as they existed before the war. Ample evidence of the latter is to be found in the number of complaints made annually to the Board of Trade and the proceedings before the Railway and Canal Commissioners concerning oppressive rates and treatment on the part of the railway companies. Treating all that as past history, however, we can come to the prolonged inquiry by the Rates Advisory Committee of the Ministry of Transport, the result of which, in a way, may be regarded by some people as disappointing, inasmuch as this committee did not itself attempt to devise a new classification on the strength of the views placed before it by the railway companies and traders, but merely laid down certain principles upon which it suggested the position in future should be governed; and at the same time it recommended the appointment of a new tribunal—to work simultaneously with the Railway and Canal Commissioners—whose function should be to fix the new classification of goods and fix rates, tolls, and charges, afterwards remaining in charge of this aspect of the situation, with power to vary and alter and generally to act as intermediary between the railway companies and traders. How far this new tribunal would overlap the work of the Railway and Canal Commissioners has yet definitely to be decided, but the intention appears to be that the new tribunal shall undertake the duty of fixing rates, tolls, and charges, and certain of the functions of the Railway and Canal Commissioners, leaving the latter to perform such duties as are not transferred to the new body. Questions of undue preference, for instance, and other questions of a legal character are presumably to be continued to be dealt with by the Railway and Canal Commissioners, although, speaking offhand, one would be inclined to suggest that it would have been better to have strengthened the Railway and Canal Commissioners and given them the additional duties suggested for a new tribunal, which, by the way, is to consist of three permanent paid members giving their whole time to the work, one being a person experienced in railway work, the second a person experienced in commercial affairs, and the third, the chairman, a lawyer having no connection with railway or trading concerns, and not holding judicial office. In addition, there are to be two panels, one to be called the Traders' Panel, nominated by the Minister of Transport after taking the advice of the various traders' associations, and the other to be called the Railway Panel, to be nominated by the Minister of Transport after taking the advice of the Railway Companies' Association. This new tribunal, however, has not yet been constituted, but with a view to avoiding delay, the Rates Advisory Committee of the Ministry of Transport called upon the railway companies, during the public inquiry, to prepare a new classification to be used as a basis of discussion with the traders in arriving at the object desired by all, viz., greater simplification and clarity of definition.

The above may be regarded as a brief summary of the position at the close of the public inquiry, at which the Federation of British Industries necessarily took a prominent part as representing the engineering industry as a whole.

The railway companies duly submitted a new schedule. This, however, was not published until December 31st, 1920, and traders were given until January 31st, 1921, in which to lodge their objections and views upon it. Without in any way judging the success or otherwise of the railway companies in their endeavour to arrive at a greater simplification, it can be said that when the traders saw the really large volume which the new schedule filled, they were justified in complaining at being given only a month in which to examine it. Consequently, as the result of a universal protest by the traders' associations, the date of lodging objections was extended until February 28th, and the Federation of British Industries, which now has its own transport department, has placed a statement of the position before its affiliated bodies, and asked for recommendations to reach the Federation by February 14th. The general principles of the railway companies' proposals were considered at a public hearing before the Rates Advisory Committee on January 18th and 19th, and in order to avoid the putting forward of conflicting opinions within each industry, an endeavour is being made to form a co-ordinating committee composed of important representatives of the various large traders' organisations which are at present dealing with the matter. Meanwhile, the railway companies have agreed to publish the proposed classification in such a form as to show together the articles comprised in each class, and when this document is available the Traders' Committee of the Federation's transport department will be able to appreciate, and criticise if need be, far more expeditiously what is put forward.

From what has been said, it will be realised how impossible—or at any rate imperfect—would any attempt be to state in a comparatively few words what is the real position, as it now exists *qua* the details of the new classification. Nevertheless, the general result may be indicated, although there is little doubt that, as finally decided upon in the light of the traders' criticisms, there will be important changes in details. In reviewing this matter, emphasis should be laid upon the point that whereas in previous inquiries affecting the relations of the railway companies and traders, a considerable amount of antagonism has been shown between the parties, great goodwill is being shown, and both sides are doing their best to help the Rates Advisory Committee to come to correct conclusions. The railway companies have voluntarily made very substantial concessions to the traders, and their willingness to accept reasonable proposals of change deserves notice. The new classification shows an endeavour on the part of the railway companies to bring the same types of goods as far as possible into one class, with certain necessary subdivisions, and so successful have they been in this with regard to one class of engineering machinery—which does not happen to be electrical, however—that the particular trade association does not propose to exercise the right that it has of lodging formal objections, its views having been met to a considerable extent. The advantage of bringing goods into as small a compass as possible, as regards classification, must necessarily have the effect of producing considerable economies on the part of traders as regards clerical work, and eliminating the interminable arguments with the railway companies which have been so prominent in the past. So keenly is this recognised that it is felt the balance of advantage would be with the trader, even if the result of such a reclassification had the effect, as it will in some cases, of increasing the aggregate amount to be paid. There should be an end, for all time, to the absurd position that some machinery, by taking pieces off here and there, for example, can be sent under a totally different classification and a different rate. That is the object in view on the part of the traders, and we believe the railway companies fully appreciate that, the traders on their part recognising the difficulties involved. Instead of the Classes A, B, and C, and 1 to 5, it is now proposed to have 21 classes numbered 1 to 21, of which classes 2, 6, 10, 13, 16, 18, 19, and 20 are intended to cover articles hitherto carried at the class rates for old classes A, B, and C, and 1 to 5, and the other classes are intended to cover as far as possible, articles hitherto carried at exceptional rates below the appropriate class rates. There will probably be considerable discussion as to the minimum loads, because as the minimum loads have been raised from 4 tons to 6 tons to get the advantage of the lowest rate, it is clear that many traders will suffer considerably on this account, quite apart from the raising of the rates themselves, on the new principles laid down in the report of the Rates Advisory Committee. It behoves the various traders and their associations, therefore, to study the new proposals, first by comparison of the position under the existing classification and under the proposed classification, and secondly, the relative position of individual goods or similar products under the new classification. This, however, cannot be done efficiently until the railway companies publish the promised new volume setting out, side by side, the relative positions. For the moment, therefore, even traders themselves are not in the best position for giving helpful suggestions to their particular trade associations. The questions of owner's risk and exceptional rates will require most careful attention. In the opinion of some people, all goods in general should be conveyed at owner's risk, at the option and discretion of the owner to send them at the company's risk for an extra charge proportionate to the value of the goods, and the new classification, we believe, is on this basis. The question of exceptional rates, under the greater subdivision of the new classification, presents certain difficulties, but there seems every prospect of such difficulties being met and many of our past troubles being swept away under the soothing influence of the new tribunal.

Incidentally, it may be mentioned that in the Board of Trade *Journal* there has been published a list of increases in goods rates on the railway systems of the world since the war. We are not at all sure that any comparison of this kind is particularly useful, having regard to the varying conditions. Special interest does attach, however, for instance, to the general rebate in France of 10 per cent. on goods for export, and this method of assisting the foreign trade of Great Britain is one which might well receive sympathetic consideration, and so remove the anomaly of its costing more to send goods from the Midlands to the coast than it costs foreigners to send similar goods many times the distance over both land and sea.

OUR FUTURE TRADE WITH SPAIN.

(Concluded from page 375).

British Goods in Favour.

The lines in which preference for British goods is most pronounced include heavy machinery, steam generators, cranes, and pumps. There is much leeway to regain, as is patent from the results of the recent tenders for rolling stock for the Spanish railways. A further reduction in freight rates from the United Kingdom to Barcelona is essential.

In short, the outlook for British trade in Spain is undoubtedly bright, but a great deal depends upon the adaptability of the British manufacturer to the market, and, as stated before, a study of the methods of business which meet with success there.

Methods of Business.

It is exceedingly difficult for the average Anglo-Saxon to understand the Spaniard, and this is probably not fully realised by the British manufacturer. Only too often one hears of or meets with commercial travellers who are entirely ignorant of the language—in Spain, unlike South America, a good knowledge of the language is essential—and make no apparent effort really to understand the Spanish character. Consequently, although Spanish firms certainly have a marked preference for British goods and for trading with the British, on account of their reputation for straight dealing, orders go elsewhere.

Another point to remember is that although the Spanish merchant is a good payer, he likes credit, and will go where he can get it. As a general rule business should be done at 90 days from date of shipment. Spanish merchants prefer that bills should be drawn on them, and in dealing with respectable firms there is no difficulty in getting these bills discounted locally if it is desired. With the establishment of British banks and organisations such as the Federation of British Industries and the Commercial Secretary's Department, to say nothing of improved Consular representation, there should be no difficulty in taking up references in any doubtful cases, where credit is asked for.

The personal element is all important, and it should not be forgotten that certain forms of courtesy which are unusual in our country are traditional in Spain. Every Spaniard considers himself a gentleman—the differences between himself and others being merely accidental—and he expects to be treated as such.

To obtain the best results it is necessary to go to Spain and study the conditions and needs of the market, and it should be borne in mind that much business can be done outside the capital and other large provincial towns. Personal propaganda is, as has already been said, the best method of all, but much can be done with catalogues, circular letters, and advertisements, provided that: (1) They are written in correct Spanish —South American Spanish will not do for Spain; (2) the metric system is employed; (3) quotations are made c.i.f. Spanish port. How many British firms are prepared to do this? The Germans are doing all this and more, and there is no doubt that they will spare no effort to regain their hold on the Spanish market, aided, as they are, by a favourable rate of exchange. German travellers with ample supplies of catalogues are to be found in villages where the British are never seen, and in districts where a command of the language is essential, they pay that minute attention to detail which goes so far to gain the sympathy of the Spanish merchant.

A last point, which is certainly important, is that of packing, which, in a country with rather irritating Customs restrictions, should not be overlooked.

Use of Electric Power. All the principal towns in Spain are served with tramways, the large majority being electric. The business is still largely in the hands of the Belgians, although evidence is not wanting that the Spaniard is anxious to obtain control, as is shown by the recent absorption of the Madrid tramways by a Spanish company.

The importance of hydro-electric development in Spain is fully realised by Spanish engineers, and the hydro-electric power generated shows an increase from 281,000 h.p. in 1914 to 618,000 h.p. in 1920. According to fairly reliable sources, there are stated to be about 2,000,000 kW (1 kW = 1.34 h.p.) available, only taking into consideration waterfalls of more than 2,000 kW. This power is spread pretty well all over the country.

In view of the fuel problem, it is of paramount importance to Spain to avail herself to the full of all the electric energy that the country is capable of producing, but there are many difficulties to be faced in connection with it. Although this power is distributed practically all over the country, climatic conditions vary enormously, and, as a natural sequence, the flow of water in the rivers varies. Some rivers are dry in summer and fullest in the winter months, others, on the slopes of the Pyrenees, are dry in winter and fullest in the summer months, when the snows have melted. This irregular water supply makes some form of reservoir essential, and this has consequently been adopted by the majority of the companies which have put up large plants in that country. There are said to be 268 plants in the country, of which the following are the most important:—

	h.p.
S.A. Riegos y Fuerza del Ebro	130,000
Hidroeléctrica Española	64,000
Energia Eléctrica de Cataluña	60,000
S.A. Catalana de Gaz y Electricidad ...	41,000
Sociedad Productors de Fuerzas Motrices	20,000
Hidroeléctrica Ibérica	16,000

The enterprise of the Ebro Co. has certainly been of enormous benefit to Cataluña. Its power plants are on a scale previously unheard of in Spain. The transmission lines are upwards of 100 miles long, transmitting at 110,000 volts. On this plant hundreds of factories in the busy industrial centres of Barcelona, Tarrasa, and Sabadell, to quote only a few, depend, and it can certainly be stated that the difficulties of the coal situation, both during and after the war, have been very largely ameliorated by this one firm.

State Commission of Inquiry. The importance of electric power in Spain has evidently not been overlooked by the State, as in 1918 a permanent Commission was appointed by Royal Order to consider the following points: (1) The possibility of the construction by the State of a national system for the distribution of electrical energy; (2) the maximum extension possible of such a system; (3) the approximate cost of such a system, calculated on a basis of normal prices or with copper at about £80 a ton; (4) the possibility of the State supplying the capital required or of guaranteeing its interest, taking tolls of the energy transmitted, or any other means of financing the system; (5) the possibility of a uniform system, and the means to secure it. The Commission published its findings in 1919, and it was estimated that the cost of the scheme would be about 130 million pesetas, but, beyond drawing up the main headings for presenting a Bill to the Cortes, the matter has not been proceeded with.

It is hoped that a final agreement will shortly be arrived at between the Spanish and Portuguese Governments for the utilisation of the falls of the Douro, from which power will be transmitted to Madrid and Bilbao for the electrification of the main line railways of western and northern Spain.

The hydro-electric enterprise is specially protected by the law of 1917 for the protection of Spanish industries, and it is scarcely an exaggeration to state that the future development of Spain is very closely linked with the progress made in the development of this great natural resource.

Lecture on Electric Vehicles.—An interesting lecture on electric vehicles was delivered on March 10th at the Salusbury Road sub-station by Mr. A. W. Blake, the electrical engineer to the Willesden Borough Council. The meeting was primarily intended for the garage attendants and drivers of the electricity department's fleet of electric vehicles, but was also attended by the other members of the staff. An invitation was also extended to the vehicle staffs of the Hammersmith and Hampstead undertakings, which was readily taken advantage of. The lecture was illustrated by lantern slides, and simplified diagrams of connections, and was followed by experimental demonstrations of first principles and of "short circuits," "open circuits," "earths," and simple series and parallel connections.

THE LONG-DISTANCE TELEPHONE SYSTEM OF THE UNITED KINGDOM.

By Sir WILLIAM NOBLE, M.I.E.E.

(Abstract of paper read before the Institution of Electrical Engineers.)

This paper describes the development of the trunk telephone system since 1905, and deals mainly with the improvements in line plant design, especially in underground cable, which have been made during the past 10 years.

The expansion of the trunk-line system since 1905 led to congestion of the pole lines, and the difficulty of finding new routes increased. A scheme of direct cross-country routes of steel tower construction capable of carrying very large numbers of conductors was prepared, but at that juncture improvements in underground long-distance telephone cable led to a solution of the difficulty. Details are given of the valuable early work of P.O. engineers in devising methods and apparatus for balancing underground cable circuits so as to render them free from mutual interference and cross talk. This early work led up to the modern precision method of cable balancing which was first applied to a 52-mile cable laid between Leeds and Hull in 1913, which involved the making of over 90,000 capacity tests under field conditions, and every individual mile of the cable throughout the whole route was balanced to a very high degree of accuracy. The cable without any modification or adjustment was found suitable for working simultaneously, without cross-talk or disturbances of any kind, loaded physical telephone circuits, loaded superposed or phantom circuits, and high-speed Wheatstone automatic telegraph circuits.

The programme of construction for 1914 included the provision of a main cable-duct route from London to Liverpool via Birmingham, and the first cable on this route was completed as far as Birmingham in June, 1915, and extended to Liverpool in 1916, being designed to give 30 circuits between London and Liverpool, and 42 between London and Birmingham and Birmingham and Liverpool. The results obtained from this cable removed all doubts as to the future success of the underground trunk cable in relieving the congestion on the aerial lines, but the quality of service afforded by this cable in comparison with that previously given by aerial lines led to a rapid increase in traffic between the centres connected by the cable. Whereas a loss of 10 to 15 per cent. of working time was a common experience on long aerial lines, the loss on these cable circuits was nil.

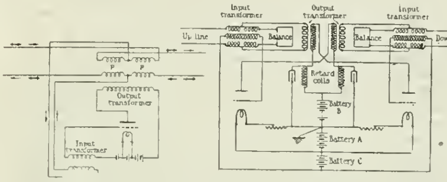

Fig. 1. Fig. 2.

Fig. 1.—Two-way Repeater with Single Amplifier.
Fig. 2.—Two-way Repeater with Up and Down Amplifiers.

More than once during the war the London-Liverpool cable saved the telephone trunk system from serious breakdown. This was notably the experience after the extraordinary blizzard which caused so much havoc in March, 1916. The storm swept across the country in a direction north-east to south-west, and reached a force of 75 miles an hour over a belt of nearly 100 miles in width between the Wash and the Bristol Channel, and was accompanied by a heavy fall of snow. Within little more than two hours practically every pole line inside that belt had been destroyed, and roads, railways and canals were blocked with the poles and wires thrown across them. It was an unparalleled disaster in the record of the telegraphic and telephonic services of this country.

Owing to the success of this premier cable, within two years of its completion every available circuit had been allocated, and the question of providing a second cable arose. It was evident that it would be necessary to increase considerably the capacity of underground duct routes in order to cope with the expansion of traffic which would follow on the extension of the underground system. At this juncture, however, the introduction of the three-electrode thermionic tube completely changed the aspect of the telephone repeater problem.

The "soft" valve has now been superseded by the "hard" valve for all telephone repeater work, but the thermionic valve with its associated input and output transformers has only a unilateral action as an amplifier. For use in the ordinary two-wire telephone circuit it must be duplexed in order to transmit and amplify speech currents in both directions through the circuit: this is effected on the principle of the duplex telegraph relay, by the use of differential winding on the line side of the output transformer (fig. 1).

Since the introduction of the thermionic valve amplifier the unbalance difficulty has become one of the chief difficulties in modern balanced repeaters. In practice, the use of the simple differential repeater circuit shown in fig. 1 is limited to those cases where the repeater can be inserted at the electrical centre of a homogeneous and stable line circuit. This condition is obtainable generally only in well-constructed cables. In this country it is seldom obtainable on aerial lines owing to the variations caused by our climatic conditions. Under the best conditions of a cable circuit the simple differential repeater may be operated to give a transmission improvement equivalent to the suppression of 16 miles of standard cable in a circuit having an equated length of 30 miles of standard cable. It has been found generally impracticable to use the simple differential repeater for tandem working.

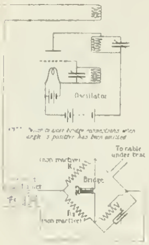

Fig. 3.

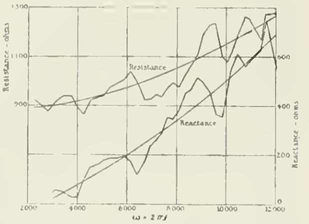

Fig. 4.

Fig. 3.—Bridge and Oscillator for Impedance Measurements.
Fig. 4.—Impedance/Frequency Curves for 70-lb. Cable Circuit.

This limitation led to the development of the double differential repeater shown in skeleton form in fig. 2. In this arrangement the line circuit is divided at the repeater station; each side is terminated in a duplex repeater and balanced by an artificial line designed to represent as nearly as possible the electrical characteristics of the actual line over the range of speech frequency. In practice, the balance can be made sufficiently accurate by the use of simple apparatus to permit the operation of as many as four repeater stations in tandem, each giving a transmission improvement equivalent to the suppression of 16 miles of standard cable. The minimum residual transmission equivalent of a repeatered circuit using repeaters of this type singly or in tandem is found in practice to be about 12 miles of standard cable.

It is necessary to measure the impedance of each line, if maximum efficiency is to be obtained from a repeater, to enable the balance to be calculated. The impedance characteristics of line circuits are obtained from a.c. bridge measurements made at frequencies ranging from 350 to 2,000 cycles per second. A thermionic valve arranged as an oscillation generator is used as a source of power for the bridge (fig. 3), and fig. 4 shows the results of measurements on a loop of 70-lb. conductors loaded with 135 mH coils at intervals of 2.6 miles. The mean curves for both the resistance and reactance components rise with frequency. This is due to the loading coil nearest to the office from which the measurements were made being too near to that office, and also to the effective resistance of the loading increasing appreciably with frequency. The irregularities in the curves are due to various causes, such as unequal spacing of loading coils and variations between the inductances of the coils along the circuit. This cable was not designed for repeater working, and in more recent cables special care has been taken to keep the inductance of the loading coils within narrower limits and to maintain accurate spacing. An improved type of loading coil has been introduced by the Western Electric Co., which it is expected will be much less liable to vary in inductance with time, and the effective resistance of which varies much less with frequency.

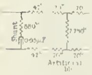

Fig. 5.

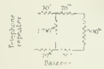

Fig. 6.

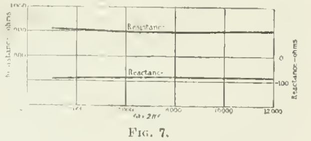

Fig. 7.

Figs. 5 & 6.—Shunt and Artificial Cable Balance, Repeater on 70-lb. Loaded Cable.

Fig. 7.—Modified Mean Curves.

One method of treating the cable of which the impedance curves have been illustrated is shown in fig. 5. A condenser in series with a resistance is placed as a shunt across the line, and this produces mean curves, fig. 7, which are practically horizontal. As the cable in this case is electrically short, an artificial cable is used to extend it, fig. 6, and the balance used is shown in the same figure. The necessity for extending the cable is due to the variations in impedance which result when a short line, that is, a line less than about 15 standard miles in length, is connected to lines or apparatus of differing impedances at the distant end. Such variations upset the balance of the repeater. If the line is sufficiently long, however, such connections do not sufficiently affect the balance to interfere with the working of the repeater.

The difficulties in operating circuits using differential repeaters in tandem have induced investigations of other systems for obtaining two-way facilities. The first is an adaptation of the principle of the simplex telegraph repeater arranged for up and down working. The line is divided at the repeater station, and the up and down sides respectively are led through the tongues and spacing contacts of an electromagnetic switch to the input circuit of an amplifier. The output circuit of each amplifier is cross-connected to the marking contacts of the opposite electromagnetic switch. The electromagnetic switches correspond to the automatic switches of the telegraph repeater, and are similarly controlled by the amplified outgoing currents, fig. 8. This principle has also been applied to wireless telephony.

The second system uses separate line circuits for transmitting in the up and down directions respectively. It is generally known as the four-wire system, fig. 9. The speech currents circulate in only one direction around the circuit and are relayed by the one-way amplifiers in each side.

In practice the terminal balances can be made sufficiently accurate to enable the repeaters to be operated so as to give a transmission improvement equal to the suppression of an attenuation length not less than that of the total line circuit. With modern balanced cables the repeaters may be spaced up to 30 standard miles apart; consequently very small conductors may be used. For long-distance cable circuits, beyond the economical range of the two-wire circuit with differential repeaters, the four-wire circuit offers important advantages and will be widely used.

Reference has been made to the London-Liverpool trunk cable and to the circumstances which led to its provision. Studies of traffic requirements between London and the Manchester and Leeds areas indicated the desirability of the same provision in these cases, and, but for the incidence of the war, a cable of similar capacity and efficiency to the London-Liverpool cable would have been commenced in 1914. Revision of the scheme in 1918 with later knowledge proceeded as follows:

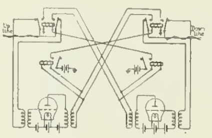

Fig. 8.

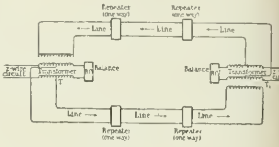

Fig. 9.

Fig. 8.—Repeater with Switching Relays.
Fig. 9.—Four-wire Repeater System.

The trunk circuits were required to give a transmission efficiency of 12 miles of standard cable between test-boards. This efficiency could be obtained with cable conductors weighing 200 lb. per mile of wire, loaded with 100 mH per mile, and a cable of maximum diameter would provide 42 circuits including phantoms. Such provision would barely suffice for two years' development, and a second cable would have to be commenced immediately on completion of the first. The development at the end of eight years would require several such cables, for which duct space should be provided at the outset.

Now assuming the installation of a midway repeater giving a transmission improvement of 14 miles of standard cable; then for an equivalent of 12 standard miles between terminal test-boards a cable containing 100-lb. conductors would be suitable. A cable of maximum diameter would provide 90 circuits including phantoms. The annual costs per circuit including repeaters would be approximately one-half that of the previous scheme, and the provision of a second cable would be postponed for about three years.

Further, assuming the installation of two intermediate repeaters each giving a transmission improvement of 14 standard miles; then the required efficiency between terminal test-boards could be obtained with cable conductors weighing 40 lb. per mile of wire, and the cable would provide 240 circuits including phantoms. The total annual charges per circuit would be approximately one-third those of the first scheme.

It was decided to proceed with the London-Manchester development on these lines, and at the time of writing this paper the duct route between the terminal stations has been completed and the cable is well on the way. Duct space has been provided to take care of developments for the next 20 years. The duct route forks at Derby, one route going north to Leeds and the other north-west to Manchester (fig. 10). The repeater stations will be located at Northampton and Derby, but a temporary repeater installation is being provided at Leicester, with sufficient equipment to operate the number of circuits required for two years ahead. The circuits will be worked temporarily at a lower efficiency than that designed for the full scheme, but they will be equal to most of the existing aerial lines and will relieve the present congestion on the routes between London and Lancashire and Yorkshire. In addition to this, the risks of interruption of service by storms will be minimised.

At the present time the construction of similar main cable routes from London to Southampton and Portsmouth and from London to Bristol and the west has been commenced. In due course the northern cable route will be extended beyond Leeds through Newcastle and Edinburgh to Glasgow, so that in the course of a few years all main telephone communications between the important commercial centres of this country will be underground, giving a quality and stability of service which will be equal to, if not better than, any in the world.

With regard to submarine cable development, in 1911 Messrs. Siemens Bros. & Co. introduced a form of balata dielectric as a substitute for gutta-percha in loaded submarine cables, on account of the greatly reduced leakance of the former as compared with the latter. The effect of this improvement was to reduce materially the attenuation constant and increase the range of speech in loaded cables.

In 1914 the Post Office engineers obtained four circuits from a loaded four-wire submarine cable, with the circuits isolated from the land lines at the ends of the cable by transformers, viz., the usual two side circuits and one loop phantom circuit, the fourth circuit being obtained by using the four wires of the cable in parallel with earth. Experiment shows that the fourth circuit can be made successful in a continuously-loaded cable, but it has not yet been successful in a coil-loaded cable.

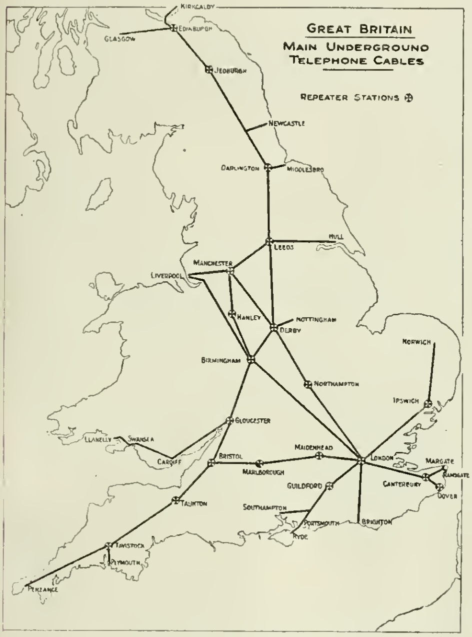

Fig. 10.—Main Underground Telephone Cables.

In certain circumstances where a four-wire loaded cable could not be satisfactorily laid owing to the weight of the cable, it might be desirable to lay single-wire loaded cables, and an investigation of the electrical constants which might be expected in such a cable has been made by the Post Office. It is found that the effective resistance of the conductor in such a cable would be materially greater than that of half the resistance of a loop circuit of the same gauge, and experiment shows that, when tested at a frequency of 800 periods per second, the resistance is approximately 2.5 ohms more than that of the resistance of the same single wire when measured by d.c. The increase of resistance was found to be the same for conductors weighing 500 lb. per nautical mile per wire and 100 lb. per nautical mile per wire. The increased resistance in the two cases is due to the effect of the cable sheath and the return path consisting of sea water, and these are similar in the two cases.

To carry a large number of circuits across a wide river or estuary four-wire cables are unsuitable. To meet this requirement a continuously-loaded cable has recently been designed and is now being manufactured for the Post Office. This cable will contain seven quads, and it is hoped that seven phantom circuits will be obtained in addition to the 14 side circuits. The weight of the conductors is 70 lb. per nautical mile per wire, and of the dielectric 110 lb. per nautical mile per wire. The attenuation constant of the cable circuits for speech purposes is 0.05 per nautical mile, which is practically the same as that of the unloaded telephone submarine cable conductors weighing 160 lb. per nautical mile per wire and insulated by gutta-percha weighing 300 lb. per nautical mile per wire. This cable was the standard type for long-distance communication before the advent of loading, and it contained only four wires. This enables us to see at a glance the progress which has been made.

The introduction of telephone relays has made it possible frequently to use submarine cables of a less efficiency than the coil-loaded cables previously required. This makes it practicable to increase the use of continuously-loaded cables in which the difficulties of maintaining loading coils in submarine cables are entirely eliminated. The present policy is, on this account, to extend materially the use of submarine continuously-loaded cables.

Concerning high-frequency or so-called "wired wireless" telephony, it is becoming evident that developments of the system are destined to play an important part in the future in long-distance communication.

It may be said that the most attractive, and at the same time the most valuable, feature of the high-frequency carrier-wave system is its adaptability to multiplex telephony, that is to say, the simultaneous operation of several communication channels over one wire circuit.

The system is already in commercial service in Germany and in the United States on long aerial telephone circuits, but the conditions under which those services are possible are practically non-existent in this country. The economical value of the system for use in the United Kingdom lies in its application to underground cables. There are, however, a few cases where the system may be applied economically to aerial lines. Some of these are now being dealt with and will be brought into commercial service and linked up with the trunk system during the coming year.

CAPILLARITY AND SURFACE TENSION.

The growing importance of colloidal chemistry is leading to an increased interest in what used to be considered the somewhat academic subject of surface tension. This revival of interest should react usefully, for the colloidal state is in truth nothing but a fine state of division in which *surface action* becomes of paramount importance. Hence the importance of accurate measurements of surface tensions and the need for a systematic determination of capillary constants.

With this end in view the Faraday Society and the Manchester Literary and Philosophical Society arranged a joint meeting in Manchester on February 11th to discuss the present position of capillarity and surface tension measurements. The proceedings were opened by Sir Henry Miers, F.R.S., President of the Manchester Society, and the discussion was presided over by Prof. Alfred W. Porter, F.R.S., the recently-elected President of the Faraday Society. The discussion was led off by Dr. Allan Ferguson, who gave a very valuable and interesting critical survey of the methods that have been proposed and used for the measurement of interfacial tensions, whether between liquid-gas, solid-liquid, or solid-gas surfaces. The importance of analysing the different methods is obvious when it is realised how varied are the values of surface tension obtained depending on the experimental method employed.

The conclusion arrived at was that the most promising methods for systematic use were those depending on :—

(1) The measurement of large bubbles or drops;

(2) The measurement of the maximum pressure required to release a bubble of air from the end of a capillary tube immersed in the liquid;

(3) The measurement of the maximum pull on an anchor ring which is immersed in the liquid and slowly withdrawn therefrom.

In a second paper Dr. Ferguson and Mr. P. E. Dowson described a modification of the capillary tube method for the measurement of surface tensions, a method described as holding the affections of experimenters by reason of a somewhat delusive simplicity. The modification devised is to force down the meniscus to the end of a short capillary immersed vertically in the liquid and measure the pressure required to do so. This pressure is measured on a separate manometer, and the difference of level of the surfaces of the liquid in the gauge—magnified by using a light liquid—is a measure of the rise that would have taken place in the capillary. Temperature control is simple, and temperature measurements are made by means of a thermo-couple.

The great advantage of this method is that it dispenses with the tedious process of selecting a long capillary of perfectly uniform cross-section, and also does away with the necessity for calibrating and keeping clear such a capillary. Sources of error, such as the big temperature correction necessitated in measuring the rise of liquid in a capillary and the difficult measurement of the height itself, are also eliminated.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

7,728. "Electrical polarity indicator." R. D. Young. March 11th.

7,743. "Method of fastening electric cables and wires to porcelain, &c., insulators." W. R. Millar. March 11th.

7,744. "Automatic switches." W. J. Allen and W. D. Vick. March 11th.

7,749. "Supports for overhead trolley wires." E. R. Myers. March 11th.

7,753. "Insulating tape." W. Connolly. March 11th.

7,778. "Electric current regulators." W. Langdon-Davies and A. Soames. March 11th.

7,781. "Accumulators." W. T. Coulson. March 11th.

7,787. "Rectangular casing for electrical apparatus." Landis & Gyr Akt.-Ges. March 11th. (Switzerland, March 13th, 1920.)

7,795. "Electro magnetic apparatus for detecting electric currents." H. J. Dale. March 11th.

7,814. "Wireless receiving systems." Ges fur Drahtlose Telegraphie. March 11th. (Germany, March 13th, 1920.)

7,817. "Induction regulator for mono and polyphase current circuits." J. Kristen and Maschinenfabrik Oerlikon. March 11th. (Switzerland, March 23rd, 1920.)

7,819. "Providing electric cables with distinguishable wrappings for various leads." Deutsche Kabelindustrie Ges. and H. Sefton-Jones (Deutsche Kabelindustrie Ges.). March 11th.

7,848. "Apparatus for detection of Hertzian waves." M. Marshall. March 12th.

7,882. "Cooling arrangements for electrical machines." A. Arutünoff. March 12th.

7,884. "Electro mechanically controlled telephone system." F. Aldendorff and H. Baron (Aldendorff). March 12th.

7,885. "Electric measuring instruments." F. Holden. March 12th.

7,887. "Oscillating valve relays." G. A. Mathieu. March 12th.

7,889. "Means for supporting thermionic valves." A. R. Taylor. March 12th.

7,896. "Electroplating apparatus." T. R. Canning and W. Canning & Co., Ltd. March 12th.

7,900. "Electric bells, &c." E. Magerle and J. Steiner Ges. March 12th. (Austria, March 12th, 1920.)

7,922. "Mine-signalling visual indicator." R. S. Gardner. March 14th.

7,933. "Electric motors." Automatic Telephone Manufacturing Co., Ltd. and A. E. Hudd. March 14th.

7,947. "Electric fuse-boards." J. B. Tucker. March 14th.

7,954 "Automatic, &c., telephone systems." W. Aitken. March 14th.

7,964. "Portable electric lamps." J. M. Fenton and Doherty Motor Components, Ltd. March 14th.

7,973. "Electrolytic cell." Elektrizitats Akt.-Ges. vorm Schuckert & Co. March 14h. (Germany, June 14th, 1920.)

7,982. "Means for magnifying effects of small efforts for telegraphy, &c." A. Orling. March 14th.

7,987. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. March 14th. (United States, March 29th, 1920.)

7,993. "Switch plates, finger-plates, &c." T. A. Ingram and J. M. Kaye. March 14th.

7,998. "Electric heaters." G. Durando. March 14th.

8,002. "Multiple low-frequency telegraphy." N. Koomans. March 14th.

8,009. "Ignition devices for internal-combustion engines." British Thomson-Houston Co., Ltd., and A. P. Young. March 14th.

8,011. "Guiding means for push-buttons in telephone boards." Telephone Manufacturing Co. (1920), Ltd. March 14th.

8,021. "Telephone systems with high-frequency oscillations." H. A. Gill (Deutsche Telephonwerke Ges.). March 14th.

8,031 "Electric signalling or call apparatus." C. F. Metcalf. March 15th.

8,047. "Dry storage batteries." W. Gardiner. March 15th.

8,049. "Electric starting and energy generating machine for automobiles." R. Bosch Akt.-Ges. March 15th. (Germany, November 29th, 1920.)

8,050. "Electro-mechanical lock." G. C. Ashbee. March 15th.

8,077. "Insulators for supporting electric conductors." E. Parry. March 15th.

8,079. "High-tension distributors for electric ignition apparatus." A. P. McGowran, M.L. Magneto Syndicate, Ltd. March 15th.

8,081. "Automatic braking apparatus for electric motors." McKenzie, Holland & Westinghouse Power Signal Co., Ltd. March 15th. (France, November 9th, 1920.)

8,089. "Electro-magnetic switch." F. Krupp Akt.-Ges. March 15th. (Germany, December 20th, 1920.)

8,096. "Apparatus for production of X-rays." E. E. Greville and F. W. Read. March 15th.

8,103. "Magneto-electric machines." H. W. H. Warren, British Thomson-Houston Co., Ltd., and A. P. Young. March 15th.

8,126. "Electric water-heaters." A. S. Dorsey. March 15th.

8,127. "Contact-breakers for magnetos." Duten, Doublet et Cie. March 15th. (France, March 19th, 1920.)

8,140. "High-frequency multiplex transmission." H. A. Gill (Deutsche Telephonwerke Ges.). March 15th.

8,141. "Circuit arrangements for multiplex cable telegraphy and telephony." H. A. Gill (Deutsche Telephonwerke Ges.). March 15th.

8,155. "Combined electric cooker and insulating box." W. M. Edwards. March 16th.

8,182. "Perpetual motion or magnetically-propelled power generator." A. E. W. Maseyk. March 16th.

8,187. "Electric torches, &c." P. V. Rowlands and W. G. Bean. March 16th.

8,197. "Electric starting gear for internal-combustion engines." W. B. Bond, Cheetham Motor and Engineering Co. and F. Sweeney. March 16th.

8,233. "Electric cables for conveyance of high-tension electrical energy." L. N. Reddie (Soc. Pirelli & Co.). March 16th.

8,235. "Commutators for dynamo-electric machines." G. Schroeder. March 16th.

8,247. "Frequency multipliers for alternating electric currents." P. Trichard. March 16th. (France, March 16th, 1920.)

8,256. "Electric primary cells." L. Darimont. March 16th.

8,277. "Reception of continuous-wave signals." H. J. Round. March 16th.

8,307. "Sparking plugs." R. S. Gallop. March 16th.

8,349. "Gearing for starting motors and electrical generators used on internal-combustion engines." F. R. Smith and Armstrong Siddeley Motors, Ltd. March 17th.

8,357. "Holders for telephones." C. H. Smith. March 17th.

8,370 "Sparking plugs." P. Challis. March 17th.

8,375. "Apparatus for suppressing higher harmonics in metal-vapour rectifiers fed through polyphase choking coils." Akt.-Ges. Brown, Boveri et Cie. March 17th. (Switzerland, March 27th, 1920.)

8,384 "Means for fixing electric cables and wires." Edison Swan Electric Co., Ltd., and F. C. Raphael. March 17th.

8,399 "Electric rheostats." British-Thomson Co., Ltd. (Soc. d'Electricité et de Mécanique). March 17th.

8,412 "Thermo-electronic relays, &c." W. J. Mellersh-Jackson (Compagnie Générale d'Electricité) and W. J. Mellersh-Jackson. March 16th.

8,434 "Means for generating electrical power." R. B. Sparrow. March 5th.

8,448 "Electric heating apparatus." E. Muntwyler. March 18th.

8,462. "Electro-magnetic relays." W. E. Barber. March 18th.

8,467. "Constant speed dynamo drive." H. C. C. Thurgood. March 18th.

8,473. "Electric generating sets." A. A. Lyon. March 18th.

8,498. "Lamp-making machines." British Thomson-Houston Co., Ltd. (General Electric Co.). March 18th.

8,509. "Electric heaters for liquids." F. Nottet. March 18th.

8,510. "Means for facilitating identification of electric conductors." N. J. Austin. March 18th.

8,550. "Means for reducing starting load on hydraulic pumps, &c., directly coupled to electric motors." F. Simpkin and G. W. Whitelock. March 19th.

8,556. "Anti-dazzle device for electric head lamps." M. Kemp and W. H. Kemp. March 19th.

8,577. "Electric switches." H. Bufton, C. Marples and W. Marples. March 19th.

8,596. "Wireless receiving apparatus." W. W. Burnham and C. F. Phillips. March 19th.

8,606. "Electro-mechanically controlled telephone system." H. Baron (Aldendorff). March 19th.

8,630. "Directional wireless apparatus." C. K. Chandler. March 19th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

10,580. "Devices for locking incandescent lamps in their holders." G. F. Coulson. June 26th, 1918. (159,228.)

1919.

2,967. "Electric fixture support couplers." S. Percival (G. Lacey). February 6th, 1919. (159,229.)

19,225. "Electric conductors." St. Helens Cable and Rubber Co., Ltd., and S. H. Lee. August 5th, 1919. (159,233.)

28,260. "Means for controlling the operative field of magnets." L. W. Goold (National Safety Appliance Co.). November 14th, 1919. (159,260.)

28,600. "X-ray apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). November 18th, 1919. (159,267.)

28,788. "Ventilation and cooling of electrical or other machines." J. Smillie and Metropolitan-Vickers Electrical Co., Ltd. November 20th, 1919. (159,282.)

28,893. "Controllers for electric motors." C. E. Fairburn. November 20th, 1919. (159,288.)

29,094. "Method of preparing storage batteries for shipment or storage." U.S. Light and Heat Corporation. September 8th, 1917. (135,517.)

29,186. "Method of controlling electric motors operating fluid-pressure pumps or the like." H. P. H. Anderson. November 24th, 1919. (159,306.)

29,284 "Electro-magnetic switches." A. M. Jane. March 29th, 1916. (135,843.)

29,322. "Telegraphy." E. S. Heurtley and Muirhead & Co., Ltd. November 25th, 1919. (159,316.)

29,339. "Electric ignition collecting, distributing and timing devices and systems." G. M. Turner. November 25th, 1919. (159,317.)

29,392. "Electric thermionic amplifiers." British Thomson-Houston Co., Ltd. (General Electric Co.). November 25th, 1919. (159,322.)

29,977. "Electric switches." Adt Akt.-Ges., Geb. June 13th, 1919. (144,993.)

30,358. "Dynamo-electric machines." Siemens Bros. Dynamo Works, Ltd., and J. C. Wilson. December 4th, 1919. (159,343.)

30,480. "Electric converting apparatus." W. E. Highfield and J. E. Calverley. December 5th, 1919. (159,345.)

30,584. "Mouth-pieces of telephones and the like." J. Joleh. December 6th, 1919. (159,348.)

30,868. "Electrical static machines and apparatus for electro-therapeutic work and for like purposes." T. Clark. December 9th, 1919. (159,358.)

31,112. "Thermostats." Calico Printers' Associations, Ld., and G. Turner. December 12th, 1919. (159,365.)

31,561. "Dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). December 16th, 1919. (159,374.)

31,673. "Wireless reception apparatus." J. Robinson and H. L. Crowther. December 17th, 1919 (159,377.)

31,806. "Refillable electric fuses." Perfect Refillable Fuse, Inc. December 18th, 1919. (136,840.)

1920.

1,768. "Electrically-propelled vehicle." J. H. Hansen. January 20th, 1920. (159,395.)

4,570. "Magnetic deflectors for electric arcs in lamps, searchlights, and the like." H. C. Gibson and J. P. Yorke. February 14th, 1920. (159,408.)

6,195. "Sparking plugs." E. Pethoud. October 6th, 1919. (152,623.)

7,944. "Compositions for insulating and protecting electrical apparatus and for other purposes." British Thomson-Houston Co., Ltd. (General Electric Co.). March 17th, 1920. (159,421.)

9,103. "Device for variably tilting the shades of electric lamps." H. H. Berry and W. J. Markham. March 29th, 1920. (159,424.)

9,178. "Sparking plugs and ignition-timing devices for internal-combustion engines." I. L. Slawter and W. Innes. March 30th, 1920. (159,425.)

11,493. "Portable electrically-driven vacuum cleaners." G. A. Celli. April 24th, 1919. (142,463.)

12,474. "Electrical time-keeping mechanism." C. D. J. Jamin. May 5th, 1920. (159,436.)

15,572. "Overhead trolleys or collectors for electric tramway and railway vehicles." T. Blaney and D. Williams. June 9th, 1920. (159,445.)

18,970. "Field magnets for magneto-electric machines." C. Von Der Weid. June 12th, 1920. (159,448.)

22,077. "Voltage regulators for electric current generators." Scincilla (Firm of). August 8th, 1919 (149,611.)

31,517. "Electrical speed-regulator systems." Metropolitan-Vickers Electrical Co., Ltd. November 6th, 1919. (153,582.)

34,897. "Thermostatic protective apparatus for use with bearings or other parts of a machine." Metropolitan-Vickers Electrical Co., Ltd. December 10th, 1919. (155,214.)

Electrical Treatment of Seed Wheat.—Experiments are to be undertaken at Werribee (Vic.) with an electrochemical process of treating seed wheat. It is claimed that considerably increased returns can be obtained by treating the seed electrically. The cost of treating is 1s. per bushel of seed, and the resulting increase in the yield is said to be from 25 to 30 per cent. Thus on 600 acres, with seed at 9s. a bushel untreated, and 10s. a bushel treated, and with a yield of four bags to the acre from ordinary seed, and five bags to the acre from electrically-treated seed, the respective returns in cash would be £2,970 and £3,750 representing a balance in favour of the treating process of £780. This means a very solid gain.—*Industrial Australian and Mining Standard.*

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THE VACANT CHAIR.

IT is with a full heart that we announce to the readers of the ELECTRICAL REVIEW the death, after a brief illness, of our Technical Director, on March 31st. For some 40 years Mr. Tom Ernest Gatehouse presided over the editorial department of this journal, of which he was part proprietor; during that period, in partnership with Mr. H. Alabaster and Mr. H. R. Kempe, he assisted at its development from small beginnings to a journal with a world-wide circulation, and a reputation for just dealing and independence of spirit. To Mr. Gatehouse and his partners those qualities are mainly due; they were ever proud of the journal and their connection with it, and it was their constant united aim to maintain its high standard of probity and honour, and to increase its usefulness to the industry which it serves.

A pupil of Sabine and Wheatstone, Mr. Gatehouse entered the electrical industry at a moment when every day occasion arose for devising means for dealing with some new problem, and he loved to recall those far-off times; he was a contemporary of practically all the great lights of electrical science, and, by virtue of his position, was acquainted with most of them. He delighted in a joke, and was immensely popular amongst his many friends; until his health began to fail, he enjoyed participation in gatherings of electrical men, and was well known for his good-humour and *camaraderie*. One of his most lovable traits was his unshakable loyalty to the friends and comrades of his youth, many of whom had good reason to rise up and call him blessed—and not only those, for he was open-handed and generous to a fault; his memory will be cherished by many in humble walks of life whom he befriended in time of need, and he never withheld his sympathy and kindly help from men who had fallen on evil days, or those who were beginning their career.

His musical talent, in the exercise of which he delighted, was also a constant source of pleasure to others, and he was always ready, when his health permitted, to place his gifts at the service of his friends. This was indeed characteristic of him, for he loved to see other people happy, and to contribute to their happiness. He abhorred ostentation, and his geniality and goodfellowship endeared him to all who came in contact with him, though, when the need arose, he could be stern and outspoken.

It was in consequence of failing health that for some years past Mr. Gatehouse had not taken a very active part in the production of the ELECTRICAL REVIEW. Latterly in the capacity of editorial and technical director he exercised consultative, rather than working, editorial control. He preferred to leave the actual conduct of affairs to those who had been so closely associated with him for from 20 to 30 years, and who with him and his partners were, and are, zealous for the maintenance of the principles and policy for which the ELECTRICAL REVIEW has so long stood, and will continue to stand.

Sectional Development of Electricity Supply.

The increased facilities for obtaining Special Orders afforded by the Electricity Supply Act, 1919, might be very usefully employed in modifying the unfortunate rigidities of the 1882 and other Acts. We are reminded of this by the application of the Hereford Council to extend its area over certain surrounding urban and rural districts, and so to get free from the parochial restrictions arising from the 1882 Act. There is no doubt that any general enterprise of this kind should be encouraged as affording that sectional development which would assist so greatly towards the ultimately larger co-ordination of supply. It is certainly working in the right direction for existing undertakers to branch out into their surrounding areas rather than that further pygmy undertakings should spring up. It would, in fact, be very much better if there were still greater facilities afforded for undertakings in remote districts to give supply wherever they could reach. It is just here that that element of personal judgment and discretion which was given by the appointment of the Electricity Commissioners should be of value. It would be an advantage to everyone concerned if in cases where any undertaking was willing to branch out into the unappropriated districts round its present circumscribed area the Commissioners did everything they could to smooth the legislative path. There is, indeed, all the more need for this sectional development to be encouraged, in view of the tendency of the Joint Electricity Authority schemes to hang fire. In rural districts especially undertakers are often only too anxious to extend their supply, but are diffident in tackling the legal side of the question, which alone forms the obstacle, and have little money to spend in promoting orders. The Commissioners might with advantage remember in dealing with these early cases that any cordial treatment meted out to them would go far *pour encourager les autres.*

Telegraphic Devolution.

The announcement to be found elsewhere in this issue, that the Peruvian Government has delegated to a company the operation of the whole of its postal and telegraphic services for a period of 25 years, will be read with interest in many quarters, and the appointment of Sir William Slingo, late engineer-in-chief of the British Post Office, as head of the department is in itself highly significant. Our congratulations are offered to the new Chief on his attainment of a position which in this country is barred to the engineer; and to the company on its embarkation on a "great adventure," which will enable it to put in force those principles which it has been prevented by circumstances from putting to the test up to the present.

In this contract two principles which have been regarded as sacred in this country have been set at nought: first, that a public service of this nature must be owned, controlled, and operated wholly by the State; and secondly, that the head of the department shall be a member of the Civil Service, without technical qualifications for the post. There are signs that those views are weakening even in the United Kingdom, for we have seen the control of the supply of electricity entrusted to a board of Commissioners consisting mainly of engineers, and the controversy about the telephone service has directed public attention to the question whether it would not be better conducted by a company than by a department of State. With the exception that in the United States the telegraph and telephone services have remained in the hands of companies, we believe that State operation of the posts and telegraphs has hitherto been universal, but on the other hand, the appointment of an engineer to the headship of the engineering department of those services has been the rule almost everywhere outside the British Empire, and we are certain that it is the right policy to follow. In the British Post Office the engineer is a subordinate official; everywhere he is subject to the rule of the clerical staff, and we have heard it said that even the Engineer-in-Chief has no power to order the purchase of a packet of nails, or to dismiss a labourer addicted to drunkenness. All that the engineer can do is to make "recommendations," which are considered, without undue haste, by the clerical official immediately concerned, and passed on by him to other officials, referred back at intervals to the engineer for further information, and in fact bandied about until a mass of correspondence accumulates and exasperating delays have occurred. All this fatuity of procedure tends to promote inefficiency and to hinder the development of the services concerned; and it all arises out of the determination of the clerical or secretarial branch of the service never to permit the engineer's department to assume responsibility or to acquire authority. Until it is freed from those paralysing trammels it is hopeless to demand from it efficiency and progress at all comparable with those attained under a common-sense organisation.

Waste of Energy.

The attention that has been given by the lay Press in recent years to the subject of conserving our national resources is so welcome an indication of healthy progress towards an appreciation of the industrial conditions of to-day that we are loath to find fault with its form; yet we are bound to comment, albeit with leniency, on the erroneous statements which almost always detract from its value. A case in point is a leading article in *The Times* of April 5th, advocating economy in the consumption of fuel, and the utilisation of water power to that end. The writer remarks that "In a well-organised steam plant 75 per cent. of the energy of coal can be delivered to the machinery; in actual practice 50 per cent. is a common average." Alas! that we should have to confess that in our latest schemes we are hoping to reach the figure of 25 per cent. at the switchboard of a steam-driven plant. Again, the writer correctly refers to the high efficiency of utilisation of energy in internal-combustion engines—but says there is "still a large opportunity for saving in the transmission gears." Finally, he turns to the ever-fascinating idea of obtaining energy from the tides, and writes hopefully about the scheme put before the French Senate last Saturday by the Minister of Public Works, outlining a turbine "capable of being used in the ocean." We wish we could emulate his optimism. By all means let the lay Press deal with engineering subjects—but let it make sure of its facts.

The German Export Trade.

Dr. Rathenau, speaking at the recent meeting of the A.E.G., when resolutions were adopted deciding to increase the ordinary share capital by 50,000,000 marks and to make a further issue of preference shares for 250,000,000 marks, stated that the company exported 40 per cent. of its total production before the war, and his further observations point to the determination to recover, if possible, this lost export business. It was proposed, he remarked, to re-establish the export organisation; a lot had been maintained in America and the East, but everything had been destroyed in the Allied countries. Having regard to the situation of gold currency, the chairman observed that it certainly sounded absurd to build up the export organisation in mark currency. This absurdity, however, did not actually exist as the question substantially concerned the possibility of supplying goods made in Germany to other countries on credit. As to the situation of business, Herr Rathenau said the company's orders on hand were satisfactory in numbers, but were not so uniform as in former years. Large machines were in great demand at present, and the orders for them would ensure work for a long time to come.

TOM ERNEST GATEHOUSE.

Mr. Gatehouse, who was born in 1854, at Eye, in Suffolk, was the son of Mr. Tom Gatehouse, a mechanical engineer; naturally, therefore, he had a bent towards engineering as a profession, and about 1870 he became a pupil of Robert Sabine, one of the most eminent and able pioneers in the electrical industry, which at that date could truly have been said to be in its infancy. In Sabine's office Mr. Gatehouse came into immediate contact with every branch of the new industry, of which by far the most important was that of telegraphy. Later he was associated with Sir Charles Wheatstone and Sir Samuel Canning, foremost exponents of the art of telegraphy on land and by submarine cable, which associations led to an intimate friendship with many of the leaders of the cable manufacturing industry. But in those days an electrician's interests ranged over the whole of the electrical field, and thus it was that the young engineer assisted at such notable events as the lighting of the Victoria Embankment experimentally with the "Jablochkoff Candle," an early form of the arc lamp, and devised an important improvement in the system, for which he obtained a patent. Amongst the various undertakings with which he was closely associated were the first electric lighting of Aldgate Station with Lontin arc lamps, and the development of the Werdermann arc lamp and the Gramme dynamo; in connection with the Lontin lamp he patented an improvement. His experience in testing cables led to his employment for many years in the inspection and testing of submarine cables in course of manufacture, on behalf of Sir Samuel Canning. He was also interested in the development of the telephone, and at a later period conducted many experiments with a view to its improvement.

Turner & Drinkwater] [*Hull.*

Tom Ernest Gatehouse, F.R.S.E., A.M.Inst.C.E., M.I.Mech.E., M.I.E.E., Editorial and Technical Director of the Electrical Review.

The introduction of the incandescent lamp, however, indirectly proved to be a turning-point in the life of Mr. Gatehouse, who invented a device (afterwards re-invented in connection with the Nernst lamp) for the patent rights of which he received a substantial sum. About this time his fellow-pupil under Sabine, Mr. H. R. Kempe (subsequently the electrician to the Post Office), had become associated with Mr. H. Alabaster, proprietor of the Telegraphic Journal and Electrical Review, and invited Mr. Gatehouse to throw in his lot with them. Mr. Gatehouse assumed the office of editor in 1881, and speedily acquired a popularity which made him a welcome figure at electrical gatherings of every description. Thus in 1883 was formed the partnership of "H. Alabaster, Gatehouse & Co.," which was destined to hold firm for nearly 40 years—a partnership which, we venture to believe, became a household word throughout the electrical industry.

Under the joint management of "Ageekay, London," the journal, which had passed through many trials and troubles, entered upon a period of success which has never suffered a reversal. During the past 40 years, Mr. Gatehouse witnessed the development of the whole of the electrical industries as they now exist (with the exception of telegraphy, which commenced 50 years earlier), including the advance from the dynamo which fed one arc lamp to the 60,000-kW turbo-generator, from the tiny electric launch to the battle-cruiser propelled by electricity, from the primitive battery 'bus to the 8,000-h.p. electric train—and all the other triumphs of electrical science with which that period is so richly strewn. Up to the last he retained a lively interest in all that was going on, and rejoiced in the progress of the science with which his whole career had been inseparably bound up.

But like most men, he had a hobby to which he was passionately devoted. From his early youth he worshipped music, and studied the violin so assiduously that he became, as an amateur, a master of that difficult instrument. So well known were his capabilities as a violinist that his services were in constant request at festive gatherings of electrical men, and the fact that he was going to perform was in itself a powerful attraction to such events. So long ago as 1885, in conjunction with his partner, Mr. Alabaster, he founded the Electro-Harmonic Society, which, at first a small and intimate body of friends, eventually grew to very large dimensions. From the commencement, Mr. Gatehouse was one of the two musical directors, and on the death of Mr. Izard he took over the whole of the duties, with the success which is indicated by the present membership of 600. In earlier years a frequent performer at the Society's concerts, he latterly played but seldom, the last occasion being the memorable Ladies' Night in November, 1920. The 21st anniversary of the foundation of the Society was celebrated in 1906 by the presentation to him, and to Mr. Alabaster and Mr. Izard, of handsome silver souvenirs, as tokens of the gratitude and esteem of the members.

Mr. Gatehouse, however, by no means confined his interest in music to an electrical environment; for very many years he took an active part in the conduct of the South London Institute of Music, and he frequently lent his assistance to charitable entertainments, Church festivals, and similar functions, the last occasion being in January, at Holy Trinity Church, where the funeral service was held on Tuesday, close to his home. He also often organised and took part in the musical programmes of the

Dynamicables, the Junior Institution of Engineers, and other bodies, to their great gratification. For 27 years he was the honorary leader of the Diss Choral Society, at Diss, where he was held in high esteem and affection. By his musical talents he "fiddled his way" into the warm affection of a host of friends whom otherwise he might never have known, but who will ever cherish the memory of the happy moments which he afforded them.

Whilst in the early days Mr. Gatehouse freely exercised the literary gifts which he undoubtedly possessed, in later years he seldom practised authorship, and latterly, owing to failing health, he withdrew from the active editorship of the journal, though as "Editorial and Technical Director" he retained his interest in its production, and lent his aid in a consultative capacity.

He was at all times keenly solicitous for the promotion of the interests of the electrical industry in all its branches, and a determined enemy to imposture and injustice in all forms. The exposure of the electric belt quackery led to costly libel actions, all of which were won by the Electrical Review, and on other occasions he was successful in defeating attempts at fraud and in dispelling false theories. As an expert witness in legal actions he won high commendation from the judges on various occasions. He prized his independence of thought and action so highly that he consistently refused to hold shares in any electrical company, and for the same reason he declined invitations to serve on the councils of societies connected with the industry. He also withdrew from consulting work, lest it should interfere in the least with his liberty in this respect. Where no such influence could be feared, however, he was ever ready to give his services in the public interest, and thus he officiated as juror at various exhibitions, including the Milan Exhibition of 1906 and several White City Exhibitions, and was a member of the Executive Committee of the Electrical Trades Benevolent Institution, of which he was a Life Governor. He was a Past Master of the School Board of London Lodge of Freemasons, and a supporter of other charitable institutions. In connection with his profession, he was an Associate Member of the Institution of Civil Engineers, a Member of the Institutions of Electrical and Mechanical Engineers, and a Fellow of the Royal Society of Edinburgh.

Fond of the open air, he enjoyed shooting in his periods of relaxation, and was a warm supporter of rifle clubs, including that connected with this journal.

He was in his chair at Ludgate Hill for a short time on Wednesday, March 23rd, and was in cheery mood as he turned homeward. He retired to rest at night as usual, but on rising next morning, he was visited by a paralytic stroke; he lingered for a week and a day, breathing his last at eventide on Thursday, March 31st.

Mr. Gatehouse, who resided at Fairfield, 128, Tulse Hill, S.W. 2, leaves a widow, a son (Mr. Ernest Gatehouse, who is a Member of Council of the I.E.E., and is on the staff of the British Thomson-Houston Company, at Rugby), and two daughters, both of whom are married to gentlemen in the electrical profession. We are sure that there will be very many who will desire to associate themselves with us in tendering to all of these an expression of our deep sympathy.

An Appreciation.

Back to the days when Sir Charles Wheatstone—the electric telegraph pioneer—was still alive, is a span of half a century, but it was at that time that my acquaintance with Tom Ernest Gatehouse commenced. He and I were then fellow workers in the office of the late Mr. Robert Sabine, and afterwards in the laboratory and the factory (The British Telegraph Manufactory) of Sir Charles Wheatstone. Prior to this, Gatehouse and I, although working in different spheres, were continually in each other's companionship, and gained experience in all kinds of mechanical and telegraphic engineering, including the early pneumatic dispatch system, and submarine cable work. On the commencement of my career in the Postal Telegraph Service, Gatehouse took up work with Messrs. Muirhead, and when the electric light boom burst upon the world, he patented, amongst other things, a form of filament lamp, for which he received a substantial reward which set him firmly on his feet. When I first knew Gatehouse I did not detect in him any tendency to literary talent, but an article which he wrote describing an electric light system, and which appeared in *Nature*, indicated that he had considerable ability in the direction of scientific description. That this would develop in the way it did I did not in the least foresee, but the chance occurred, and on the alteration which took place in the status of the *Telegraphic Journal*, *i.e.*, its change from a fortnightly to a weekly journal, Gatehouse at my suggestion (a fortunate one) became a member of the staff, and continued so ever since. Little did I think what a tower of strength he would become, or what a really remarkable personality his would be. Distinctly self-assertive, but in a most straightforward and courteous way, he could hold his own with all with whom he had to come into contact; he was decidedly a strong man, and not "retiring" or troubled by "nerves."

It is almost unnecessary to allude to his musical ability as a violinist, as this might, in a sense, be said to be renowned in the world in which he lived. Those who used to listen to his performances did so with rapture, and it was delightful to hear the applause with which he was always received. Many were the friends he made owing to this musical talent.

It was not often that his name appeared in connection with matter in the columns of the Electrical Review, but the actual amount of his writings in the earlier days, would fill a respectable-sized volume, and his articles were always marked by excellent logic and well-expressed ideas—his influence being, perhaps, more felt than seen, although it was certainly seen as well as felt.

Although not, perhaps, a robust individual, but always more or less—to use an oft-repeated expression of his—"in the hands of my doctor," he always showed remarkable vigour—so much so, that only those who knew him intimately would have thought that he was other than constitutionally strong. But, alas! the fell enemy triumphed at last, and, at the age of 66, a dear personal friend, and one who can ill be spared, is no more.

H. R. Kempe.

The funeral service was held on Tuesday morning at Holy Trinity Church, Tulse Hill, and the mortal remains of our lamented colleague were subsequently laid to rest in Norwood Cemetery.

Among those present either at the Church or at the graveside, were:—Mrs. Gatehouse (widow), Mr. and Mrs. Ernest Gatehouse, Mr. and Mrs. A. R. McCallum, Mr. and Mrs. L. A. Gomersall, Mr. Charles Gatehouse (brother), Mrs. Cutler, Mrs. Carnell (niece), Messrs. Turpin, Cutler and Day.

Mr. H. Alabaster (managing director of the Electrical Review) was represented by his son-in-law, Dr. James Lyle. The Review was also represented by Mr. H. R. Kempe, Mr. Arthur H. Allen (Technical Editor), Mr. Albert H. Bridge (Commercial Editor), Mr. E. S. Middleton (Secretary), and Messrs. H. Porter Cox, P. J. Haskell, W. B. Warwick, F. R. Bantin, H. E. Stockley, and J. Hanger; Messrs. W. H. Wicken (overseer) and W. J. Palmer, who appeared on behalf of the Composing Department; and Mr. W. Cate (of Wm. Cate, Ltd., printers).

The Institution of Electrical Engineers was represented by the President (Mr. Ll. B. Atkinson), and the Secretary (Mr. P. F. Rowell); the Electro-Harmonic Society, by Mr. W. E. Lane and Col. Clay; the Dynamicables, by Mr. R. H. Tree; the Electrical Trades Benevolent Institution, by Mr. F. B. O. Hawes; the Diss Choral Society, by Messrs. Pullen.

Among others in attendance were Sir Tom Callender, Sir Charles Bright, Messrs. J. E. Kingsbury, H. Scholey, George Watson, A. H. Walton, A. M. Sillar, A. M. Wilcox, McCallum, senr., W. J. Tennant, W. R. Cooper, W. Mackie, Basil Gee, S. Rentell, H. A. H. Newington, D.S.O., W. M. Madden, T. B. Goodyer, and G. French.

The large number of floral tributes included tokens from W. T. Henley's Telegraph Works Co., Ltd., the General Electric Co., Ltd., the Electro-Harmonic Society, and the Diss Choral Society.

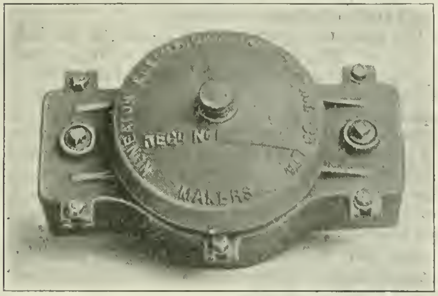
Mr. Alabaster and the staff of the Electrical Review desire to acknowledge receipt of a large number of messages of sympathy. As it will not be possible to reply to these kind communications individually, we shall be grateful if our correspondents will accept this expression of our deep gratitude.

NEW LINK DISCONNECTING BOXES.

An Improved Design of Joint Box.

SOME little time ago the Nuneaton Electrical Contracting Co., Ltd., of Nuneaton, commenced to manufacture, and are now able to supply from stock, a new and improved type of joint link-disconnecting box (registered design No. 679,075), with fittings also made to a registered design (No. 676,030) for which fittings the makers have manufacturing arrangements with the Western Electric Co., Ltd. A number of these boxes have been supplied to municipal engineers in various parts of the country who, after having put them to practical use, have passed most favourable criticism upon them. For example, an engineer who has put several of the boxes into service, writes as follows: "My jointer reports that he is able to install two three-way link disconnecting boxes in one day, whereas it takes a full day to connect the type of box we were previously using. Besides being a sound mechanical job, the box is very roomy, and a very liberal current-carrying capacity is provided everywhere. By carrying a spare set of concentric fittings, the jointer is able to tackle either a multicore or concentric cable, which is a valuable feature. I intend using these boxes exclusively on the new distribution network we are installing."

Fig 1.—One-way Joint Disconnecting Box.



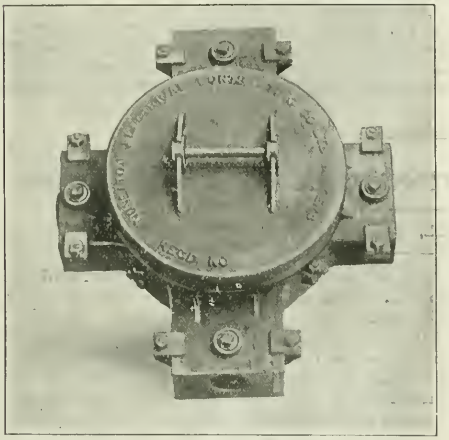


Fig. 2.—Four-way Joint Disconnecting Box.

Under the circumstances we recently availed ourselves of an opportunity to inspect the manufacture of these boxes and their fittings, and in consequence have no hesitation in stating that the following general description thereof will be of interest to all mains engineers.

As will be seen from the accompanying illustrations, the new boxes are of the well-known diving-bell pattern, but contrary to familiar designs, the lids for all types are circular, as indicated in figs. 1 and 2, which makes them easy to replace. The boxes are fitted with double glands for each cable, and are equally suitable for use with either cored or concentric cable. They may be provided with two wood bushes for bitumen-sheathed cable, lead armour clamps for lead-covered cable, or with plumbing sleeves in cases where it is desired to plumb the lead. They can also be fitted with single or double wire armour clamps as used in colliery work, and the larger types of two, three, and four-way boxes can be provided with separate glands where three or four cables enter one way of the box.

The general design of the box appears to leave little to be desired; it is sound both mechanically and electrically, and ample dimensions are allowed everywhere. The box is cast from good quality grey iron, and the makers guarantee every one to be free from blow holes and mechanical defects. As regards general proportions, the illustrations will suffice to make them clear; figs. 1 and 2 illustrate the one- and four-way boxes respectively, while fig. 3 shows the three-way box with the lid removed, and fig. 4 is a similar view showing the internal fittings. Fig. 5 is a more detailed view of the interior of the box, and, finally, fig. 6 is a line drawing of the heavy-duty fitting itself.

Concerning the internal fittings of the box, the baseboard on which the fittings are mounted consists of a circular slab of "Siluminite," the properties of which are too well known to need reiteration. This material has been chosen in preference to wood, because, as the majority of mains engineers will admit, the latter material has a tendency to warp even under ideal conditions, and particularly if it has

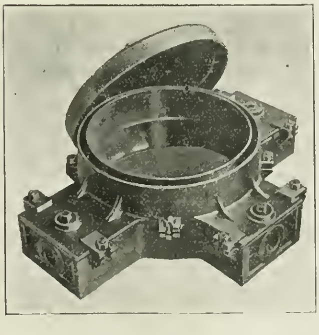


Fig. 3.—Joint-box with Lid Removed.

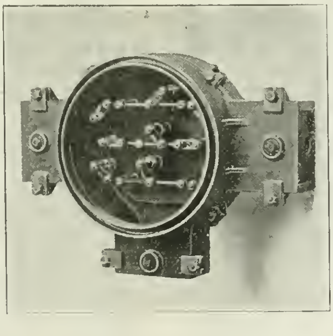


Fig. 4.—Joint-box, showing Interior.

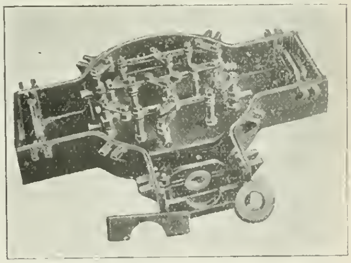


Fig. 5.—Internal Fittings.

been kept in stock for any considerable time. Again, instead of using the ordinary type of porcelain mushroom insulators to provide a space between the board and the bottom of the box, good quality black hard-vulcanised fibre insulators are employed in the new boxes, whereby the liability of the insulators to be broken, either during transit or when in stock, is practically eliminated.

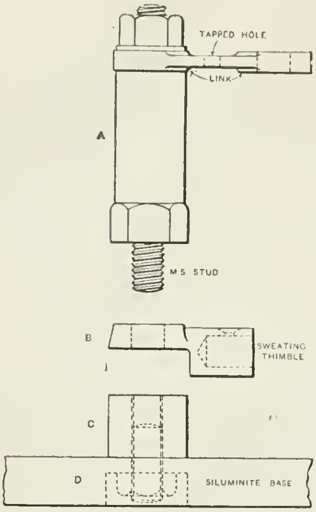


Fig. 6.—Link and Fitting.

The following are amongst the advantages that are claimed for the fitting itself:—Dependence is not placed upon one or more small wood screws to secure it firmly to the base, which becomes apparent on reference being made to fig. 6. It will be seen that the base C is not disturbed by the jointer, consequently the alignment is not affected. There is no danger of foreign matter becoming lodged, or air pockets forming, in the cavities into which the nuts fit in the "Siluminite" base board D, as the holes are filled up by the makers. The fitting A can be easily tightened up by means of a box spanner, and the sweating thimble B is machined on both sides of its contact areas by means of two milling cutters at one and the same time, so that it can be assured that the two faces are perfectly parallel. Moreover, the face of the base C and the base of the fitting A are also carefully machined to fine limits, thus ensuring that a very good contact can be obtained.

The component parts A and B, as well as the links, are made of an alloy containing from 96 to 97 per cent. pure copper, and are made as mechanically and electrically sound as possible, there being no stint of metal, which remark applies equally to the light as to the heavy-duty patterns.

The ease with which cored cable may be jointed by the aid of these new boxes will, we think, be obvious to every mains engineer, as the only tool which the jointer need use, once he has sweated the cable core into the thimble B, is a box spanner by which he can tighten up or unscrew, as the case may be, the link and fitting A. In the case of concentric cable the same remark holds good, although it is admitted that somewhat more care is necessary, as with any type of concentric fittings.

In conclusion, we have to express our indebtedness to Mr. Geo. P. Cosway, engineer and manager of the Nuneaton Electrical Contracting Co., Ltd., for his assistance in the preparation of this article, and congratulate him on the success which his new joint-box has already achieved.

A CRITICISM OF THE REGULATIONS FOR OVERHEAD LINES.

By W. FENNELL, M.I.E.E.

The following criticism of the existing Ministry of Transport Regulations for "low and medium pressure" may be of interest in connection with the article "Overhead Lines and Wayleaves" in a recent issue.* This criticism is not intended to replace the reconsideration of the regulations by those interested, but it has been prepared to show that the existing regulations need a drastic overhaul.

The present regulations are to be found in scattered form.

In the first place, Section 11 of the general Board of Trade Regulations for Securing Safety of the Public provides that precautions shall be taken to prevent injury to the *line* by lightning. It is obvious that on our present terrestrial sphere no overhead line can be free from risk of being struck by lightning—notwithstanding regulations to the contrary made by an authority as exalted as the Board of Trade, or even the Ministry of Transport—but guidance should be, but is not, given as to the means which should be taken to confine the injury to the line, and keep the abnormal potential from entering consumers' premises. This is the only contingency affecting the safety of the public in this connection, and it has been overlooked.

Section 13 incorporates for overland lines any special regulations the Board of Trade likes to make for them; and as a matter of practice the Board of Trade (now the Ministry of Transport) issues a special set of regulations applying to each overhead line as sanction. This is an admission of the inadequacy of the standard regulations, which should, like those for underground working, apply to all ordinary conditions.

The regulations of the Commissioners—now a mimeographed exact copy of the old Board of Trade Regulations for Low and Medium Pressure Overhead Lines—contain several amusing and many annoying and expensive items.

Clause 1: *Minimum Area of Conductors.*—A copper conductor shall not be less than 11½ S.G.G. = 200 lb. per mile, but presumably, in the absence of further directions, if one uses aluminium or bronze, one may use any desired section. The condition as to mechanical strength, resistance to corrosion, or whatever consideration led to the choice of 11½ S.W.G. copper could be stated, and then one could apply it to other materials. The writer suspects there is no real basis for this "copper rule."

Clause 2: *Interval Between Supports.*—This is limited to 200 ft. This rule is absolutely out of date. There is no reason for a limit irrespective of material used and spacing of wires. The factor-of-safety clause protects the public, who certainly do not want to see more poles than are necessary. In practice, the rule compels much awkward and ugly work. It is true the clause states "without consent, &c., but who can wait for this when a difficulty arises?

Clause 3: *Factor of Safety.*—For wooden poles this is much higher than that used by the G.P.O.—which *should* know—and involves undertakers in much needless expense. Again, poles do not break. If too thin they either bend or they cut their way through the soil and tilt long before they break, so that stays become necessary. Nothing is said as to cross arms nor as to creosote, nor other means for preservation of the pole—a most important matter. The regulation also states that the pole shall be properly stayed against the force of the wind, whereas stays are not ordinarily provided for this purpose, the pole itself being designed to withstand wind pressure.

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* Electrical Review, March 18th, 1921, p. 336.

The specified wind pressure is much higher than that used by the G.P.O., and one is thankful to record that we do not need to allow for a combination of added weights due to a gale, snow, and birds collecting for their autumn migration.

Clause 4: *Attachment of Wires to Supports.*—Overhead wires should, it is stated, be attached to insulators, and so guarded that they cannot fall away from their supports. This regulation is not open to criticism looked at as a counsel of perfection, but as we live in a world of imperfections, the regulation requires redrafting. It should be stated that the conductors shall be so placed that if they become detached from the insulator, they will fall on the insulator support. In passing, it may be mentioned that few linesmen realise the need for locating wires on the correct side of the insulator, and in the case of bracket insulators on the correct side of the pole, to ensure this.

Clause 5: *Height of Overhead Line.*—This is fixed at a minimum of 22 ft., irrespective of the location, leading to much waste of valuable timber. Incidentally, a low-pressure line has to be two feet higher than a high-pressure line! The writer is bound to record that on pointing this out to the Board of Trade in 1919, the height was reduced in the special case then under discussion, but the old figure, 22 ft., continues in the latest copy issued by the Electricity Commissioners. The correct height of a line is obviously governed by its situation. Along a hedge or across a moor, 15 ft. is ample. We have neither giants nor giraffes wandering about. The cost of a pole is probably proportional to the cube of its height, so that as timber is so expensive to-day, high poles mean dear electricity. The writer is informed by farmers that 18 ft. clearance is ample at field gateways. Across public roads the headroom should be governed by local conditions. It is useless to go much higher than existing telephone wires or other obstructions.

Clause 6: *Earthed Conductors.*—This clause asking for the earthing of the mid point of single-phase supplies is not effective. It is usually arranged that a single-phase supply is operated on an earthed outer system.

Clause 7: *Guarding of Wires.*—This clause defines the limit of "low" pressure. Here we have established a danger ratio of 125 volts a.c. to 250 volts d.c. There is, however, no distinction between a.c. and d.c. in the regulations applying inside consumers' premises. Live terminals are easily accessible to the public on consumers' premises, so it is not clear why, if the premise is correct (that 125 volt a.c. is as dangerous at 250 volt d.c.) the logical result of this should *only* appear in the case of aerial wires which are out of reach. The writer considers the potential of 250 volts to earth forms a convenient and reasonable limit for low-pressure conditions, both a.c. and d.c. for overhead work. There is no scientific reason for considering the potential "between wires" overhead, and this fact renders the structure of Clause 7 technically incorrect. Hence all the guard wires which have been erected on 3-wire "medium-pressure" systems represent wasted expenditure, due to a mistaken idea of the Board of Trade officials.

If falling or fallen wires are to be considered from the point of view of shock, this can best be dealt with by suitable protective or earthing devices for both a.c. and d.c. Guard wires are ugly, costly, and of doubtful efficiency. The wording of this clause is confused, and much more detailed consideration should be given to it than is possible in the limits of this article. It is sufficient to state that a 4-wire a.c. distribution at [illegible]20 volts to earth is an ugly and expensive proposition under the regulation, whereas it should be one easily and cheaply carried out. The alternative to such distribution is a high-pressure line, which, curiously enough, is much more easily run under the present high-pressure regulations than is a low-pressure line—presumably because the high-pressure regulations are more recent.

Clause 8: *Service Lines.*—This clause is excellent; it is, moreover, a model of lucidity and common sense. It effectively protects domestic servants from the possibly unpleasant results of curiosity, and the wash-lady cannot, without a ladder, use the service line for supporting the family washing.

Clause 9: *Road Crossings.*—An angle of street crossing of not less than 60 deg. is specified. This is one of the worst clauses from all points of view. The Post Office does not adhere to any such rule. One may, and does, actually run overhead lines over public streets and footpaths along their length at very slight angles, provided the line does not go right across the road. The writer knows of a case where an overhead line almost crosses a road at a curve, and returns to the same side in one span. If, however, a pole had been placed on the far side, a better job would have resulted, but the regulation would have been contravened. The rule cannot, in fact, be kept in the spirit, and it is an entirely unnecessary restriction. The regulation prevents one taking advantage of curves to make a natural crossing; it also causes zig-zag lines, and therefore increased side stresses, involving the use of stays and struts. Generally, it is good for trade, but bad engineering; it also makes for ugliness. It would be a great improvement from the point of view of safety of the public if the 60 deg. rule were cancelled, and the factor of safety for lines over public highways were specified to be a percentage higher than that required for general use.

THE WORK OF THE LATE LORD RAYLEIGH.

Prof. Alfred W. Porter, F.R.S., who has recently succeeded Sir Robert Hadfield as president of the FARADAY SOCIETY, delivered his presidential address on March 22nd, devoting it to the consideration of some of the most striking characteristics of the scientific work of Lord Rayleigh. Lord Rayleigh had been one of the founder members of the Faraday Society, and he was the first vice-president; but for his failing health he would have accepted the presidency on the death of Lord Kelvin.

The outstanding features of Rayleigh's work in physics were its range and precision. The 446 papers he published have enlarged our knowledge of physics in all its branches. The second quality, reliability and exactitude, is well exemplified in his experimental work in electrical standards—the ohm and the electrochemical equivalent of silver. It is noteworthy that the value of Rayleigh's ohm differs by one part in ten thousand only from the latest determinations. Striking characteristics of his experimental work were the simplicity and ingenuity of his apparatus and methods—in this he recalled the methods of Faraday. As examples Prof. Porter alluded to his design of interferometer and to his elegant work on the nature of surfaces and capillarity. He was among the first to realise the true meaning of a *clean* surface, whether of a solid or a liquid, and to point the way of attaining this physical cleanliness.

Present interest in colloidal phenomena (which may be defined as arising from matter in a fine state of division when surface forces become all-important), emphasises the curious fact that his very last paper dealt with a subject that first attracted his attention in 1871, and to which he returned again and again, the scattering of light by small particles, and his famous theory of the origin of the blue of the sky. In his last paper he attempted a mathematical study of the curious observations made by Professor Porter himself on the optical properties of precipitated sulphur. If light be passed through a suspension of sulphur produced by precipitation by acid from a hyposulphite solution, as the sulphur particles increase in size the transmitted light changes in colour from red to blue, green-blue, green-white, and, finally, when the solution becomes ordinarily opaque, to white. Unfortunately the assumptions Rayleigh found it necessary to make prevented him from arriving at a mathematical solution of this problem. In an allied problem, however, the colours exhibited by potassium chlorate crystals under white light incident at varying angles, he showed that the phenomenon was due to the laminæ formation of the crystals, and his solution is of considerable importance in that it can be applied to the reflection of X-rays from the interior of crystals and utilised in elucidating the secrets of crystal structure.

Rayleigh's researches on surface phenomena led him to the study of the important subject of intrinsic pressure in liquids and solids, the theory of which was first worked out by Laplace on the simple assumption of an attractive force of inverse square dimensions between every particle of solid or fluid in the body referred to. The earlier theory failed in not taking account of the molecular character of these interior forces in bodies, which were regarded as simple Newtonian attractions proceeding from point sources. The meeting was greatly interested to learn that Prof. Porter is now advancing this subject a stage further, and by introducing into the theory of intrinsic pressure the known values of surface tension, he has arrived at values for the molecular attraction constant and for the power law coefficient, which works out at the high value of 8.3.

Finally, the address touched on Rayleigh's work on hydrodynamics, and referred to its great value in our studies of the laws of flight. Here he introduced a new method, the method of dimensions, which has been very fruitful. The study of the sandblasting of glass was adduced as an example of its suggestiveness.

In conclusion, brief reference was made to Rayleigh's open-minded yet strictly scientific attitude to psychical research. It will be recalled that he was president of the Society for Psychical Research.

The study of the work of a man of the noble type of Lord Rayleigh, who devoted his life to the disinterested pursuit of knowledge for its own sake, regardless alike of profit, gain, or honour, must ever be an example and an inspiration to the true student of science. He was among the greatest of England's sons.

At the conclusion of the presidential address discussion took place on an important paper presented by Mr. S. Field on the Electrolytic Recovery of Zinc. This will be reported in a subsequent issue.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Electric Cloth-cutting Machines.

The speeding-up of production in clothing factories is as dependent on the introduction of labour-saving devices as in any other industry. The use of the band knife for the cutting of cloth and other fabrics is gradually being superseded by more efficient apparatus, such as that we describe below. This is a class of work where the use of any other agent but electricity to supplant hand labour is precluded, and the fractional h.p. motor finds yet another application.

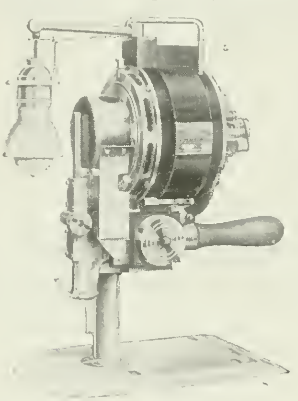


Fig. 1.—Reciprocating Cloth Cutter.

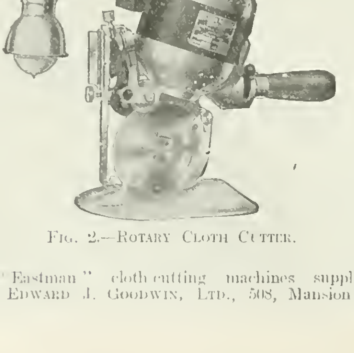


Fig. 2.—Rotary Cloth Cutter.

The "Eastman" cloth-cutting machines supplied by Messrs. Edward J. Goodwin, Ltd., 508, Mansion House Chambers, Queen Victoria Street, E.C.4, fall into two general classes—reciprocating and rotary.

The reciprocating model (fig. 1) is driven by a motor which can develop up to .75 h.p. on an overload. The motor is a marvel of compactness, being closely wound and of very substantial construction. The weight is borne by a standard fixed in a base of ample size. The armature of the d.c. type is balanced, and runs on ball bearings giving very smooth running and freedom from vibration. The motor speed is 3,000 r.p.m., and the length equivalent of the cut is as high as 960 ft. per minute. A lubrication system is fitted, which, while performing its duties efficiently, will not permit leakage of oil on to the material being cut. The reciprocating cutter is fitted with interchangeable tool steel knife slides, permitting easy and cheap replacement. A guiding handle is fitted close to the standard to facilitate the following of the cutting line; the starting switch is conveniently near to this handle, and is operated by a simple movement of the worker's thumb. For the protection of the operator a guard is fitted in front of the knife; this is brought down upon the work and locked in position, making it impossible to touch the blade. The rotary type (fig. 2) is in many respects similar in construction to the reciprocating model, but is fitted instead with a circular cutter driven by strong toothed gears from the motor shaft. The blade is guarded at back and front when the machine is working, and a sharpening attachment is fitted, which, by a simple movement of a lever, brings two hones on to the sides of the blade.

These machines are wound for voltages between 100 and 250 d.c. and a.c., the a.c. types being made to suit frequencies of from 40 to 100 cycles.

As will be seen from the illustrations the cutters can be fitted with a detachable and adjustable lamp bracket to give local illumination at the cutting line.

New Polishing and Buffing Machines.

Among a number of new types of small buffing and polishing machines being made by The Consolidated Pneumatic Tool Co., Ltd., Egyptian House, 170, Piccadilly, W.1, is the portable machine illustrated in fig. 3. This is designed for use in motor car works, garages, or show rooms where a light and easily transportable machine is necessary. The motor is wound for either a.c. or d.c., and the rotor is perfectly balanced and mounted on ball bearings giving very smooth, noiseless running. A larger machine made by the firm has a 1 h.p. motor; at one end is a coarse buffing disk and at the other end a fine polisher. The machine is mounted on a standard, and is fitted with ball bearings. Either a.c. or d.c. can be employed to drive the motor.

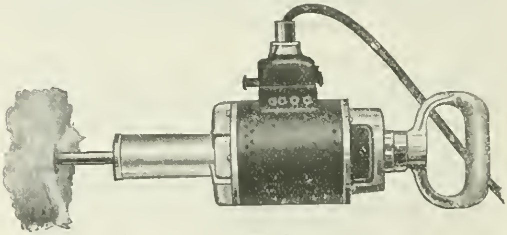


Fig. 3.—A Portable Buffing Machine.

Is Current "On" or "Off"?

An indicator that tells at a glance whether the current is "on" or "off," for use with electrical devices of every kind, has been placed on the market by the Berghman Co., of Chicago. According to the *Electrical News* the device can also be used as a socket extension when, for example, a narrow lamp shade is to be used. The indicator consists of a solenoid electromagnet set in the upper end of a tube and connected in series with the appliance and with the line. A small armature with a pointer attached to the lower end is placed in the solenoid. When the electro-magnet is energised, the armature is drawn up and the pointer indicates "on." When the current is broken the armature falls and the pointer indicates "off." The appliance is inserted in an ordinary lighting socket and has a socket at its lower end for receiving the plug of an electrical appliance.

Water-Power in Germany.—Herr van Heys, of Cassel, formerly director of the Cassel Tramways Co. has been appointed Ministerial Councillor in connection with the Federal Railway Ministry for the special purpose of ascertaining in what manner the existing water powers can be utilised in connection with the supply of electricity in order to counteract the scarcity of coal for industrial uses, as a consequence of the Treaty of Peace. It is proposed in the first place to devote attention to the completion of the large hydro-electric installations in the districts of Diemel, Eder, Fulda, and Weser, and then to deal systematically with all other water-powers in the country.

LEGAL.

Embezzlement of E.T.U. Funds.

At Sheffield on March 31st, Harold Harris, a branch secretary of the Electrical Trades Union in Sheffield, was charged with embezzling and converting to his own use moneys belonging to the Union. The prosecuting solicitor said that defendant received a sum of £70 with which to pay some men affected by a lock-out. He only paid out £49 6s. of this amount and retained the balance. With regard to the charge of embezzlement, the total sum involved was about £23, but the Union was only prosecuting on three small amounts obtained from members as subscriptions. These amounts were entered on the members' cards, but the defendant failed to make corresponding entries in the Union's books. The defendant stated that he took over the accounts of the branch in a muddled condition, and that the shortage was due to neglect upon his own part. The magistrates sentenced him to six months' imprisonment.

An Up-to-date Burglar.

At the Old Bailey, on April 5th, Walter Taylor, an electrician, was sentenced to six months in the second division for breaking and entering the counting house of the New Gallery Kinema. A police witness stated that prisoner was in possession of a portable electric drill which he connected by about 50 yards of "flex" to a lighting point. When discovered he had drilled a number of holes in the back of the safe, but had failed to penetrate the inner plates.

CORRESPONDENCE.

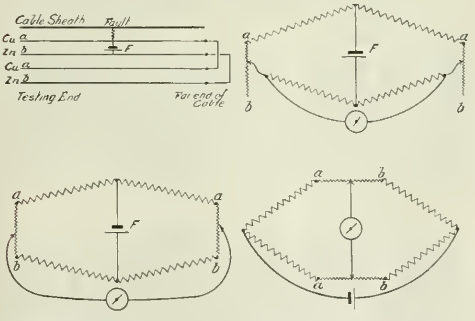
Letters received by us after* 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Bi-Metal Auto-Conductor Cable Protection.

I have read with interest your notes on a system of cable protection designed by H. Pfannkuch, in which you called to mind my bi-metal system (p. 394, March 25th).

Both these systems are the same inasmuch as they are both designed to the same end, *i.e.*, to save the actual rupture due to final cable breakdown, but you will see how curious the matter is when I tell you that I was already at work on an exactly similar method to that of H. Pfannkuch, in fact, I wrote my provisional specification about two weeks ago, and had adopted exactly the same way—insulating some wires in the working conductors. It looks as if I shall now be saved the trouble and expense of continuing.

I was led to take up the question of protection against faults from the *inside* of a cable *outwards* because the bi-metal system only deals with faults from *outside inwards*, although most engineers will allow that the latter faults are at least 95 per cent. of the total, but probably the remaining 5 per cent. should be guarded against.



Sketches showing diagrams of bi-metal conductor arranged for localisation of fault by slide-wire bridge methods.
The two lower figures are the same.
a to *b* = slide wire in each case.
a to *a* = Cu strip. *b* to *b* = Zn strip.

Further to my article of July 30th, 1920, I may give some additional attributes of my system which were not given in that article:—

(*a*) As to automatic protection against faults from the outside, this can be obtained by using a sensitive relay across the two metals, at both ends of the cable, so that when a fault occurs through damage to the cable a tripping circuit is cut in and the switches are opened. When soil water enters the cable at the damaged part of the sheath, some of the bi-metal strips only are affected at first, but as the water travels round the cable, more strips are moistened, and hence more primary batteries are formed, and these being in parallel, the current flowing through the relays is increased, because of the decreased internal resistance of the fault battery.

But as such an early indication of damage to the cable can be obtained by means of a galvanometer, it would, I consider, be unwise to trip the cable out of circuit, seeing that one would have plenty of time to unload the cable in an ordinary manner, and then to locate the fault on the bi-metal strips. The method of tripping the cable described is, however, quite discriminative, *i.e.*, healthy cables are not affected, and there is the great advantage that no transformers are required.

I give some sketches showing how the bi-metal strips may be formed up for fault location by slide wire methods—there are others.

(*b*) The bi-metal system is useful to the cable manufacturer and to the purchaser long before the cable is laid—in fact, before it leaves the factory. In most cable specifications it is usually provided that each cable length must be in the tanks for 24 hours—this is done with a view to ensuring that, if the cable sheath is punctured during manufacture, water will get sufficiently far into the dielectric to cause a breakdown whilst excess pressure is being applied.

If the cable is, however, furnished with the bi-metals, three or four hours in the tanks is all that is really necessary, as there is only 20 mils or so of paper for the water to soak through before a reading would be obtained on a galvanometer connected across the two metals. In most cable factories the tanking accommodation is none too great, and manufacturers should, therefore, welcome a suggestion to cut down the time.

On the purchaser's side, apart from the saving that should be affected by the above, he can assure himself that the paper with which his cables are insulated is properly and adequately dried before and during impregnation, because there should be no reading on the galvanometer, if applied to any of his cables in the factory. If the paper has not been sufficiently dried, a reading will be obtained. This test should be specially useful on dry-core air-space telephone cables, and could be used as a method of indicating the well-being of the cable during laying, if the outer ring of conductors were formed up with two metals. The method can be used by the manufacturer with advantage whilst the cables are being dried in the vacuum tanks.

The above matter should be read in conjunction with the article of July 30th last.

L. R. Lee.

Electricity Works, Manchester.
March 28th, 1921.

Synchronous Induction Motors and Power Factor.

Referring to the letter in last week's issue of the Electrical Review relative to the above, the industry should be grateful for having this method of improving power factor brought to their notice.

Although it is hardly possible to employ existing induction motors for this purpose, the ratio of rotor to stator ampere turns being insufficient for stability, we are prepared to construct self-starting and self-synchronising motors of all sizes with self-contained exciters. These machines are capable of starting against two and a half times full-load torque and synchronising against full-load torque.

The only control gear required is a three-pole switch for the stator and a liquid starter for the rotor, the whole operation of starting being practically the same as with the ordinary slip-ring induction motor. If desired, the user can employ a shunt regulator for the exciter, by means of which the power factor can be adjusted as desired.

We have supplied and have under construction a large number of these motors with outputs of from 50 to 800 B.H.P., and with leading power factors of 0.6 to unity.

Crompton & Co., Ltd.

Chelmsford.
April 4th, 1921.

Payment According to Ability.

Referring to "Regular Reader's" letter, I served a term of apprenticeship with a well-known Lancashire firm, and during that period I was a student at a technical college. No doubt all your readers are well aware that 50 per cent. of our new ideas and methods are taught at technical institutions; therefore, the student at that time has an advantage over the man of the "Regular Reader" class, simply because he ("Regular Reader") has never had the latest ideas and methods taught him. (By that assertion I do not wish to insinuate that "Regular Reader" is not a first-class man.) Therefore, I cannot imagine how a man who has long been out of his apprenticeship, as "Regular Reader" states, is a better man than the average man who has just completed a term of technical and practical training. Another point I should like to emphasise is that we are not all gifted with the same intelligence, therefore we cannot all shine in our respective callings. If there were a little less cant amongst British workmen I feel confident that with good management the unemployment problem would be partially solved. Probably "Regular Reader" has never looked on the domestic side of his argument—that for every married man who fails to obtain work, there is at least one other, who is suffering anxiety at the same time. As regards a foreman or manager being able to distinguish his clever men and his men who probably are quite willing, but cannot grasp the situation as quickly as men of "Regular Reader's" category, he is well aware, but as a rule he will stretch a point, for the simple reason that he knows that the slow man is less liable to be confused than the man who hurries his work on purpose to do twice as much work as his workmate. I sincerely hope that "Regular Reader" will reverse his opinion on the point that a man of 21 is not nearly so good as the man of 40; everyone requires a living, no matter whether he be possessed of quick intellect, or of dull intellect.

Broad Minded.

April 2nd, 1921.

Wiring in Ferro concrete Factories.

I have read with interest the correspondence regarding wiring in ferro-concrete structures. I fail to note that either "Inquirer," Mr. Purday, or "Phase," mentions any instances where C.T.S. is unsuitable; I should be pleased to hear of any job for which C.T.S. *is* unsuitable.

I know of one job where a 3-core C.T.S. is supplying an electrically-driven pump in a sewage tunnel now under construction; water is continually on the cable, rocks are falling around it, workmen handling it, trucks occasionally running over it, but still it "carries on." I have used a considerable amount of it in my time, and in nine cases out of ten, it is far ahead of conduit in my estimation. Regarding Mr. Brooking's suggestions *re* taking action against persons making libellous statements, in such cases the manufacturing firm should obtain the opinions of people using their product, and then ignore the libellous person.

If "Phase" himself was a bootmaker, for instance, and some person made a remark about his boots being unsuitable for certain duties, if he himself knew they were suitable for any duty, then I say "Phase" would adopt Mr. Brooking's attitude.

But the vital point is: Is C.T.S. suitable for all jobs, or only certain jobs? I invite "Inquirer," Mr. Purday, and "Phase" to name any job for which it is not suitable. As a reader of the Review for a considerable period, and finding it very fair in its dealings, let us have fair play.

Two Phase.

April 4th, 1921.

An Electrostatic Phenomenon.

I am interested to note that Mr. Cooper has also noticed the "green cloud" in a 6-volt motor bulb. I noticed this effect on handling a 6-volt side lamp of the vacuum type. The lamp in question does not always light up, as if the filament is intermittently open-circuited. The "green cloud" only appears after the lamp has been burning and is, therefore, warm and dry, and if I moisten the bulb the effect disappears. The merest touch is sufficient to produce the green glow. None of the other bulbs behave in this way, and I shall be glad to know why this particular bulb is in this sensitive condition.

K. Younghusband.

Hawarden.
March 31st, 1921.

Mr. Luckiesh and the Sheringham Daylight.

Mr. Luckiesh is evidently quite determined to "pass judgment" on my invention. This, of course, he would be entitled to do if he had made a first-hand examination of it, but it is a pity, I feel, that he should in the meantime make statements which I fear may mislead your readers.

Mr. Luckiesh, in the letter you have just published, calls into question the permanence of the Sheringham reflector. Here, it would seem he is again referring to his own experiments and not to my invention.

The colours used on the Sheringham reflector are among the most permanent in existence, but, what is more important, is that—thanks to the assistance of one of the leading industrial chemists in this country—we have discovered a medium for mixing with the colours and for applying them to the metal of the reflector, which renders the colours heat proof and, while keeping the purity of the colours—as in their powder form—is to a great extent waterproof. So far as we can ascertain this medium has never before been used for admixture with pigments. Till now we have not published this information, and therefore Mr. Luckiesh could not, of course, be aware of these facts; but had he not fallen into the error of assuming a knowledge of the Sheringham reflector he would, doubtless, not have included the remarks in his letter on the question of permanence.

I do not want to follow Mr. Luckiesh's example and draw comparisons between the two methods of producing artificial daylight—doubtless both have their special usefulness, and time and practical tests alone can show to what different purposes (in what is undoubtedly a vast field) the two different methods are best suited.

I entirely reciprocate Mr. Luckiesh's good wishes, and hope for the future no further misunderstandings will arise.

With regard to the misquotation, your Editorial Note, subjoined to Mr. Luckiesh's letter, seems to me to say all that need be said.

George Sheringham.

Frognal.
April 5th, 1921.

City and Guilds Examinations.

With further reference to my letters, dated January 31st, 1921, and March 22nd, 1921, on the subject of the discontinuance of the City and Guilds first and second-grade examinations in all electrical subjects, it is interesting to note that the disastrous effect of these cancellations, which I have previously mentioned, is now being realised by educational authorities, and I have pleasure in enclosing herewith a cutting from *The Times Educational Supplement*, dated March 31st, 1921, which shows clearly the feeling of those interested in the technical education of the present and future generations.

Trusting this belated resolution will interest you and your readers.

Gus. C. Lundberg.

London.
April 1st, 1921.

[The extract relates to a resolution of the Guildford Education Committee, approving of resolutions passed at a recent Conference of Directors of Technical Institutes in Surrey, to the effect that the discontinuance of the examinations was regrettable, that a system of examinations was necessary to ensure an accepted standard of proficiency and its recognition by employers, and to provide an incentive to study, and that steps should be taken to secure the re-establishment of the system or its equivalent. With all of these we heartily agree. —Eds. Elec. Rev.]

A Transformer Problem.

Whilst working with a Scott transformer on which one fuse had blown on the 3-phase side (not due to a fault on the transformer) I measured the voltages on the 2-phase side and found them to be as follows:—

A Phase, 288 volts. B Phase, 420 volts.

By replacing the blown fuse and taking out one of the others, the voltages on the 2-phase side were found to be the same as above. Again, by replacing this fuse and taking out the third fuse the voltages were as follows:—

A Phase, zero. B Phase, 460.

The transformer is 3-phase, 6,600 volts; 440 volts, 2-phase.

At the time of testing, the supply voltage was 6,900 volts. I am not quite clear about these voltages, and would be obliged if anyone could inform me how to account for them.

Scott.

March 31st, 1921.

[If our correspondent makes a diagram of connections of the Scott system, he will see at once why the above results were obtained. Apparently in the fifth line A and B should be interchanged. In the first two cases the primary of transformer A was in series with part of the primary of transformer B; in the third case the primary of transformer A was cut out and the whole of the primary of transformer B was active. —Eds. Elec. Rev.]

The Real Wealth of Nations.

In your issue of March 4th, your critic accepts as correct the statement that of themselves neither capital nor labour, nor the two of them together, can produce wealth at all, and that only when they are harnessed to brains and skill can they become productive, but he omits to explain to your readers why this truth is generally unrecognised.

Value being the measure of wealth, just as volume is that of water, the failure of the economists to discover a unit of value, or to measure wealth, has led them to *invent* the law of supply and demand, according to which no article has any value unless there be a demand therefor. In consequence, goods have no value immediately upon their production, so that the brains and skill utilised therein cannot, after all, claim to be the producers of wealth, in spite of the pretence of your critic.

Further, according to this same law, "carrying goods to those that want them" increases their value (it is in reality the price and cost which increase), whereby the transport workers and handlers of goods, always the least mentally endowed members of the community, are the creators of wealth. I maintain, therefore, that this law is also responsible for Bolshevism, which can well be defined "as the claim of unskilled manual labour to produce wealth, and therefore to control its distribution."

It is also through acceptance of this law that your critic thinks it inevitable that when things are scarce people will charge more for them, or that robbery and profiteering are the basis of civilisation. On the other hand, were a unit of value recognised in the daily necessaries of life of the average man with the average family, the control of the price of this value would become obvious, in order that the wage of the most unskilled labourer could purchase the necessaries for himself and his family. This would allow of the establishment of a real living wage, based upon the size of the family, and remove the principal cause of strikes, whereas, according to the law of supply and demand, wages must always depend on the demand for labour, and be a matter for strife.

Your reviewer is quite unjustified in stating that I suppose the cost of production to be constant, and although it is true that the cost $= mx + c$, it can, in spite of your critic, be expressed as the necessaries of life of the workers, direct and indirect, and their dependents, ignoring, of course, the loss of any irreplaceable raw material.

The statement attributed to me "that the sale of luxuries at home is injurious, yet if sold abroad their sale may benefit the producing country" is another misrepresentation, for what I did say was "that an excessive home price for a luxury benefits one section of the community at the expense of another, whereas a high price for such exports does benefit the nation, because it is thereby entitled to receive a greater quantity of foreign commodities in exchange."

Your critic sums up my book as "an attempt to prove that only by means of an adequate system of protection can a country be really wealthy," from which it would appear that he has "skipped" the first two parts, in which the limit of a nation's well-being is set out without considering foreign trade at all. Further, my justification for the reservation of the home market for our skilled industries is based, again, on the measurability of wealth, and the proof that a skilled workman produces a greater value per hour than an unskilled one. Indeed, the moment it is recognised that one industry is better for a nation than another, the necessity for protecting such industries becomes apparent. And engineering is the best industry of every country!

Your critic's suggestion that "wealth can only result when production exceeds purchasing power" may be comprehensible to an economist, but any engineer could realise that the purchasing power of a people is the amount of *goods* they have available for exchange, and that this is exactly *equal* to the total production.

It is evident that your reviewer has entirely failed to grasp the real principles of my book, viz., the measurability of wealth, the possibility of a reward for every man according to the value of his work, and the right of every nation to an independent economic existence.

The possibility of a new civilisation depends, therefore, upon the rejection by all scientific minds of the economic fallacies propounded during the past 150 years, the fruit of which is visible in the universal discontent existing to-day.

Alassio, Italy. **J. S. Hecht.**
March 14th, 1921.

[We shall adhere to the resolution expressed in our review of Mr. Hecht's book, and decline to be drawn into a controversy. We find this the easier, since Mr. Hecht's letter answers itself, to a great extent. We cannot suppose that he takes exception to our acceptance of one of his own statements, and those who wish to go further into the reasons upon which this view—correct, as we think—is founded, will do well to buy the book and read it. It is no part of the duty of a reviewer to condense the book for the benefit of the reader who is too busy (or thinks he is) to read it for himself; and we cannot see authors thanking reviewers for such a course of action, were it possible. The reviewer's work is done when, to the best of his ability, he has criticised a book from the standpoints of its literary and scientific (or artistic) value.

We do not plead guilty to having misrepresented any of Mr. Hecht's statements. If we have misrepresented any of his views, it is because our view of the meaning he intended to convey may have differed from his own. We were prepared, as we said, to be told that we had not read the book; and we did not expect to convince Mr. Hecht of the correctness of our views where they differed from his. He must, therefore excuse us if we are not convinced of the correctness of his views where they differ from ours.—The Reviewer.]

Third Harmonics.

In the interesting article on "The Influence of Transformer Connections on Third Harmonic Voltages and Currents," by Mr. Austen Stigant, appearing in your issue of March 11th, there is a small error in figs. 5 and 6, and in Table I. Since the e.m.f. is at each instant equal to the rate of change of flux, a smooth flux wave without ripples cannot give ripples to the e.m.f. wave. The induced voltage can only be zero at points where the flux wave is horizontal. In the given flux waves, this occurs but once in each half cycle, *not* several times, as the ripples would require.

J. B. Stansfield.

Newport (Mon.).
March 24th, 1921.

[Several letters are held over.—Eds. Elec. Rev.]

DENMARK'S FUEL SUPPLY.

Coal constituted one-seventh of the value of Denmark's foreign purchases last year. Taking the nine months ending September last, for which exact figures are available, Denmark imported some 1,600,000 tons of coal and some 324,000 tons of cinders and coke, for which she paid 376,000,000 kr. Before the war the Danish coal bill was about 40,000,000 kr. yearly for some 3,000,000 tons of coal and coke.

With this huge fuel bill, no wonder attention has turned to the derivation of power for industry from other sources. Reference to this question is made in H.M. Commercial Secretary's report on the economic situation in Denmark, which has just been published by the Department of Overseas Trade. At present the large electric power stations on the islands are mainly driven by steam or oil engines. On Jutland, however, efforts are being made with some success to harness water power, while in other cases plants have been installed in which peat can be used as fuel. In some of the latter cases the farmers have made arrangements whereby electricity is delivered to their farms from the high-pressure systems in return for peat delivered by the farmer to the power station.

Electrical Schemes Planned.

The general question of the further development of the use of electricity is attracting the interest both of the Government and of such institutions as the Chamber of Manufacturers. Schemes are under discussion for the generation of electricity by means of windmills, and also for a more general utilisation of the water power available. The suggestion is still being canvassed that electricity might be transmitted from one or other of the great water power stations of Norway or Sweden to some point on the coast of Jutland, whence it could be distributed over the peninsula and linked up with already existing or contemplated local power stations. H.M. Commercial Secretary admits correctly enough that the realisation of this scheme would be exceedingly expensive in view, he says, of the length of submarine cable required. Its advocates maintain, he adds, that it would be economically sound so long as the c.i.f. price of coal in Denmark exceeds 50 kr. per ton. It may here be mentioned that the average c.i.f. price per ton of coal in Denmark from January to October last year was 185s., or taking the kroner at 25 to the £, say, 200 kr. On the Norwegian side, however, it was stated in the report of the Department of Overseas Trade on Norway, recently reviewed in these columns: "It would appear improbable that such transmission will become a practical proposition in the near future."

Engineering industries generally suffered last year under the high cost of fuel and raw material, the future of certain sections being further jeopardised by German competition. The branch that would seem to be in the most satisfactory condition is that manufacturing electric motors and dynamos. Of these there has been no inconsiderable export both to Sweden and Norway, and also to other markets, while there is also a considerable demand in Denmark itself, where small electric motors are much used in agricultural districts.

Power from Peat.

There are considerable peat bogs in Denmark, particularly in Jutland, and various proposals have been put forward for a rational development of some of the largest of these peat bogs. It is suggested that in the neighbourhood of the Vildmoserne in Jutland industrial undertakings, such as steel, metal, and glass works should be erected and supplied by electrical power developed from the peat, perhaps in conjunction with power derived from the water-power station on the Gudenaa, which is rapidly approaching completion.

No definite steps have, however, as yet been taken to realise these plans. On the other hand, a fuel committee has been established, one of the principal duties of which will be to study the question of the development of the Danish supplies of fuel. It may be added that besides the peat bogs, some brown coal is found in Denmark.

In 1914 120,000 tons of peat were produced, and no brown coal. During the war, however, and the two years since the armistice, the yearly production has been 90,000 tons of brown coal, and 200,000 tons of peat, while the output during the current year has again been materially increased.

The private working of the peat bogs proceeded actively during the year, and efforts are being made to establish offices throughout the country, whereby a standardisation will be secured of the peat offered for sale.

In view of the increase in the use of peat, boilers capable of using the fuel economically and effectively should be able to find a market in the country.

Oil to Replace Coal.

Considerable interest is being shown throughout the country in the use of oil fuel to replace coal. Some attempts have been made to alter existing plant with this object, and recently the Danish State railways have been experimenting in this direction. The high cost of fuel oil, and the difficulties attendant on the construction of adequate storage tanks have, however, up to the present, prevented any general adoption of this form of fuel.

BUSINESS NOTES.

Bankruptcy Proceedings.—Ernest Albert Goodings, trading as Goodings & Son, The Grove, Watlington Street, Reading, Berks., motor and electrical engineer.—The first meeting of creditors was held recently at 14, Bedford Row, London, W.C. It was stated that debtor commenced business in 1911 as an electrical engineer at Staines, with no capital, but in 1912 he gave it up and went into employment until the end of 1918. In January, 1919, he commenced business as a motor and electrical engineer with about £40 capital. He had no business premises at first, but did work at owners' houses. The creditors began to press him in September, and seven had obtained judgments against him. He estimated his liabilities at £240, due to about 30 creditors. The matter was left in the hands of the Official Receiver for summary administration.

L. P. Howse and G. H. B. Snell (Howse & Snell), electrical engineers, 6 and 8, Duke Street, Margate.—First meeting, April 8th; public examination, April 30th; both at Canterbury.

Company Liquidations.—Fluorundum Flame Carbons, Ltd.—Particulars of claims were to be sent to the liquidator, Mr. F. N. Clarke, 4, Pavilion Buildings, Brighton, by April 6th.

Dissolution of Partnership. — Arc Electrical Co., dealers in electrical supplies, Trevelyan Buildings, 52, Corporation Street, Manchester.—Messrs. L. Backhouse, C. H. Thornton, and A. S. Penn have dissolved partnership. Debts will be attended to by Messrs. L. Backhouse and C. H. Thornton, who will continue the business under the same style, and at the same address.

Trade Announcements.—Messrs. G. S. Peckham & Co., have been appointed agents for Messrs. Rhodes Motors, Ltd., Riverside Works, Doncaster, for shipping, as well as for London and South of England. Correspondence should be sent to either Rhodes Motors, Ltd., at Doncaster, or 4-5, New Compton Street, London, W.C. 2. New Telephone No. Gerrard 7388; telegraphic address: "Switches Westcent."

The business of the Oriental Tube Co., Ltd., steel tube makers, West Bromwich. Birmingham, has recently been acquired by the General Electric Co, Ltd. Mr. E. H. Dowler, who for upwards of 22 years has held the position of managing director, is vacating that position.

Mr. V. C. Badois, electrical engineer, of Egham and Staines, has opened premises at 75, London Road, Camberley.

Messrs. Vickers-Petters, Ltd., have opened their new offices and showrooms in conjunction with Petters, Ltd., at 75B, Queen Victoria Street, London, E C. 4. Various types of Petter oil engines and Vickers-Petter semi-Diesel crude oil engines are exhibited in the new showrooms, where a full technical and commercial staff is engaged. The company's head office and works are situated at Ipswich, while there are branch offices and showrooms at 163, Hope Street, Glasgow, at 140, Victoria Street, Bristol, and at 30, Lower Sackville Street, Dublin; the last of these has been recently opened.

Messrs. Herbert Morris, Ltd., Loughborough, state that their Sheffield branch office has been removed from Cairns Chambers, St. James Street, to Montgomery Chambers, Hartshead, Sheffield. The telegraphic address and telephone number are as before, viz.:—Telephone No. 2400 Central; telegrams: Comorris.

Mr. D. M. Edwards, many years manager of Messrs. Nettlefold and Sons, Ltd., has now joined Messrs. Baxter & Caunter, Ltd., as their representative.

Messrs. W. E. Weekes & Co., electrical and telephone engineers, inform us they are opening a new showroom at No. 79C, Tottenham Court Road, W. 1, and are open to receive catalogues and price lists of heating and cooking apparatus, fittings, shades, &c.

Catalogues and Lists.—The Edison Swan Electric Co., Ltd., Ponders End, Middlesex.—Leaflet No. BB 216, dealing with "Ediswan Acme" accumulators, showing construction of positive and negative grids.

British Insulated and Helsby Cables, Ltd., Prescot, Lancs.—Publication P 169, a leaflet showing a new and improved type of jointers' tent frame, with dimensions and prices.

The B.E. Co. (of London and Birmingham), Ltd., Hendon House, 57, Upper Thames Street, E.C. 4.—An illustrated price list of "Hendon" lamps, vacuum and gasfilled.

The English Electric Co., Ltd., Queen's House, Kingsway, W.C. 2.—Publication No. 225 (51 pp.).—A splendid example of publicity matter, giving illustrations and full details of the construction of English Electric steam turbines. The brochure gives many illustrations of the constructional shops, as well as a list of sets in use in all parts of the world, and a station lay-out for two 10,000-kW sets.

The A. & A. Electrical Co., Ltd., 13, Farringdon Road, E.C. 1.—List A 24, an illustrated and priced leaflet dealing with motor-car interior lighting fittings, including roof and side lights, with switches, &c.; List L 25, a priced pamphlet of incandescent electric lamps for house, train, and automobile lighting, &c.; also a price list of small drawn-wire lamps for automobiles.

Messrs. Higgs Bros., Sand Pits, Birmingham.—"Monthly Magazine," Vol. III, No. 2, containing stock lists and prices of a.c. motors and d.c. motors and dynamos, and usual items of utility and humour.

The Electrical Apparatus Co., Ltd., Vauxhall Works, South Lambeth Road, S.W. 8.—Leaflet M 6, giving illustrations, dimensions, and prices of moving-iron ammeters and voltmeters.

Messrs. W. Goodyear & Sons, Ltd., Dudley.—An illustrated publication (8 pp.) giving details of the "Greenbat" industrial electric truck, of which Messrs. Goodyear are the sole distributing agents.

Messrs. Gillespie & Beales, Amberley House, Norfolk Street, Strand, W.C. 2.—An illustrated price list and a descriptive booklet of various models of the "Nilfisk" vacuum cleaner.

The Electric Street Lighting Apparatus Co., The Foundry, Canterbury.—An illustrated pamphlet dealing with the longitudinal lighting lantern invented by Mr. Haydn T. Harrison, giving types of lanterns and lighting curves and diagrams.

Messrs. Charles Churchill & Co., Ltd., 9-15, Leonard Street, Finsbury, E.C. 2. Abridged catalogue No. 44 (96 pp.).—An extremely comprehensive catalogue of machine shop equipment and small tools. This gives details and illustrations of milling machines, gear cutters, key-seaters, drills, boring machines, shapers, profilers, and practically everything else which goes to make up the equipment of a modern engineering shop.

Messrs. Rich & Bundy, 11A-13, New Road, Ponder's End, N.—Three leaflets giving details and revised prices of electric toasters, hot-plates, kettles, fires, &c.

Automatic and Electric Furnaces, Ltd., 281-283, Gray's Inn Road, W.C. 1. Heat Treatment Bulletin, No. 27, "The Effect of Overheating High Carbon Steel," by L. W. Wild, M.I.E.E.

The Falkirk Iron Co., Ltd., Falkirk.—Leaflet giving illustrations and reduced prices of "Falco" electric irons.

Book Notices.—*The Engineer's Year-Book for 1921.* Edited by H. R. Kempe, M.Inst.C.E., &c., and W. H. Smith. Pp. 2,697, and figs. London: Crosby Lockwood & Sons. Price 30s. net.—This valuable publication continues to expand, the twenty-eighth edition possessing an additional hundred pages. The many and varied sections have been brought up-to-date, and in some cases entirely re-written and re-arranged. In the electrical engineering section a note on mercury vapour rectifiers appears for the first time, but the recent developments in radio-telephony appear to have been overlooked. The usual features for facilitating research are retained, the index being a very good guide to the subject matter. The five-language glossary of trade terms is still present, and the legal notes have been reinforced by the inclusion of one or two new judgments of the Courts.

"The Mining Electrical Engineer." Vol. I. No. 6. March, 1921. Derby: The Association of Mining Electrical Engineers. Price 1s. net monthly.—The present issue contains several papers and attendant discussions, among which are:—"Some Considerations on Modern Illumination," by H. Girdlestone; "Some Considerations in Regard to Low-tension Switchgear," by R. Gregory, &c.

"*Proceedings* of the Physical Society of London." Vol. XXXIII. Part II. February 15th, 1921. London: Fleetway Press, Ltd. Price 6s. net.

"*Proceedings* of the Belfast Association of Engineers, Session 1919-20." Vol. I, No. 6 (62 pp.). Belfast: The Association.—The papers embodied in this issue include "Wireless Communications in the War," by Major R. Stanley, B.A.; "The Ultimate Structure of Matter," by Mr. W. C. Ward; and "Fuels," by Prof. H. Wren, D.Sc.

"Arithmetic of Telegraphy and Telephony." By T. E. Herbert and R. G. de Wardt. Pp. viii + 188; figs. 38. London Sir I. Pitman & Sons, Ltd. Price 5s. net.

"The Decimal Educator," Vol. III, No. 11, March, 1921 (20 pp.). London: The Decimal Association. Price 6d.—The present issue contains the secretary's quarterly report, and articles upon "A Metric Motor Factory" (Messrs. Higgs Bros.), "A Decimal Policy" (Australia), "The Teaching of Decimals," and "A Metric Bill in the U.S.A. Congress."

"The M. and C. Apprentices' Magazine," Vol. V, No. 17. Price 3d. (to employés).—The spring number contains the usual interesting notes, articles and illustrations, among which is a memoir of Prince Kropotkin, by Mr. Sam Mavor.

"Tidal Power." By A. M. A. Struben. Pp. xii + 116, 13 figs. London: Sir I. Pitman & Sons. Price 2s. 6d. net.

German Exports to Sweden.—The Board of Trade's statistics relating to imports into Sweden, show that imports from Germany are beginning to take an absolutely preponderating place in some lines, such as leather articles, chemical products, glass, clay articles, electrical machines, electrodes, incandescent lamps, instruments, and bicycles. Out of 59,000 tons of rails, over 29,000 came from Germany.—*Reuter's Trade Service* (Stockholm).

E.D.A. Activities.—We have received two of the latest publications of the British Electrical Development Association, Hampden House, 84, Kingsway, W.C. 2, from the Director and Secretary. One is an illustrated booklet (E.D.A. 145), entitled "The Home of 1921—Electricity for Ease and Comfort." This describes, in an interesting manner, the "home beautiful" rendered possible by the introduction of electricity for all domestic purposes. The reproductions of interior photographs are particularly good, and give their message of health and cleanliness very distinctly. The other publication is also an illustrated booklet (E.D.A. 139). This refutes the time-honoured phrase, "Woman's work is never done," by an exposition of the new order of things brought about by electricity in the home. These two booklets are written in a very lucid style, and should be in the hands of every housewife.

Reduction of Wages.—In connection with the negotiations now in progress on the reduction of wages in the industry, the Engineering and National Employers' Federations have prepared a statement dealing with the present trade situation, in which every cause is explained and weighed, and which finally winds up with a collection of examples of orders lost through the present high cost of production in this country. The complications of the foreign exchange situation are dealt with at considerable length, and it is shown that the depreciation of the European exchange is due both to inflation of currency and to inability to export on account of low production. In short, the apparent over-production at the moment in this country is attributed in part to under-production elsewhere, and also in part to low individual output here, which has forced up British prices to such a level that people abroad either cannot, or will not, buy British goods. The solution of the troubles as to wages and profit is indicated in the sentence, "If output per hour is high, there is no inconsistency between high earnings per hour and a low wage per piece." The probable future course of the cost of living is analysed, and it is shown that if the decline in wholesale prices is fully reflected in due course in retail prices, there is no reason why by December 31st next the cost of living should not be down to about 66 per cent. above the pre-war level. This figure, of course, is only put forward in a tentative way. Immediate action in reducing the cost of production is urged as the only way to prevent a vast increase in unemployment. The statement concludes: "It is the considered opinion of the employers that a definite reduction in hourly rates and an increase in individual output are both necessary. The effect of the reduction on the standard of life will depend on the fall in the cost of living and the extent to which the workpeople maintain and increase their actual earnings by a greater intensity of output.—*Daily Telegraph.*

On April 1st the conference held at Carlisle between the Federation of Engineering and Shipbuilding Trades and the Shipbuilding Employers' Federation terminated in a refusal by the employés to agree to any reduction in wages. The question discussed was the discontinuance of the special increase granted to the workers during the shipping "boom" and for which no justification now exists owing to the enormous falling off in the industry. The employers refused to submit the matter to arbitration, and the employés' side has decided to ask the Minister of Labour to intervene in order that a stoppage at the end of the present month may be obviated.

Applications for British Trade Marks.—Appended is a summary of the recent applications for British trade marks in respect of goods and articles connected with the electrical trades and industries:—

Sangamo. No. 406,833. Class 8. Electrical instruments. Sangamo Electric Co., 1,084, Converse Avenue, Springfield, Ill., U.S.A. August 11th, 1920.

Emeralite. No. 411,699. Class 13. Electric lamps (ordinary). Globe Wernicke Co., 222, Kensal Road, London, W. 10. January 19th, 1921.

Rayonite. No. 411,631. Class 13. Switches, sparking plugs, &c. Ward & Goldstone, Ltd., Salford, Manchester. January 18th, 1921.

Andaco. No. 411,822. Class 13. Electric irons. Hans P. Hansen, trading as the Anglo-Danish Commercial Co., 29, New Bridge Street, London, E.C. January 24th, 1921.

S (letter combined with Grecian lamp design). No. 368,947. Class 13. Metal filament incandescent electric lamps. Siemens Bros. & Co., Ltd., Caxton House, Westminster, S.W. 1. August 26th, 1920.

Newcastle Graphite (lettering combined with design). No. 409,254. Class 4. Graphite products for electrical purposes. The Newcastle Graphite Co., Ltd., Prince Consort Road, Hebburn-on-Tyne. October 25th, 1920.

Herculo. No. 411,190. Class 50. Insulating preparations (electrical) of asbestos, mica, resin, oil or bitumen. Bell's United Asbestos Co., Ltd., 59½, Southwark Street, London, S.E. January 4th, 1921.

Forthcoming Exhibitions.—CORRECTION.—We regret that our announcement of the Building Trades' Exhibition at Olympia, in our last issue, gave the duration as from April 1st to 30th. We are informed that the exhibition commences April 12th, and remains open until April 26th.

Cheap Labour and Efficiency.—Speaking on "Industrial Unrest as a Factor in Progress," at Caxton Hall on March 30th, Mr. John Baker, of the Iron and Steel Trades Federation, said that millions of people were being starved to death in an attempt to adjust economic forces. To-day they were going on just as blindly as in past centuries, and had failed to learn from the records of history and experience. Industrial unrest was due to the fact that a number of the employing class thought that anything was good enough for the other fellows, whilst Trade Union leaders were out to extract as much as possible from the employers. "There are still, I am afraid," continued the lecturer, "the lineal descendants of the old slave-owners amongst us, with the slave-owners' instinct for cheap labour. Employers have got to get rid of their antediluvian notion as to what is a fit wage for the working man before they can hope to make any progress." They had to get rid of the idea that 30s. a week was the limit to which the workman was entitled. There should be no limits to the amount of wealth of anyone except that of production, and each ought to see to it that the question of wealth production and distribution received due consideration, so that all might have a better time.—*Daily Telegraph.*

"Poor Germany."—Under the heading of "Poor Germany," the *Industrie Electrique* (quoting from a German paper) points out that during the month of January the increases in the capital of share companies concerned with electricity reached the figure of 190,500,000 marks. Among the 16 companies which during that month augmented their capital were the Brown-Boveri Co., of Mannheim, from 55,000,000 to 75,000,000 marks; the Rheydt Cable Co., from 10,000,000 to 25,000,000 marks; the Pöge Co., of Chemnitz, from 12,000,000 to 24,000,000 marks; the South German Cable Co., from 8,000,000 to 24,000,000 marks; the Rheinische Gesellschaft, from 20,000 000 to 24,000,000 marks; and the Berlin Insulated Cable Co., from 14,500,000 to 26,000,000 marks.

New French Electrical Companies.—There has been formed at Paris a company under the style of L'Outil Electrique Français for the carrying-on of an established electro-mechanical business. The capital is 150,000 fr., and the offices of the company are at 99, Rue du Faubourg du Temple.

At Grenoble has been embodied the Société des Chaudières Françaises for the manufacture of a special type of electric boilers. The capital is 250,000 fr., and the works are at 10, Place Victor Hugo.

At Lyons has been established a company under the style of Berruet et Pradat, with a capital of 150,000 fr., for the manufacture of, and trade in, manometers, and other instruments of calculation and precision. Offices, 7, Chemin Saint Sidoine.

Force et Lumière Electrique de la Rozèille is the title of a company started at Point du Jour, Faubourg de Crocq (Creuse) for the development of a waterfall on the River Rozeille, for the generation of light and power for industrial and private uses.

Under the style of Léo Lévy et Alfred Monnier (Lampes Nels), has been formed a company at Paris (11 bis, Rue Torricelli), for the manufacture and sale of electric glow lamps. The capital is fixed at 200,000 fr.

U.S. Exports of Electrical Goods.—The exports of electrical goods to foreign countries for December were valued at $13,812,251, compared with $6,665,660 for the corresponding month in 1919, or an increase of $7.146,591. For the 12 months ending December, 1920, the total exports amounted to $101,990,075, an increase of $12,900,364 over the 1919 figures and an increase of $42,006,469 over the total for the 12 months ending December, 1918.—*Reuter's Trade Service* (Washington).

A New Swedish Wireless Company.—A new company has lately been formed in Stockholm with the title of the Svenska Aktiebolag Trädles Telegrafi.

Calendar.—THE METROPOLITAN-VICKERS ELECTRICAL CO., LTD., has issued a wall calendar for 1921. Monthly date slips from April onwards appear beneath an excellent "Girl" study.

A Satisfied Consumer.—MESSRS. WATSON MARSH AND CO. (BRONDESBURY), LTD., write:—"The half-page advertisements appearing in your valuable paper have proved there is no better medium, inasmuch as we have received applications for samples and orders from all over England, Ireland, Scotland, and Wales, except on the last occasion."

Lead.—Reporting on April 2nd, MESSRS. JAMES FORSTER AND CO. state:—"The tone of the market has been steady throughout, but almost entirely of a professional character, the rise in values being due chiefly to "bear" covering and a small amount of buying forward for speculation. Arrivals this month have been about 15,000 tons, a sufficient quantity in face of the almost complete absence of business from consumers, who report a very stagnant trade demand, while there is little or no inquiry for export."

Catalogues Wanted.—The Controller, Government Stores, Russian Buildings, Jerusalem, is desirous of receiving trade catalogues of any class of stores for placing in the catalogue reading room. Catalogues may be in English, Arabic, Hebrew, or French, and should, wherever possible, be priced.

The London and Hull Shipping Co., Ltd., 20, Minories, London, E. 1, wish to receive catalogues, price lists, &c., of electrical machinery, switchgear, cables, and accessories.

For Sale.—Wolverhampton Corporation Electricity Department has for sale eight steam-driven "E" type Underfeed Stoker Co.'s mechanical stokers; Walthamstow Urban District Council Electricity Department invites offers for the purchase of three disused gas engines and dynamos, rated at 160 kW each. For particulars see this issue.

The Miners' Strike.—Reports received from various parts of the country appear to indicate that electricity undertakings and similar works found themselves in a better position at the beginning of the miners' strike, last week, than upon the previous occasion of a coal stoppage. Halifax had a full two months' supply; Leeds, aided by the advent of "summer time," had sufficient for a few weeks; owing to the factories in the district having been on short time recently, the Bradford stocks were very high. Burnley was less fortunately placed, having barely sufficient for three normal weeks. Birmingham, both as regarded the municipal services and manufacturers, was very well stocked, owing to the recent slackness in industry. In London the coal stocks were said generally to be sufficient for five weeks' normal running. The proclamation of the existence of a "state of emergency," on April 1st, gives the Government powers to supervise and restrict the distribution and use of coal.

LIGHTING AND POWER NOTES

Accrington.—Bulk Supply Inquiry.—The Corporation is ascertaining from the Blackburn Corporation if it will be possible, and on what terms, to secure a bulk supply of electricity from the new generating station at Whitebirk. Accrington recently applied for sanction to borrow further sums of money in connection with the proposed extensions to its own works, and the Commissioners have made the suggestion that Blackburn should be approached. In the meantime, an application for a supply from the Oswaldtwistle district is being held in abeyance.

Birkenhead.—Hydro-electric Survey.—Messrs. Sir Alexander Binnie, Son & Deacon have reported to the Birkenhead Corporation with reference to suggestions as to the possibility of obtaining electrical energy from the Alwen Reservoir.

Brighton.—Cause of Failure.—At a meeting of the Shoreham Harbour Trustees, it was stated that a recent failure of the Brighton electricity supply was due to the blocking of condenser pipes by silt disturbed by a passing vessel. A stoppage due to similar causes recently occurred at Dundee.

Burnham-on-Sea.—Inquiry.—An inquiry was held, last week, respecting the application of the Electric Light Co. for power to increase the maximum cost of electricity to 1s. per unit. The Urban District Council, at the last moment, decided to offer no opposition.

Canada.—Montreal.—The complicated network of overhead lines which is a feature of the business district of Montreal, is to be replaced by underground cables in conduits. The cost of the work, which is estimated at $200,000, will be borne by the municipality, which will sell the old cables and rent the underground lines to the power and telegraph companies concerned.

Carlisle.—Proposed New Station.—The Electricity Committee has instructed the engineer to prepare a report with plans, and an estimate of the cost, of proposed new electricity works, near the sewage disposal works at Willow Holme.

Continental.—South Jutland.—The Kolding municipal council has adopted a project for the supply of electricity to the eastern part of South Jutland from the Kolding electrical works and Harte power works. The cost of carrying out the project is estimated at 15 or 16 million kroner.—*Reuter's Trade Service* (Copenhagen).

France.—The shareholders of the Compagnie Electrique de la Loire et du Centre recently held an extraordinary meeting to consider the question of guaranteeing the issues of bonds projected by its associated companies, the Société de la Haute Isère and the Energie Electrique de la Basse Isère, with the object of carrying out certain extensive works. The Haute Isère company was recently constituted for the development of a number of falls on the Isère and its feeders, estimated to yield a total of 100 000 h p. At present only one fall—the Vielaire Fall—is actually under way; its capacity is reckoned at 40,000 h p., but it is not expected to be in full working order for two or three years. The Basse Isère company is building, at Beaumont-Monteux, a large hydro-electric station of a capacity of 35,000 h.p., and erecting a 120,000-V transmission line to Saint Etienne and Saint Chamond. To carry out these works the company proposes to raise its share capital from 18,000,000 to 24,000,000 fr., and to issue new bonds to the extent of 12,000,000 fr.

A concession to build a 25,000-h p. generating station on the River Maronne has been applied for by the Société Civile d'Etudes des Forces Hydraulics du Massif Central. A dam, 50 metres high, will create a reservoir of 80,000,000 cb. metres content, with a fall of 200 metres, yielding an average of 17,000 kW and a maximum of 30,000 kW. Two side falls may supplement these figures by 1,000 kW.

The Groupement des Houillères du Nord et du Pas-de-Calais, in conjunction with the Société Electrique des Houillères du Pas-de-Calais, has established a large central generating station at Dourges, the capacity of the plant being 24 000 kW. The same group of collieries is contemplating the establishment of a number of additional generating stations of 60,000-kW capacity in conjunction with the collieries in the North of France.

Germany.—*The Times*' Berlin correspondent reported, on April 2nd, that as a protest against the manner of the death of the Communist Sült, who was shot while trying to escape from his guard, the Berlin municipal electricians were planning a 24 hours' strike for the day of the funeral. The Communists wanted the strike to continue until all Communist prisoners awaiting trial had been released.

Darwen.—Loan Sanctioned.—The Electricity Commissioners have approved of the borrowing by the Town Council of £15,524 in respect of various transformers and apparatus for the supply of electricity from the neighbouring town of Blackburn.

Dublin.—Public Lighting Costs.—It is announced that the original Corporation estimate for public lighting during the coming year, which amounted to £80,000, was, after consultation between the Lighting Committee, and the Estates and Finance Committee, reduced to £60,000.

"Curfew" Hours Altered.—The hours of the military "Curfew" have been altered again from 8 p.m.—5 a.m. to 10 p.m.—5 a.m. The consumption of electricity will not be increased a great deal, however, owing to the commencement of "Summer time."

Dundalk.—Bulk Supply Declined.—The Urban Council has declined an offer by the Dundalk Linen Co., of a supply of electricity, the chairman of the Electricity Committee remarking that they would soon have to provide additional plant.

Electricity Districts.—South-West Midlands.—The Electricity Commissioners announce that the time within which objections or representations may be made, or schemes submitted, in connection with the above-named district, has again been extended from the last day of March to June 30th, 1921.

East Midlands.—A similar extension of time has also been made in the case of this district, the date having been altered from March 31st to July 30th, 1921.

Foleshill.—Opposition to Company's Application.—At a meeting of the Foleshill (Coventry) Rural Council held last week, it was decided to adopt a recommendation of the Bedworth Parochial Committee to oppose the application by the Midland Electric Light and Power Co. to the Electricity Commissioners, for permission to supply Bedworth Parish with electricity. The clerk to the Council said the company wished to charge 1s. a unit for electricity, in order to prevent anyone else coming into the district. The Council was against any company having a monopoly.

Glasgow.—Report on Explosion.—The explosion in November last of a steam pipe at the Port Dundas power station of the Glasgow Corporation electricity department was due, according to the Board of Trade inquiry report, to the defective welding of the flange of the pipe accentuated by the method of jointing the flanges with corrugated metallic rings and paste within the bolt circle. The evidence at the inquiry showed that since 1911 Messrs. Stewarts & Lloyds had turned out some 60,000 welded flanges, and this was the first case known to them where a flange had been pulled off a pipe. A modification of their welding process now made such an occurrence even less likely to occur.

Grangemouth.—Gas for Houses.—The Corporation has agreed that owing to the difference in cost between installing gas and electric light, it has no alternative but to adopt the cheaper method of lighting, namely, gas at the municipal houses. The burgh engineer reported that the cost of gas lighting was £7 10s. per house, and of electric lighting £12 10s.

Grimsby.—Extensions.—The Electricity Committee has recommended the expenditure of £41,000 upon sub-station buildings, transformers, e h.p. feeders, &c.

Halifax.—Mains Extensions.—The Tramways and Electricity Committee proposes to lay direct current feeders during the coming summer from the electricity works to several parts of the district, at an estimated cost of £8,555.

Leeds.—Increased Reserve Funds.—At a recent meeting of the City Council, Ald. C. H. Wilson proposed that the maximum amount of the reserve funds of the waterworks, gasworks, and electricity undertakings be increased to £50,000 for each undertaking, and that a resolution of March 19th, 1908, fixing these amounts at £25,000 each be varied accordingly. He said these funds should not be available for repairs or renewals, but set aside for use only for very special purposes, such as the repair of a serious breakdown at any one of the undertakings. The resolution was adopted.

Leyton.—Extensions.—At a meeting of the Electricity Committee the electrical engineer reported with reference to application for supplies of electricity in connection with proposed new works in Lea Bridge Road and as to prospective applications in connection with other works which will doubtless be erected in the vicinity. The Committee recommends that the engineer be authorised to prepare a scheme for the supply of power at 400 volts from transformers at the sub-station site at the junction of Church Road and Waterloo Road, which will cost approximately £15,000.

Liverpool.—Foreshadowed Extensions.—At a meeting of the Tramways and Electric Lighting Committee on April 1st the chairman forecasted expenditure on fresh plant amounting to £3,600,000, owing to the fact that the demand for electricity had overtaken the Committee's resources.

London.—Islington.—The Borough Council announces that in consequence of the continued increase in the cost of the production of electricity, it is compelled to increase the price of electrical energy for all purposes, as follows;—Units at 1d., or under, a further increase of 30 per cent., making 150 per cent. increase on pre-war prices; units above 1d. a further increase of 30 per cent., making 100 per cent. increase on pre-war prices. The increases will commence with the midsummer quarter's account.—*Daily Telegraph.*

Power from Kent Coal.—A correspondent to the *Observer* refers to the generation of power for Berlin by the use of lignite deposits 78 miles distant, and suggests that the Kent coalfield could do the same for London. The deposits in Kent were calculated by a Coal Commission to be about 6,000 million tons generally of good calorific value.

Hackney.—At a meeting of the Borough Council, a member objected to an advertisement warning prospective consumers to have their installation work executed by a firm paying Trade Union rates, as otherwise the Council's employés might refuse to connect up to the mains. This was characterised as gross tyranny, and the Councillor said that the Corporation was bound to connect up a consumer under pain of a daily penalty of £2. The chairman of the Electricity Committee asserted that the Council had never yet refused to connect up a consumer's installation, but his statement was queried.

Londonderry.—Bombs at Power Station.—During a riot outbreak in Londonderry on April 1st, bombs were thrown at the city electricity supply station, Strand Row, but it is believed they were really intended for a military post at that point of the road. Fortunately, no damage appears to have been done to the station, but two civilians who got in the line of fire were wounded and were afterwards treated in hospital.

Maidstone.—Mains Extensions.—The Town Council has decided to extend and reorganise the electricity mains in the Postley Road district at an estimated cost of £1,543.

Manchester.—Loan.—The Electricity Committee has recommended the City Council to apply for sanction to borrow £20,000 for the provision of service mains.

New Zealand.—Proposed Auckland Power Board.—At a meeting of local authorities recently held in Auckland, it was decided to proceed with the formation of a power board for the Auckland isthmus. The Minister of Public Works, who originated the scheme, said that a large power district meant economy in control and distribution. The project would cost, if carried out within 10 years, a total of £60,000,000, but the work would have to be done in steps as funds became available.

Large Expenditure Sanctioned.—The Department of Overseas Trade notifies us that Orders in Council have been made sanctioning the following loans, all or part of which are to be expended on electrical development:—Auckland City Council, £500,000; Invercargill Borough Council, £81,600, and £60,000 for the erection of power transmission lines at Springs-Ellesmere.

Queensferry.—Power from Factory.—At a special meeting of the Hawarden (Flintshire) Rural Council, it was intimated that the War Office had submitted an agreement for the supply of electricity in bulk from H.M. Factory, Queensferry, for Chester and the Deeside district. The proposed agreement is of two years' duration, subject to 12 months' notice on either side; the joint committee to bear all the necessary expenditure to make the supply available; £4 10s. to be paid per kW for power up to 3,000 kW, and £4 per kW afterwards; the joint committee to pay the costs of generation, that is, wages, fuel, water, oil, maintenance and repairs, plus 7½ per cent.

Reigate.—Proposed Alterations.—At a recent meeting of the Town Council, the chairman of the Electricity Committee submitted the proposals of Messrs. Handcock & Dykes for the improvement of the electricity supply. He stated that the nominal capacity of the station was 760 kW, but the effective capacity was only 670 kW. It was proposed to substitute two 220-kW Diesel sets for three of the four existing steam sets, thus adding 190 kW to the capacity of the station. These would cost £20,587, and the cost of switchgear, transformers, and new sub-stations would amount to an additional £15,000. This improvement would meet the needs of consumers for the remainder of the year and next winter. The consultants then recommended the purchase, in 1922, of two 500-kW Diesel sets, at a cost of about £45,000. The report was adopted.

Rotherham.—Opening of New Station.—It is expected that the formal inauguration of the Corporation's new power station will take place on July 20th next, and it is stated that, probably, the Prince of Wales will attend to perform the opening ceremony.

Stalybridge.—Price Reduction. — The Stalybridge, Hyde, Mossley and Dukinfield Joint Board has made a slight reduction in the cost of electricity supplied to mills and other large consumers, and it is hoped to make a further reduction shortly.

Taunton.—Extension of Supply.—The Town Council having received applications from persons in the area of the Rural District Council between Staplegrove and Bishop's Lydeard for a supply of electricity, has decided to carry out extensions to that district.

Walthamstow.—Sliding Scale.—The Electricity Committee states that it has considered the report of the electrical engineer as to the desirability of increasing the price charged for the supply of electricity for power purposes in the event of the average price paid by the Council for the supply of coal to the electricity works exceeding 43s. per ton. The Committee recommends that the electrical engineer be authorised, if he considers it necessary, to increase the charge by ·01d. for each 6d. by which the average price paid for coal exceeds 43s. per ton.

York. — Housing and Electricity. — The Housing Commissioner for Yorkshire has objected to the York Housing Committee providing electric lamps and shades in the houses on the Tang Hall estate, York. The Committee has requested him to reconsider his decision.—*Yorkshire Post.*

TRAMWAY AND RAILWAY NOTES.

Birkenhead.—Position of Undertaking.—At a special meeting of the Town Council, when consideration was given to the budget for the ensuing year, it was stated that the Electricity Committee gave nothing to the relief of the rates and asked for nothing. It was claimed that the tramway department was one of the best-managed concerns, and one of the best financial businesses in the country. In eight years it would be free from debt.

Bolton. — Wages Increase. — In redemption of a promise made last December, the Tramways Committee has offered an advance of ¾d. per hour, or 3s. a week, to motormen, conductors, cleaners, overhaulers, general labourers, and overhead linesmen, in its employ. This is an adjustment to the level of the wages paid in similar towns, and it will mean an increase in the annual wages bill of about £7,000.

Cork.— Tramway Strike Ended.—The prolonged strike of the employés of the Cork Electric Lighting and Tramway Co., on the wages issue, has been settled, a 5s. per week increase all round being granted.

Edinburgh.—Tramway Electrification.—The tramway manager has drawn up a report on the arrangements for converting the city tramway system from mechanical cable to electricity. He emphasises the desirability of changing over without any stoppage in the tramway traffic. The various routes to be taken in hand first are enumerated. Some of the latest top-covered cars are to be converted for use as electric cars. The cost of electrifying all the routes mentioned is estimated at £825,195.

Free Passes.—In the course of discussion at a meeting of a sub-committee of the Tramways Committee, on the question of free passes on the tramway system, it was stated that passes issued to councillors, officials, and others cost the ratepayers about £28,000 per annum.

Glasgow.—Visits of Inspection.—With a view to securing information which may be of use when the contemplated big tramway extension scheme is brought forward, the Tramways Special Committee on Extensions has appointed a deputation to visit Leeds, Bradford, and York to make inquiries as to the railless trolley system.

Great Britain.—Railway Electrification Progress.—The electrification of the railways, particularly of lines carrying suburban traffic, is being considered by a number of the big companies, but nothing further is likely to be done until the railways return to private control and the Electrification of Railways Advisory Committee has presented its report. The Advisory Committee has now been sitting for over 12 months; an interim report in July recommended standardisation both of methods and appliances. The companies which are contemplating the electrification of portions of their lines include the London and North-Western, the Midland, the Great Eastern, the North-Eastern, the London and South-Western, and the London, Brighton, and South Coast. Financial considerations enter largely into all such schemes. Few companies are in a good position to face the capital expenditure involved. On the other hand, Sir Herbert Walker pointed out recently that the effect of electrifying the suburban lines of the London and South-Western had been to double the number of passengers carried, and that while the cost of working electrified lines was double what it was before the war, the cost of working by steam was now more than three times as great as in 1914.—*The Times.*

Leicester.—Collision.—Last week a tramcar was proceeding along the London Road, when it ran into a wagonette which had broken down upon the tramway lines, and which was being repaired. The vehicle was completely smashed, but the car escaped with a broken window. There was no personal injury, although one or two passengers complained of shock.

Liverpool.—Increased Revenue. — During the first three weeks in which the 2d. minimum fare has been in operation on the Liverpool Corporation tramways, the receipts show an increase of £14,708 on the corresponding three weeks of last year.

Sunderland.—Through-Running Unremunerative.—The Corporation Tramways Committee has decided to inform the Sunderland District Tramways Co. that it cannot continue the present through-running arrangement on the Corporation's Grangetown route. Alderman New, chairman of the Committee, recently stated that through-running was resulting in a loss to the Corporation equal to £4,000 per annum. A deputation has been appointed to discuss the matter with the company's representatives.

Tees-Side. — Municipalisation of Tramways.— On Saturday, April 2nd, the Tees-side tramways which were owned by the Imperial Tramways Co., Ltd., were handed over to the Corporations of Stockton, Middlesbrough, and Thornaby. The purchase price is stated to have been £400,000.

Wallasey.—Effect of Fare Increase.—During the first 28 days that increased fares have been in operation on the Corporation tramways, over 10,000 passengers per day less have been carried. The minimum fare was increased from 1d. to 1½d. Nevertheless the revenue for the period, compared with the corresponding period of last year, showed an increase of £1,064.

TELEGRAPH AND TELEPHONE NOTES.

China.—Wireless Station at Shanghai.—The United States Department of Commerce on March 29th announced that work will shortly be commenced on the erection of a wireless station at Shanghai under the terms of the agreement arrived at between the Chinese Government and the American Federal Telegraph Co. It is anticipated that the task will be completed within 18 months, when it is believed that it will be found possible to establish direct wireless communication across the Pacific without the help of relay stations. It is also proposed to establish additional stations at Peking, Harbin, and Canton. About the middle of February a message from New York stated that, after an inquiry had been made into the alleged activities of a British company to have the American contract abrogated, the State Department had notified China that the U.S. Government would regard as an unfriendly act China's cancellation of the contract with the American Federal Telegraph Co. for the erection of a high-powered wireless plant at Shanghai. It was also added that the State Department was in communication with the British Foreign Office on the subject.—*Reuter's Trade Service* (Washington).

France.—The Société Indépendente de Télégraphie Sans Fils has just installed a wireless plant on board the *Emile Duchemin*, belonging to the pilotage service of the Lower Seine. Two other ships of the service are likewise undergoing similar equipment, the *Pouyer-Quertier*, and the *Richard Waddengior*, and a wireless station is to be erected at Rouen. By these means the pilots will be able to easily intercept ships arriving in the Havre roadstead and forward information to Rouen of their port of departure, and the nature of their cargo. From Rouen they will be informed whether the ship should go up the Seine, or wait till her berth is free.

New Wireless Station.—The powerful wireless station of Sainte Assise, near Mélun (Seine-et-Marne), the first stone of which was lately laid by the French Sous-Sécretaire d'Etat, is intended to link up the French capital with its most distant colonies, and so make that country independent of foreign countries. The transmission station will consist of a European and an overseas section. The plans include the erection of 16 250 metre high-standards supporting a 3,000-metre antenna. The latter and the earth lines will call for 214 metres of bronze, copper and steel wire. The power developed will amount to 5,000 h.p., the total capacity of the motors and generators being 10,000 kW. The buildings will cover an area of 8,000 sq. metres. Eight telegrams can be forwarded at once, and seven received, rising to 14 on pressing occasions. Telegrams will be received at a central wireless bureau at Paris and forwarded to Sainte Assise. The constructive works are expected to take two years to complete, but the European transmission station will probably be ready to work in a few months.

Jersey.—Proposed Acquisition of the Telephone Service from the Government.—The Jersey States on March 29th discussed the advisability of purchasing the telephone system from the Government, and to that end, says the *Financier*, a Committee has been appointed to obtain full details as regards price, &c., and to report later.

United States.—Press Telegraph Rates.—Marconi's Wireless Telegraph Co., Ltd., announces that its Press rates to and from New York are to be increased to 3½d. per word, and the rates to other places in America are also to be advanced.

Wireless Censorship Removed.—The U.S.A. Navy Department announces the removal of all censorship of messages handled by the naval wireless telegraph station.—*Reuter's Trade Service* (Washington).

Peru.—Marconi Co. to Operate Posts and Telegraphs.—By agreement with the Peruvian Goverment, Marconi's Wireless Telegraph Co., Ltd., will, on May 1st, take over and operate for a period of 25 years the whole of the postal, telegraphic, and wireless services of Peru, receiving as remuneration 5 per cent. of the gross receipts of the services and 50 per cent. of the annual profits. Sir William Slingo, late engineer-in-chief of the British Post Office, who was commissioned by the Marconi Co. to examine the postal and telegraph situation, has accepted the position of chief of the department, and will act in this position on behalf of Marconi's Wireless Telegraph Co., Ltd. The postal and telegraphic conditions in Peru are of great interest. Of the approximately 9 000 miles of telegraph communications some exist at a height of 16,000 ft., notably where crossings are made of the Andes, and of the 42,000,000 odd words telegraphed annually, a considerable percentage has consisted in the past of traffic for Government departments which has been handled without payment. The concession to the Marconi Co. includes the sole and exclusive operation of all international wireless telegraph stations within the Peruvian Republic, the exclusive right to erect any further wireless station that the company may think necessary, and the sole and exclusive usufruct in the case of all Peruvian telephone services, except the few local ones already existing. It is believed that the modernisation of the posts and telegraphs, and their operation by a commercial company, will lead to a remunerative business, and that with the wider use of wireless telegraphy, especially over the forest and southern areas, a large increase in traffic will be recorded, and a corresponding impetus given to the development of trade. *The Times* states that the foreign personnel under the Marconi administration is limited to 20 per cent. of the total employés, and the Marconi Co. is to advance the requisite funds for the reorganisation of the services at an interest rate of 9 per cent. It is expected that this advance in the first year will amount to £200,000 sterling.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—April 27th. Victorian Railway Commissioners, Spencer Street. Caustic soda primary cells, complete (Contract No. 33,914).*

Extension of Date.—The Department of Overseas Trade states that the time limit for tendering for the telephone switchboards recently notified as being required by the Postmaster-General's Department at Melbourne (Schedule No. 1,670) has been extended from April 19th to May 31st.*

Postmaster-General's Department, May 31st. Supply and delivery to several States manual telegraph transmitting devices (Schedule No. 1,680). (See this issue.)

May 2nd. With reference to the recent invitations to tender by the Victorian Government Railways for 12 miles of two-core, lead-sheathed, wire-armoured 2,200-volt cable, the Department of Overseas Trade learns from H.M. Senior Trade Commissioner in Australia that the Railway Department is prepared to give consideration to alternative offers for cable with the section of each core ·0145 sq. in., in lieu of ·015 as originally specified.

June 22nd. Victorian Railway Commissioners. One electric lifting magnet (capacity ½ ton), one 440-V motor generator.

June 29th. Supply of 1-ton platform type industrial storage battery trucks, also battery charging equipment.—*Reuter's Trade Service* (Melbourne).

Ballinrobe. — April 23rd. Electricity Supply Co. Wiring of consumers' premises. (See this issue.)

Belgium.—April 11th. The municipal authorities of Schaerbeek, Brussels. Supply of a quantity of electric cable. Particulars can be obtained from the Service d'Electricité, Hotel Communale, Schaerbeek.

April 25th. Deputation Permanente du Limburg. For the establishment of an electricity supply in the Genck-Hasselt-St. Trond district. Copies of the specification and plans can be obtained on application to 99, Rue des Flamands, Louvain, while tenders, on special forms, are to be sent by registered post to Le Gouverneur de la Province de Limburg Hasselt, Belgium.

May 27th. The Service d'Etudes et de Controle des Applications de l'Electricité, 52, Boulevard du Regent, Brussels. For the supply and installation of ten electrically operated capstans in connection with the locks on the Upper Scheldt.

Bridgend.—April 12th. Urban District Council. Electricity Department. One 400-kW triple expansion steam engine, direct-coupled to an alternator. (April 1st.)

Cardiff.—April 11th. Welsh National Memorial Association. Electric lighting plant for the Glan Ely Sanatorium. Two 20 kW internal-combustion engine-driven generator sets, battery charging booster, switchboard, and battery of accumulators, (March 25th.)

Holmfirth.—April 8th. Urban District Council. Electricity Department. Erection of additional overhead mains (approximately four miles). (April 1st.)

Jugo-Slavia.—May 1st. The Serb, Croat, and Slovene Ministry of Public Works. Erection of a power-station, main conductors and transforming stations in connection with an electrical scheme at Kostolao for the supply of energy to Belgrade, Semlin, &c.*

London.—H.M. Office of Works. April 12th. Supply of electrical labour-in-daywork in the Leeds district. (March 18th.)

L.C.C. April 18th. 5,500 tons of standard steel girder tramway track rails, lipless track rails and renewable guard rails with fastenings. Chief Engineer, County Hall, Spring Gardens, S.W. 1.

Lowestoft.—April 18th. Electricity Department. L.p. cable feeder pillars, joint boxes, &c. (See this issue.)

Manchester.—April 11th. Direct-current switchgear, for Dickinson Street generating station. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall, Manchester.

New Zealand.—April 19th. Public Works Department. H.M. Trade Commissioner has forwarded particulars of a call for tenders for 6 000 pin insulators, suitable for a line operating at 66,000 volts between phases. Tenders (accompanied by deposit of £100) to the Secretary, Public Works Tenders Board, Government Buildings, Wellington. Specifications may be seen at the Department of Overseas Trade, 35, Old Queen Street (Room 59), Westminster, S.W.1.

South Africa.—Pretoria.—May 10th. Municipality. Switchgear. Tenders, marked "Electric Light and Power Department, 1920 Extensions, Contract No. 5," to Deputy Town Clerk, Municipal Offices, Pretoria. Deposit, five guineas.

Further particulars may be obtained from the general manager of the Electric Light and Power Department, or from the consulting engineer, Mr. G. M. Clark, 40-42, Meischkel's Buildings, Johannesburg.

JOHANNESBURG. — June 22nd. South African Railways and Harbours. Electrification of Capetown and Simonstown and Durban-Maritzburg lines: Overhead equipment of permanent way and overhead transmission line, switchgear and accessories, and trackbonds. (April 1st.)

St. Helens.—April 15th. Electricity Committee. Supply and erection of one double girder, hand-operated, 5 ton overhead travelling crane. (See this issue.)

May 1st. Electricity Department. One d.c., 3-wire, distributing switchboard, complete with supporting steelwork. (See this issue.)

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Australia. — NEW SOUTH WALES. — P.M.G.'s Department:—

4,000 switching cords, £1,633.—British General Electric Co., Ltd. —*Tenders*

Victorian Electricity Supply. The Victorian Electricity Commissioners have accepted Messrs. Babcock & Wilcox's tender for the construction and erection of an engine-house at Newport (Australia) power station. The price is approximately £40,000, and the work is to be finished in eighteen months. This period is longer than that specified in some British tenders, but the Commissioners have given preference to Australian manufacturers. It will be remembered that Messrs. Babcock & Wilcox purchased twenty acres last February at Regent's Park, New South Wales, for the purpose of erecting a boiler-making and engineering factory to cost £100,000, and employ ultimately 1,000 hands.—*Reuter's Trade Service* (Melbourne).

Birkenhead.—The Electricity Committee has accepted the tender of Messrs. George Ellidge & Sons, of Birkenhead, for the erection and completion of electricity sub-stations in Marshall Street and Beaufort Road, £3,449.

Corporation:—

Five miles of service cables, £1,260.—Edison-Swan Electric Co., Ltd.

Halifax.—Tramways and Electricity Committee. Accepted:—

Foundation work for two cooling towers at electricity works, £5,971.—E. & T. Bower.
Two penstocks for above towers, £301.—Ham, Baker & Co., Ltd.
Steam piping for new boilers and the 10,000-kW set at the electricity works, £1,383.—Babcock & Wilcox.

Leith.—Electricity Committee:—

Electric light installation, Trinity Academy, £393.—J. Goodall & Sons.

London. — STEPNEY. — Borough Council. Electricity Department. Recommended:—

Annual contract for cable.

W. T. Henley's Telegraph Works Co., Ltd. (recommended)	**£28,406**
Siemens Bros & Co., Ltd.	24,6[illegible]9
Callender's Cable and Construction Co., Ltd.	30,580

Nine other firms were invited to tender, several tenders were incomplete, and some firms were unable to quote.

½-mile ·0225 sq. in. armoured cable.

British Insulated and Helsby Cables, Ltd. (recommended)	**£134**

150 yds. india-rubber-covered cable.

Wm. White & Co. (recommended)	**£136**

Manchester.—Tramways Committee. Accepted:—

Electric welding equipment.—Metropolitan-Vickers Electrical Co., Ltd.
Portable arc welder.—Forest City Electrical Co., Ltd.

Electricity Committee. Accepted:—

Supply and laying of 33,000-V trunk-feeder cables.—British Insulated and Helsby Cables, Ltd.
Overhead hand-power travelling crane.—Middleton Bros.
Cable.—Enfield Ediswan Cable Works, Ltd.; Johnson & Phillips, Ltd.; Western Electric Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.

Salford.—Tramways Committee. Accepted:—

Stores for six months.

Lamps.—Power and Lighting Supplies Co.
Cables and insulating tapes.—L. Andrew & Co.
Dry cells.—English Electric and Siemens Supplies, Ltd.
Armature and field coils.—P. R. Jackson & Co., Ltd.
Cable connectors.—Ward & Goldstone, Ltd.
Field coils and commutator spares. — Metropolitan-Vickers Electrical Co., Ltd.
Carbon brushes.—J. Eades.
Insulating tape and varnish.—British Insulated and Helsby Cables, Ltd.
Brake blocks.—National Railway and Tramway Appliances Co., Ltd.
Gear and pinion wheels.—Metropolitan-Vickers Electrical Co., Ltd.
Electrical solder.—L. Andrew & Co.

Tramways Committee.

2½ miles of round copper trolley wire.—London Electric Wire Co. and Smiths, Ltd.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, April 8th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary scientific meeting.

Edinburgh Electrical Society.—Friday, April 8th. At the Philosophical Institute. At 8 p.m. Electrical questions and answers.

Junior Institution of Engineers.—Friday, April 8th. At Caxton Hall, Westminster, S.W. At 8 p.m. Questions and general discussion.

Association of Engineers-in-Charge.—Saturday, April 9th. At St. Bride's Institute. At 7 p.m. Social and dance.

Wednesday, April 13th. At St. Bride's Institute. At 7.30 p.m. Paper on "Oil and Colloidal Fuel," by Mr. A. Arnold.

Birmingham and District Electric Club. — Saturday, April 9th. At the Grand Hotel, Colmore Row. At 7 p.m. Paper: "Supply of Electrical Energy in Birmingham and District," by Mr. F. Forrest.

Manchester Wireless Society.—Saturday, April 9th. At the Albion Hotel. At 7 p.m. Whist drive and dance.

Wednesday, April 13th. At the Albion Hotel. At 7.30 p.m. Ordinary meeting.

Salford Technical and Engineering Society.—Saturday, April 9th. At the Royal Technical College. At 7 p.m. Paper on "Correct Lubrication," by Mr. A. B. Smith.

Institution of Railway Signal Engineers (Incorp.).—Wednesday, April 13th. At the Midland Grand Hotel, St. Pancras, N.W. At 3 p.m. Resumed discussion on "Some Problems of Track Circuit Lay Out."

Institution of Electrical Engineers.—Thursday, April 14th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Paper on "Magnetos for Ignition Purposes in Internal Combustion Engines," by Mr. E. A. Watson.

Informal Meeting.—Monday, April 11th. At the Institute of Patent Agents, Staple Inn Buildings, High Holborn, W.C. At 7 p.m. Discussion on "Some Characteristics and Applications of Multispeed a.c. Motors." To be opened by Mr. F. Creedy.

Liverpool Sub-Centre. — Monday, April 11th. At the Liverpool University. At 7 p.m. Ordinary meeting.

North-Eastern Centre.—Monday, April 11th. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Ordinary meeting.

East Midland Sub-Centre.—Tuesday, April 12th. At the College, Loughborough. At 6.45 p.m. Paper on "Electric Drives for Rolling Mills and Colliery Winders," by Mr. H. Cotton.

North-Midland Centre.—Tuesday, April 12th. At the Hotel Metropole, Leeds. At 7 p.m. Paper on "Some Developments in Multi-Speed Cascade Induction Motors," by Mr. F. Creedy.

North-Western Centre.—Tuesday, April 12th. At the Engineers' Club, Manchester. At 7 p.m. Annual general meeting. Paper on "Some Recent Developments in Steam Turbine Practice," by Mr. K. Baumann.

Scottish Centre. —Tuesday, April 12th. At 207, Bath Street, Glasgow. At 7.30 p.m. Lecture on "Wireless," by Dr. J. Erskine-Murray.

NOTES.

Automatic Train Control.—A demonstration was given recently on the North Staffordshire Railway of the "Syx" automatic electro-mechanical system of train control which has been brought out by the W. R. Sykes Interlocking Signal Co., Ltd. According to *Engineering*, the system makes use of a ramp, which in the case of the trial equipment on the North Staffordshire Railway is fitted in the centre of the track. A tank engine was used for the demonstration. If the distant signal is at "danger," the action is purely mechanical, the plunger controlling the admission of air to the train pipe and engine brake cylinders and sounding a warning whistle. If the road is clear the ramp is energised, and electrical means cause a bell to ring in the cab, and to hold the brakes off. A re-setting valve is provided in the cab, which, however, if the driver fastens down permanently in order to cut the apparatus out, admits steam automatically to the steam brake, thus preventing the driver from proceeding. No batteries are used on the engine in this apparatus, the ramp only being connected with a 30-volt battery cut in and out by a contact controlled by the signal arm.

Electricity in the Glass Industry.—A contributor to *Chemical and Metallurgical Engineering* describes a number of applications of electric furnaces to processes in the glass manufacturing industry. A 72-kW furnace is used for annealing glassware at a temperature of 2,000 deg. F. This furnace is 22 in. wide, 10 ft. long, and 5 ft. high, and is of the overhead conveyor type. In one test, several thousand goblets were annealed, and during the test 65 of these were taken from different parts of the furnace. Of this number 64 were found to show absolutely no refraction of light rays, while the remaining one had almost imperceptible refraction, and under ordinary conditions would have been classed as first-grade. It is stated that in a natural gas-fired oven the result would have been the reverse. Moreover, in the natural-gas oven glass obtains a slight blue finish, while the electrically-annealed glass possesses a bright polish.

The work of fusing bi-focal optical lenses must be done at a very critical temperature, besides requiring a uniform temperature to prevent strains, and a clean atmosphere to prevent spoiling the polished faces of the lenses being fused. When the work was carried on originally through gas-fired furnaces the loss was approximately 20 per cent., whereas the average loss under electrical treatment is only from 3 to 4 per cent.

Tests were made to determine the practicability of using an electric furnace for vitreous enamelled kitchen ware. Thirty-six miscellaneous pieces were fired in the furnace, and a most careful inspection showed that the results were perfect as to polish, absence of pitting, and general smoothness. Due to the ease with which a definite temperature could be maintained it was a very easy matter to get results of the highest order with almost no attention.

Power Transmission from Norway to Denmark.—As was mentioned a few months ago, a Joint Committee representing the Governments of Denmark and Norway has been appointed to consider the question of the electrical transmission of power from the latter to the former country *via* Sweden. Mr. Hjalmar Cassel, recently discussing the question in a Stockholm newspaper, stated that the present requirements of Denmark were represented by 40,000 kW, and that this could easily be quintupled in the future. On the other hand, Mr. W. Borgquist, principal of the Swedish Hydro-Electric Administration, is reported to have stated that the question had not yet been submitted to the Administration. Speaking unofficially, he recalled the fact that the problem had been discussed at a meeting of representatives of supply works, held at Christiania three years ago, when he expressed the opinion, from an economic point of view, that it would scarcely pay to transmit power from Norway to Denmark until the consumption of power in the latter country had been at least doubled. Such a scheme would be carried out sooner or later, but he doubted whether the time had yet arrived. The project would render necessary the adoption of a very high pressure—in Norway a pressure of 200,000 V was proposed—and would require a considerable amount of capital, having regard to the phenomena associated with the use of high pressures, and that, too, even if the amount of power transmitted were only moderate; and the coal which would be economised in Denmark by such transmission would be far from yielding the interest on the capital expenditure. Proceeding from the assumption that no other practical alternative existed than to transmit energy *via* Sweden, Mr. Borgquist pointed out that in addition to the considerable capital expenditure for transmission from Norway to Zealand, a large outlay would also be needed when the promoters of the scheme extended the distribution beyond Zealand, while, on the other hand, the possibilities of selling energy would be inappropriately restricted if the import of power were limited to Zealand alone. It was certainly true that about 50 per cent. of the total power consumption of Denmark was concentrated in Zealand, but this was only estimated at 100,000,000 kWh for 1920. The sale possibilities would be substantially increased, as suggested by Mr. Cassel, if Denmark proceeded generally to introduce electric traction on the railways and tramways, which would hasten the execution of the scheme. In the opinion of Mr. Borgquist, Sweden should adopt an accommodating attitude towards any sound project which aimed at the promotion of the supply of power to Denmark. A transmission line from Norway *via* Sweden would follow from Trollehatte to Oresund, the same way as the Swedish Hydro-Electric Administration was thinking of for the most southern link in the State's electric main line system, the first portion of which—the lines from Trollehatte to Vasteras—would be brought into service in the present year, and would subsequently be extended to Norrland. It would be a natural solution, the principal concluded, if the Swedish State took a hand in the power lines from the Norwegian frontier to Trollehatte, and sent on the power with its projected southern main line to Oresund, as this would open the possibility for an extensive future co-operation between Norwegian and Swedish installations. At the same time the possibility already existed of delivering surplus power from Swedish hydro-electric works to Denmark in such quantities as would at least meet a large portion of the power requirements of Zealand.

The Batti-Wallahs' Society.—The tenth annual dinner of the Society was held at the Holborn Restaurant on April 1st, when the President, Mr. W. F. Ireland, took the chair, supported by a large number of past officials and their wives. An excellent concert, interspersed with toasts, succeeded the dinner. The toast-list, commencing with "The King," included "The Society," and "The Ladies and Visitors." Mr. E. Barralet became a lady and a visitor for the time being, and responded in his inimitable style. The concert programme was provided by Messrs. Harry Heap, E. G. Batt, Maurice Charles, Mrs. A. J. Greenly, and Miss Amy Ambrose.

Faraday House Old Students' Dinner.—Old students are reminded that the annual dinner will be held at the Holborn Restaurant (Venetian Hall) on April 15th, at 6.30 for 7 p.m., when Mr. C. C. Paterson, O.B.E., will be in the chair. A record attendance is anticipated, and early application for tickets is desirable. A musical entertainment will follow the dinner.

Cabinet Changes.—Among the many changes in the constitution of the Cabinet, announced on April 1st, are the following:—Mr. F. G. Kellaway, Parliamentary Secretary, Department of Overseas Trade, to be Postmaster-General; Mr. Stanley Baldwin, Financial Secretary to the Treasury, to be President of the Board of Trade; Sir Philip Lloyd Greame, Parliamentary Secretary to the Board of Trade, to be Director of the Department of Overseas Trade; Sir Alfred Mond, Bart., First Commissioner of Works, to be Minister of Health; and Sir William Mitchell-Thomson, Bart., to be Parliamentary Secretary to the Board of Trade. Mr. Illingworth is relinquishing the position of Postmaster-General on account of ill-health.

Finsbury Technical College Old Students' Association.—The annual smoking concert will be held at Anderton's Hotel, Fleet Street, on Friday, April 22nd, at 8 p.m., when Prof. G. T. Morgan, O.B.E., D.Sc., F.R.S, will take the chair. Old students may obtain tickets, 2s. 6d. each, personally, from the following members of the Council;—*Chemical*—Dr. M. O. Forster, F.R.S., H. F. Knight, F.I.C.; *Electrical*—E. W. Moss, A.M.I.E.E., R. P. Howgrave-Graham, M.I.E.E.; *Mechanical*—W. G. Head, M.I.M.E. C. F. Cleaver, M.I.A.E.; or by post on application to the Hon. Secretary, Mr. H. P. Guy, 209, Northumberland Park, N. 17.

The Sonoscope.—This instrument, with binaural attachments, recently placed on the market by the Capac Co., is manufactured in various standard forms (while special instruments can be obtained to order), and is distinctly useful in locating engine defects; in its simplest form it comprises a test rod attached to a diaphragm plate fixed in a metal cone, to which are connected tubes with ear pieces. Whilst the arrangement is, perhaps, more particularly applicable to machinery of moderate size, its uses for large plant cannot be ignored, and it may be noted that no sound reaches the ear of the operator until the test rod is actually applied to a suspected part. Testing is continued until the sound is at a maximum, when the nature of the defect may be judged by the user. Such features as slack bearings, badly-worn cam gear, &c., are recorded with remarkable distinctness, whilst, at the same time, it will be appreciated that there is an extremely wide scope for the utility of the instrument in various directions associated with the running of marine machinery. All outside noises are excluded, and the operator can, therefore, detect with speed and accuracy the exact portion of the plant which is giving rise to trouble, even should the actual mechanism be out of sight. For specially accurate work two types of Sonoscope are supplied, one carrying independent sounds to each ear, while the other is arranged on the binaural principle. An additional device, the sonophone, will locate a defect if the instrument is placed several feet away from the actual source of trouble, and should be useful for testing Diesel machinery.—*Motor Ship.*

Belgian Supply Charges.—Some time ago a number of Belgian supply companies, each holding concessions in various towns or districts, approached the Government with a view to securing permission to raise prices for supply in accordance with one of the sections of a law passed in October, 1919. A Technical Committee was appointed by the Government a year ago to investigate the applications, and the report of the Committee was recently published. The first question examined by the Committee was whether the financial charges now borne by the companies exceeded those which could have been normally foreseen when the concessions were granted, and whether the increase in expenses had been compensated by a growth in the profits. The report states that the enormous advance in the cost of raw materials, labour, &c., as a result of the war, could not have been predicted, and the expansion in profits by no means equalised the augmentation in the working expenses. Having reached this conclusion, the Committee next dealt with the question what the charge should be for electrical energy, sold by meter for lighting purposes from steam power stations, if the pre-war rate was 50 centimes per kW-hour. The Committee put forward formulæ for calculating what present charges should be for lighting and power purposes from steam power stations and hydro-electric works existing prior to January 1st, 1917, while other arrangements were suggested for generating stations established since that time. The report recommends that the prices should be revised twice a year, in accordance with the average price of a specified quality of coal used by the State Railways, and a Royal Decree was recently issued authorising the increases in charges proposed by the Committee.

The British Association Meeting.—For the meeting of the British Association, which will take place at Edinburgh on September 7th-14th, the following presidents of Sections have been appointed:—Section A (Mathematics and Physics), Prof. O. W. Richardson; B (Chemistry), Dr. M. O. Forster; C (Geology), Dr. J. S. Flett; D (Zoology), Mr. E. S Goodrich; E (Geography), Dr. D. G. Hogarth; F (Economics), Mr. W. L. Hichens; G (Engineering), Prof. A. H. Gibson; H (Anthropology), Sir J. Frazer; I (Physiology), Sir W. Morley Fletcher; J (Psychology), Prof. C. Lloyd Morgan; K (Botany), Dr. D. H. Scott; L (Education), Sir W. H. Hadow; M (Agriculture), Mr. C. S. Orwin. Among the subjects of general interest which are being arranged for discussion at joint sectional meetings are the age of the earth; biochemistry; vocational training and tests; the relation of genetics to agriculture; the proposed Mid-Scotland Canal; and the origin of the Scottish people. The President of the Association, Sir Edward Thorpe, will deliver his address at the inaugural meeting on Wednesday evening, September 7th.—*The Times.*

The A.O.E.C.—The annual general meeting of the Association of Officers and Staff Members of Electricity (Power and Supply) Companies of Great Britain was held on Monday, April 4th, at the Caxton Hall, Westminster. Sir Alex. B. W. Kennedy, F.R.S, presided.

The Report of the Executive Committee for the year 1920 showed that little had occurred of moment to the Association. On the opening of the Inquiries by the Electricity Commissioners, the Committee took action to safeguard the interests of members in connection with the superannuation schemes, &c., authorised by the Act of 1919, pressing for uniformity throughout the country, and for terms not less favourable than those applicable to the Civil Service. When the formation of Joint Electricity Authorities takes place, the Committee will take further steps to secure protection for the members in accordance with the Act. The statement of accounts shows a credit balance of £338. Proposals for the amendment of the constitution of the Association were circulated with the report.

The report and accounts were adopted, and Sir Alex. Kennedy was re-elected president with enthusiasm. The Executive Committee was re-elected *en bloc*, as well as the hon. treasurer, Mr. F. Wood; the hon. secretary, Mr. O. M. Andrews; and the auditors, Mr. W. E. Rowland and Mr. A. W. Price. The revised constitution was then discussed, slightly amended, and adopted. The meeting concluded with votes of thanks to the president, hon. secretary, and other officers.

Appointments Vacant.—Instructor in oxy-acetylene and electrical welding in works department of the Loughborough College; traffic manager for the Calcutta Tramways Co., Ltd.; distribution engineer (£551), for the Sunderland Corporation Electricity Department; telegraph engineer (£180), for the Government of the Gold Coast. See our advertisement pages to-day.

Electrical Trades Benevolent Institution.—A smoking concert, which was organised by the Local Advisory Committee for Manchester and District Electrical Trades Benevolent Institution, was held at the Albion Hotel, Manchester, on Friday evening, April 1st, and over 200 were present. An excellent programme had been arranged by Mr. W. J. Smith, the energetic secretary of the Committee, who also accompanied the songs. The artistes were:—Mr. Peter Wood, Mr. Claud Ratcliff, Mr. Arthur Giddons, Mr. H. A. Palmer (entertainer), Messrs. Wilks and Simmonds (humorists). Mr. J. A. Robertson, the engineer of the Salford Corporation, who is chairman of the committee, presided. In the course of the evening, Mr. Robertson pointed out that the main object of the smoking concert was to induce some of the very large number of those in Manchester who were qualified to become members to join the Institution. He expressed the hope that in view of the fact that there were more people on the staffs of the electrical firms in Manchester than in any other town, the number of members joining the Institution from that district would be greater than all those at present included in the list of members. He afterwards called upon Mr. F. B. O. Hawes, honorary secretary of the Institution, who gave a short address on the object and operations of the Institution. Those present were enthusiastic in their desire to support the Institution, and a considerable number of new members joined.

The annual general meeting will be held on Monday, 25th inst., at 2 30 p.m., at the offices of the Cable Makers' Association, Sardinia House, Sardinia Street, W.C. 2, to receive the report of the Committee of Management, and to pass the accounts and balance-sheet, and to consider proposed alterations in the rules.

Service Notes.—It is intimated that full accountant responsibilities are to be taken over by officers in charge of wireless stations at Malta and Ceylon, including the payment of *personnel.* Warrant telegraphist, J. J. Cook, has been appointed to the battleship *Barham*, and warrant telegraphist, C. C. Nash, to the Signal School at Portsmouth.

Creeping of Electrolyte in Storage Battery.—Mr. E. S. Baxter, in a contribution to *Power*, states that recently his attention was called to what seemed to be a cracked or leaky jar in a set of storage batteries. The faulty cell happened to be the first one on the positive end. No crack or any other spot that the electrolyte could leak through was visible. The sand round the jar was very damp, and the electrolyte low in quantity and in specific gravity, owing to the frequent addition of water to make up for the leakage. A new jar was procured, and after testing it thoroughly for leaks and equalising the electrolyte among all the jars in order to get correct specific gravity, the battery was given a charge. But this did not remedy matters; the electrolyte kept going down in the same jar and only in that one, and the sand around it was as moist as ever. Upon examining the cell closely, it was observed that the jar was wet all over the outside, and it was concluded that some form of creeping was taking place. So the plates were raised, thoroughly dried and the connecting strap cleaned, also the edge and outside of the jar, after which the connecting strap was covered with vaseline down to within one-half inch of the top of the electrolyte; and the leakage ceased. It seems evident that the electrolyte by some means was being carried up over the plate terminals, and from there to the outside of the jar, by what seems to be a form of creeping or capillary action.

Fuel Oil Ignited in the Economiser.—A certain plant contained three Stirling boilers, with a 0·2-in. draught and burning crude oil, using four burners under each boiler. The load had been very heavy for some hours and the fireman was not an expert on oil burning. So when the demand came for more steam, he simply fed more oil to the fires and did not notice that they were smoking, and not burning the oil completely. A good deal of unburnt oil was carried off with the gases and lodged in the economiser, where it finally caught fire and made a fierce heat, practically making a boiler of the economiser. As the economiser relief valves were set 3 lb. higher than the safety valves on the boiler, the steam was forced through the feed lines into the boilers. The feed pumps were running at the time, and we let them run, and as the valves were blowing we put out the fires by shutting off the oil supply. The trouble was soon over, because the fire burned itself out in the economiser chamber. As there were two 500-kW turbines running at the time, it was not over an hour before the burners were all lighted and the boilers steaming as if nothing had happened. I do not suppose there is in this anything new to engineers or old firemen, but it may be of some good to young engineers and firemen who have not had such things happen.

If the engines are running, do not shut them down; let them run. Do not stop the feed pumps and do not close the stack dampers, as this is likely to cause an explosion which will destroy the economiser walls and do other damage, such as breaking steam pipes and endangering life with flying brick. There is nothing that can be done to put the fire out in the economiser, at least not in the one I am speaking of; and as they are all on the same line of engineering, there will be but little difference in any of them.

Watch the water in the boilers closely. When you put out the burners, the water may drop out of sight in the glass in water-tube boilers. Do not get excited; keep cool, and know why you do anything and what the consequences will be before you do it, not after, as it will then be too late.—Fred. E. Cupper in *Power*.

Amplifying the Optophone.—In a letter to *Nature*, Mr. A. A. Campbell Swinton recorded some experiments that he had recently been making on the application of a thermionic amplifier to increase the volume of the sounds produced by Dr. Fournier d'Albe's optophone, so as to render the sounds audible to everyone in a room without the necessity of each listener being furnished with a separate telephone receiver. The optophone was recently fully described in our pages. The experiments were carried out at the instance of Mr. J. M. McCarthy, who is teaching blind soldiers to read with the instrument, and who asked Mr. Campbell Swinton whether it would not be possible to magnify the sounds sufficiently to enable a class of a dozen or more to hear them simultaneously. The amplifier found to work best, out of several that were tried, was an audio frequency one with three "R" valves, transformer-coupled, of the French military type. This was used with a Brown loud-speaking telephone with considerable success. The best results were obtained when the optophone was arranged for what is technically known as "black sounding."

In the following issue of our contemporary, Dr. E. E. Fournier d'Albe stated that experiments had been made with a Marconi three-valve amplifier and an S. G. Brown loud-speaking telephone, the sounds reproduced rendering ordinary printed matter "legible" to several blind pupils in a room.

In the same issue, Mr. J. W. French, a director of Messrs. Barr and Stroud, Ltd., wrote that amplifiers had been tried in conjunction with the instrument a considerable time ago, but it was thought that the complexity due to the addition of the amplifier was not justified.

French Tidal Power.—A statement on the utilisation of tidal energy made in the Senate by M. Le Trocquer, Minister of Public Works, has evoked considerable interest. A Commission was appointed two years ago to consider how France could utilise what the Minister termed "the blue coal," and according to M. Le Trocquer, the commission is on the verge of solving the problem. Up to now, he said only very moderate results had been obtained from the system of constructing artificial reservoirs in the sea by means of barrages, and utilising the emptying of such reservoirs for the production of power, the lack of success being due to the inconstancy of the power obtained. The idea was, therefore, conceived of having recourse to a series of interconnected reservoirs, acting as regulators, which would permit of a fairly constant supply of power being obtained at any period of the tide.

This was not all, however. It remained to find a type of turbine to work in, and resist the action of sea water. A competition was therefore opened. "This has ended favourably," declared the Minister, "and the prize has gone to a French firm. Under these circumstances, manufacturers are now considering the practical carrying out of the project. We have had applications for concessions, and soundings are at present being made with a view to using the estuary of the Rance. I, therefore, see no objection to the necessary credits being made the subject of a special Bill, to which I hope Parliament will give a good reception."—*Reuter's Trade Service* (Paris).

Light as an Aid to Publicity.—An interesting discussion on the above subject was held on February 24th, by the Illuminating Engineering Society. The proceedings were opened by two papers, one on "Show-Window and Spectacular Lighting," by Captain E. Stroud, and the other, "Illuminated Signs," by Mr. E. C. Leachman. Captain Stroud again repeated the protest against the indiscriminate use of gasfilled lamps in shop windows, pointing out that, apart from the bad effects of the glare of this kind of lighting, generally 60 per cent. of the light was wasted. This led to the discussion of the correct type of reflector to be employed with these lamps. Often reflectors were used which although eminently suitable for vacuum lamps, were totally useless for the gasfilled types. The best effects could be obtained by placing lamps with suitable reflectors near the window-glass at the top of the window. The units should be entirely concealed from view—not merely from distant vision, but invisible at close quarters. Owing to the varying nature of goods to be displayed, it was impossible to formulate any rules regarding intensity of illumination, &c.; the position of the shop was also an important factor, with considerable variation. The author criticised the methods usually adopted for lighting the stands at exhibitions where each exhibitor was permitted to be a law unto himself.

Mr. Leachman's paper dealt with the use of illuminated signs on small and large scales, as well as other methods of advertising out-of-doors by means of electric lighting. In Mr. Leachman's opinion, every street corner should bear an illuminated direction sign, and every business house should bear its name as plainly at night as in the daytime. Public lighting would thus be aided, if the work was properly executed, as the distances between street lamps made a semi-dark portion inevitable. The author's remarks upon the designs of flashing and other large electric signs made it plain that there was a great deal more in the art than met the eye. The effect of distance had to be studied carefully; the choice of lamps and the method of arranging them to give the best results at all distances required much thought and experience. The possibilities of flood-lighting for illuminating large posters was dealt with, as well as the system of lighting transparencies by means of lamps fitted in the rear of the advertisement. Mr. Leachman also criticised exhibition lighting, and suggested that each section should be illuminated distinctively in colour, in order that the visitor might be able to pick out any particular section by a glance at a colour key. Each stall should bear an illuminated number, and regulations should be framed to prevent an exhibitor's lighting spoiling a neighbour's exhibit.

Overseas Anti-Aircraft Searchlight Sections Reunion.—The annual dinner of officers of the Overseas Anti-Aircraft Searchlight Sections, R.E., was held on April 1st, at Frascati's Restaurant, Lieut.-Colonel W. C. H. Prichard, D.S.O., R.E., being in the chair. About 20 officers attended, and a very pleasant evening was spent. It was decided to hold the next dinner in April, 1922, and the undermentioned joint hon. secretaries were appointed to make the necessary arrangements. Capt. D. R. Ffrench-Mullen, R.E., Anti-Aircraft Searchlight and Sound Locator School, Gosport, Hants, and Mr. K. L. Wood, 95, Salisbury House, Finsbury Circus, E.C. 2. It is requested that all officers who did not receive a communication concerning the recent dinner should forward their addresses to one of the above-mentioned gentlemen.

Electric Vehicles in Italy.—The shortage of motor fuel during the war has brought about a considerable use of electric trucking vehicles in Milan (Italy), more particularly for heavy work. Although under normal conditions petrol will not continue at its present price, it will always be high in Italy, and the cost of electricity is comparatively low. The cities of the Po valley are level, and the roads good. There is one electric garage in Milan which operates electric 'buses for all the hotels and also a regular express truck service between Milan and Bergamo. This concern is organising a corporation to manufacture and handle electric vehicles.—*Scientific American.*

INSTITUTION NOTES.

Institute of Metals.—The Autumn meeting of the Institute will be held in Birmingham, on September 21st-23rd. The arrangements for the meeting are in the hands of the committee of the Birmingham Section of the Institute, of which Dr. H. W. Brownsdon, M.Sc. (Member of Council) is chairman. The programme will include a reception by the Lord Mayor of Birmingham, visits to the University and works in the neighbourhood, as well as excursions in the locality. Persons desirous of attending the Birmingham meeting as members of the Institute should obtain the necessary application forms from the Secretary, Mr. G. Shaw Scott, M.Sc., The Institute of Metals, 36, Victoria Street, London, S.W. 1, before April 20th, when a ballot for the election of members will take place. The Eleventh Annual May Lecture is to be delivered at the Institution of Mechanical Engineers, on May 4th, by Prof. T. Turner, M.Sc., A.R.S.M., the subject of the lecture being "The Casting of Metals."

Incorporated Municipal Electrical Association.—Major H. Richardson, President I.M.E.A., informs us that the following papers are to be read at the Annual Convention of the I.M.E.A., to be held in Dundee during the week commencing June 13th:—

(1) "Financial and Business Aspects of Electricity Supply," by Mr. E. Cross (Rotherham), and Mr. C. W. Charlesworth (Electricity Supply Department, Wolverhampton).

(2) "Modern Boiler-House Practice," by Mr. David Wilson (Messrs. Babcock & Wilcox, Ltd.), and Mr. W. M. Miles (Electricity Supply Department, Sheffield).

(3) "State of the Electricity Supply Industry after the War," by Mr. I. V. Robertson (B.E.A.M.A.).

Physical Society of London.—At a meeting to be held this afternoon (April 8th) at the Imperial College of Science, the following papers are to be read:—"A New Registering Microphotometer," by Dr. W. J. H. Moll, University of Utrecht; "The Examination of the Structure of Crystals in the Form of Powder by Means of the Ionisation Spectrometer," by Prof. Sir W. H. Bragg, K.B.E., F.R.S., and "A Balance Method of Using the Electrometer for the Measurement of Power," by Mr. Hubert Parry.

Belfast Association of Engineers.—The annual general meeting of the Association was to be held yesterday, when elections to office for 1921-22 were to be made. The nominee for the position of President is Mr. Silk, A.M.I.C.E., M.I.N.A.

Manchester Wireless Society.—On March 17th at the College of Technology, and March 24th at the Headquarters, Albion Hotel, Manchester, the President, Mr. J. Hollingworth, M.A., B.Sc. (Eng.), delivered two lectures on "Direction Finding." The aim of directional wireless was explained both as regarded position finding and the reduction of interference between wireless stations. The theory and means of obtaining directional effects were shown by reference to the earliest and the modern systems, and by means of many diagrams and his own direction-finding apparatus, the lecturer demonstrated the practical working of the subject.

Institution of Electrical Engineers.—The following is a list of the Council's nominations for election to the Council to fill the vacancies which will occur on September 30th next:—

President (one vacancy).—J. S. Highfield.

Vice-Presidents (two vacancies).—Prof. E. W. Marchant, D.Sc., C. C. Paterson, O.B.E.

Hon. Treasurer (one vacancy).—Sir James Devonshire, K.B.E.

Ordinary Members of Council. Members (four vacancies).—S. Evershed, A. L. C. Fell, C.B.E., H. E. O'Brien, D.S.O., A. Page, T. Roles, Captain H. J. Round, M.C.

Associates (two vacancies).—Sir Andrew M. Ogilvie, K.B.E., C.B., A. W. Tait, C.B.E.

These members, together with those remaining on the Council, will, if elected, represent the various branches of the electrical profession as follows, the names of those now nominated being indicated by italics:—

Educational.—Dr. W. H. Eccles (Vice-President), *Dr. E. W. Marchant* (Vice-President), Dr. A. Russell.

Manufacturers and contractors.—(*a*) Traction, light, and power H. J. Cash, J. R. Cowie, *S. Evershed*, E. A. Gatehouse; (*b*) Cables: P. V. Hunter, C.B.E., B. Welbourn; (*c*) Telegraphs and telephones: F. Gill, O.B.E.

Traction, light, and power.—(*a*) Companies (excluding railways): *Sir J. Devonshire* (hon. treasurer), A. H. W. Marshall, *A. W. Tait, C.B.E.*, P. D. Tuckett, C. Vernier; (*b*) Local authorities: S. E. Fedden, *A. L. C. Fell, C.B.E., T. Roles*; (*c*) Railways: *H. E. O'Brien, D.S.O.*

Consultants.—A. A. C. Swinton, F.R.S. (Vice-President).

Telegraphs and telephones (excluding manufacturers).—Sir W. Noble, *Captain H. J. Round, M.C.*

Miscellaneous (*i.e.*, Law, Government departments, other than Post Office, electro-chemistry, research, &c.)—*Sir A. M. Ogilvie, K.B.E., C.B., A. Page, C. C. Paterson, O.B.E.* (Vice-President).

Paisley Association of Electrical Engineers.—On April 1st the annual smoking concert was held. Mr. W. R. Bruce, the President, who presided, said that the membership had increased very considerably during the past session, and the same could be said regarding attendance at meetings. Prizes were presented to apprentices for papers read during the session, and an excellent concert programme was listened to.

Institute of Marine Engineers.—The annual report shows that the membership has increased from 2,052 to 2,376.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

The recommendation of the Blackpool Corporation Staff Salaries Committee to increase the salary of MR. C. FURNESS, the tramway manager and electrical engineer, from £1,250 to £1,500 a year has been rejected by the General Purposes Committee, as it considers the time inopportune for any increases of salary to officials. In a letter to the Tramways and Electricity Committee, it is stated, Mr. Furness had assessed the value of the dual appointment at £2,000 a year, and had suggested £1,800 as a reasonable salary. Two years ago the salary was £900, but the Corporation has since taken over the Blackpool and Fleetwood Tramroad undertaking.

SIR JAMES KEMNAL, managing director of Messrs. Babcock and Wilcox, Ltd., was received in audience by His Majesty the King of Spain on completion of the Spanish branch works of the Babcock and Wilcox Co., which will employ from 2,000 to 3,000 people on locomotive construction under the direction of an English staff.—*The Times.*

Messrs. Handcock & Dykes, consulting engineers, of 11, Victoria Street, Westminster, S.W. 1, announce that MR. H. W. HANDCOCK, who has for several years past taken little active part in the work of the firm, retires altogether as from March 31st, 1921, thus terminating a partnership of over 27 years. The firm will be carried on as hitherto, under the old name, by Mr. A. H. Dykes, assisted by Engineer-Lieutenant W. T. Townend, R.N., and the existing staff.

MR. E. H. BENNETT has been appointed manager of the States Telephone Department, Guernsey, in the place of the late Mr. R. McLean. For the last seven years Mr. Bennett has been engineer to the Oriental Telephone Co. at Singapore.

MR. V. H. CRUIKSHANK has resigned his position as station engineer on the staff of the Poplar Borough Council electricity department, and has joined Messrs. E. Downton & Co., Ltd., mechanical and electrical engineers, of 69-71, West India Dock Road, Poplar, E. 14.

After being in the service of the British Insulated & Helsby Cable Works 35 years, MR. JOHN BEARD, upon leaving the firm, was presented with a set of cutlery, an inscribed clock, a pair of bronzes and a suit case.

MR. R. L. DAWN, senior partner of Messrs. Dawn & Co., one of the rising Indian firms, has been elected an additional director on the board of the East India Electric Supply and Traction Co., Ltd. —*Indian Engineering.*

Maidstone Town Council has increased the salary of the electrical engineer from £791 to £835 per annum, in accordance with the salary scale of the Associated Municipal Electrical Engineers.

MR. R. LINE, A.M.I.E.E., is now engineer-in-charge of the municipal electricity department at Simla, in succession to Mr. Milne, who resigned the appointment to take up the position of electrical adviser to the Punjab Government.

MR. WALTER RUTHERFORD, whose resignation as joint managing director of the English Electric Co., Ltd., was recently announced, has been elected a director of the Calcutta Tramways Co., Ltd.

NEW COMPANIES REGISTERED.

Emergo Economic Lamp Co., Ltd. (173,880).—Private company. Registered March 24th. Capital, £1,000 in £1 shares. To acquire the undertaking of the Emergo Co., together with the trade mark "Emergo," and to carry on the business of manufacturers of and dealers in electric lamps, electric light bulbs and fittings and accessories, engineers, &c. The first directors are: H. R. Prosser, Woodstock, Poplar Road, Kings Heath (director, Etna Lighting & Heating Co., Ltd.); E. T. Pheils, 92, Newhall Street, Birmingham; W. S. Melling, 59, Alcester Road, Moseley, Birmingham; E. T. Cruise, Imperial Stores, Wills Street, Smethwick; H. L. Denston, 48, Hawkes Street, Small Heath, Birmingham. Secretary: H. L. Denston. Registered office: 45, Newhall Street, Birmingham.

Manchester Electrical Maintenance Co., Ltd. (173,969).—Private company. Registered March 31st. Capital, £1,000 in £1 shares. To carry on the business of electrical, mechanical, and sanitary engineers, &c. The first directors are: W. Fazackerley, 55, Guildford Road, Levenshulme, Manchester; D. Foote, 15, Bristowe Street, Droylsden, Manchester; H. Renshaw, 3, Central Road, Gorton; W. Wolfenden, 12, Mattison Street, Openshaw. Registered office: 182, Stockport Road, Ardwick, Manchester.

Globe & Simpson, Ltd. (173,934).—Private company. Registered March 29th. Capital, £2,000 in £1 shares. To take over the business of electrical equipment engineers carried on by R. C. Globe and T. W. Globe at Burgess Street, Barker's Pool, Sheffield, as "Globe & Simpson." The first directors are: R. C. Globe, 33, Oxford Street, Rotherham; T. W. Globe, 33, Oxford Street, Rotherham; S. Higgs, 171, Bagley Road, Sheffield. T. W. Globe is permanent, subject to holding £260 shares. Secretary: J. W. Collier. Registered office: 32, Burgess Street, Barker's Pool, Sheffield.

C. T. Briscoe & Son, Ltd. (173,926).—Private company. Registered March 29th. Capital, £5,000 in £1 shares. To acquire the business carried on at Blackburn as "C. T. Briscoe & Son," to adopt an agreement with C. T. Briscoe, A. E. Briscoe, and G. H. Officer, and to carry on the business of electrical engineers and contractors, &c. The first directors are: C. T. Briscoe, Yarlsber, Second Avenue, South Shore, Blackpool, electrical engineer; A. E. Briscoe, 16, Strawberry Bank, Blackburn, electrical engineer; G. H. Officer, 48, Lynwood Road, Blackburn, electrical engineer. Solicitor: H. A. Smitton, 5, Richmond Terrace, Blackburn.

Reversible Marine Engines, Ltd. (173,897).—Private company. Registered March 24th. Capital, £2,500 in £1 shares. To adopt an agreement with R. Brennan and J. O'Connor, to develop and turn to account the inventions of the said R. Brennan relating to rotary engines, pumps, and the like, and to carry on the business of marine, electrical, hydraulic, and mechanical engineers, &c. The first directors are: J. O'Connor, 50, Izani Road, Bexley Heath, Kent (managing director); R. Brennan, 24, Queen's Road, Erith, Kent. Secretary: T. Claremont. Registered office: 27-28, King William Street, E.C.

F. Patrick, Ltd. (173,905).—Private company. Registered March 24th. Capital, £15,000 in £1 shares. To take over the business of an electrical and mechanical engineer and tool maker carried on by F. Patrick at Penraevon Place, Meanwood Road, Leeds, as "F. Patrick." The permanent directors are: F. Patrick, 26, Delph Lane, Leeds; T. H. Breed, Wood Nook, Meanwood, Leeds. Secretary: A. Hodgkinson. Solicitor. B. B. Burrows, Basinghall Square, Leeds.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

R. W. Crabtree & Sons, Ltd.—Charge on various properties in Leeds and London (subject to prior charge) and company's undertaking and other assets, present and future, including uncalled capital, dated March 9th, 1921, to secure all moneys due or to become due from company to Lloyds Bank.

Implitico, Ltd.—Return dated December 20th, 1920. Capital, £3,000 in £1 shares. All shares taken up. £3,000 paid. Mortgages and charges: Nil.

Vulcan Arc Welding & Transport Co., Ltd.—Debenture dated March 1st, 1921, to secure £643, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: T. A. Norris, 79, Seabank Road, Wallasey.

CITY NOTES.

British Aluminium Co., Ltd.

The annual meeting was held on March 31st at Winchester House, E.C. Mr. A. W. Tait, C.B.E., who presided, said that the trading profit for the year was £373,779, an increase of £81,000. That substantial increase in profit was undoubtedly a satisfactory one, but the year 1920 was an exceptional one, particularly in the motor trade, which was a large user of the metal both in ingot and manufactured forms. Those conditions applied not only to this country, but throughout the world generally. The year started with a very strong demand, and he thought it was fair to say that, notwithstanding the large increase in the production capacity of aluminium in several countries, the demand for the first half of the year could not be met. In consequence of financial stringency, caused largely by over-speculation in all commodities, there was a sudden falling off in business in August and September last, and the motor trade was placed in a very serious position, owing to the large stocks which it was carrying and had on order, and the almost wholesale cancellation of contracts for the delivery of cars. The Eastern trade, for which there was a very large and insistent demand for manufactured metal in the beginning of 1920, also fell off in a striking manner towards the end of the year. Consequently, although all the works had been operated to their full capacity during the whole of the year, and a record output obtained, and the sales effected were the largest in the history of the company, it was necessary to make radical alterations to meet the changed conditions, and to prevent accumulation of stocks. Substantial reductions in output were made as from the beginning of the year at all their production works, and also at their rolling mills, and he was afraid that this programme, which necessitated the discharge of a considerable number of their employés, could not be altered until there was a general revival in the industry. The company took over all the stocks of aluminium in the hands of the Government, and it had been successfully disposed of without creating any disturbance in the markets. Reductions had been made in the price of ingot and manufactured metal since the beginning of the year in order to encourage demand. The immediate future was, however, somewhat uncertain, and the industry would necessarily take some little time to get back to normal. There were signs that the worst period of depression might shortly be over, but it was essential that they placed themselves in a position to meet foreign competition, particularly from Germany, which arose largely on account of the present exchange position of that country. That could only be done by reduction in costs and by greater efficiency in production. A great development of the industry lay in the investigation and application of suitable alloys in the motor trade and in general engineering, apart from uses in certain other industries. There was also the development in the electrical industry, where there was a large field, but that had been somewhat retarded by the war and the inability during that period to supply the demand. In domestic utensils there was a large and growing market all over the world, particularly in the East. It was, therefore, evident that when the present period of depression was over, which was to a great extent the result of financial crises and high prices, trade should resume its normal progress under more healthy conditions, and the field for development in their particular industry was, in his opinion, large. It was, therefore, necessary to look ahead if they were to participate in that development as and when it arose, and, as the industry very largely depended upon the generation of electricity at the lowest possible figure, the board had again decided to approach Parliament in the hope of obtaining the powers which they previously applied for in 1918, and which, although they received the approval of the Board of Trade and the Ministry of Munitions, could not be proceeded with on account of opposition which arose in the House of Lords. In order to meet that opposition, which was largely of a local character, the scheme had been somewhat altered and improved, and in consequence, it had now the strong support of the local authorities, the public, and the proprietors interested. He was pleased to say that the Bill had passed its second reading in the House of Commons, and it was hoped that the committee stage would be reached next month. If an Act was finally obtained, the powers would be granted to a statutory company which would, to all intents and purposes, be under the auspices of that company. It was not proposed that work should be proceeded with until the position of the industry and the general conditions of finance justified it. Considerable time would be given under the Act, if it was granted, before it was necessary to proceed with the work, and, in any event, there was no intention of the board to invest any large portion of the company's resources in the scheme without the consent of the shareholders. It was, however, important to the company that this large water power, located so near to their existing works at Kinlochleven, should be obtained for the industry, and for the development of other local industries which it was hoped might be established in the district. As to the Orsières power scheme in Switzerland, certain further work had been carried out, and the construction of the tunnels, intakes, and penstock had now been practically completed. Owing, however, to the present uncertainty, it was not proposed to proceed further with the work in the meantime, and that delay would probably be of benefit to the company, as it was reasonable to assume that the cost of pipe lines and the erection and equipment of the power house and factory could be carried out at considerably lower cost later on. Having gone through the figures in the balance sheet, the chairman said it was satisfactory that they had been able to pay a dividend of 10 per cent. upon the increased amount of capital while maintaining the appropriations to depreciation and reserve accounts at practically the same figure. The liquid resources of the company showed that it was in a strong position, although the industry, in common with nearly every other industry in the country, was passing through a period of acute depression. Undoubtedly that period had to be encountered sooner or later, and it was probably better that it should happen now, so that there might be a quicker return to normal conditions and real value. It was a healthy if uncomfortable process, and one which the company could face with equanimity. Although the immediate conditions were unsatisfactory, there were signs that the worst period was passed, and he hoped it would not be very long before there was a distinct revival in the industry.

Lieut.-Col. S. H. Pollen, C.M.G., seconded the motion, which was adopted without discussion.

Metropolitan-Vickers Electrical Co., Ltd.

The directors report that the profit available for the year 1920, including the balance of £51,089 brought forward, amounts, after providing for taxation, to £359,580, which has been appropriated as follows: To special depreciation of plant, machinery, &c., £35,000; general reserve, £100,000; dividend on preference and ordinary shares at 8 per cent. and 12½ per cent. respectively, less income tax, £165,756; balance carried forward, £58,824. Notwithstanding the difficulties attendant on production during the period covered by the accounts, the directors are pleased to be able to present an improved position as compared with the previous year. During the year 32,866 preference shares have been converted at various dates into 65,732 ordinary shares, and an application for a quotation of the latter is now before the Stock Exchange, as henceforth they are in all respects identical with the ordinary shares now quoted. The total conversions to December 31st, 1920, amount to 42,952 preference shares into 85,904 ordinary shares. The option of conversion expires on April 11th next. The directors announce the resignation of Sir E. V. Hiley, and they have elected Sir Francis H. Barker to the vacant position of vice-chairman. Sir Vincent Caillard, D.L., has been appointed on the board.

British Engine Boiler and Electrical Insurance Co., Ltd. The annual meeting was held at Manchester on April 1st. The chairman (Mr. R. C. Longridge) said that the volume of business undertaken last year exceeded all previous figures. The premiums and fees amounted to £290,799, against £208,970 in 1919, and it was gratifying to find that the growth was well spread as between insurances on electrical plant, boilers, engines, lifts, cranes, and special inspection work. The race between premiums, and claims and expenses had continued unabated, and expenditure had progressed more rapidly than the receipts, with the disappointing result that for the sixth year in succession there had been a shrinkage in the ratio of trading profit, which had fallen from 15.5 per cent. in 1914 to 4.8 per cent. in 1920, as would be seen from the following figures: Premiums and fees, 1914, £112,165; 1920, £290,799. Claims, expenses, and provision for unexpired liability, 1914, £94,933; 1920, £276,815. Trading profit, 1914, £17,532; 1920, £13,984. Ratio to income from premiums and fees, 1914, 15.5 per cent.; 1920, 4.8 per cent. The company's charges had necessarily been increased with a view to recovering the enhanced working costs, but the company had been resolutely opposed to fixing rates of premium which would yield undue profit. Examining more closely the reasons leading to the expenditure exceeding anticipations, the chairman stated that in the early part of last year wages were raised substantially in various engineering trades, thus further advancing the cost of repairs, whilst the cost of additional remuneration to the company's own staff had been substantial. Other causes had also contributed to a continuance of the adverse experience of recent years. For example, during the war the rationing of metal and other difficulties and delays experienced in obtaining new boilers resulted in many discarded boilers being repaired and brought into use again. For the same reasons many other boilers which owners normally would have replaced during the past few years had been kept in use. In other classes of plant, particularly engines, the company had also been affected by the pressure of economic conditions upon plant owners. During the year there had been some particularly heavy losses caused through the breakdown of large generating machines in public electricity supply stations, sometimes at the steam end and sometimes at the electrical end. There was a readier disposition on the part of public authorities to insure against such losses. This no doubt reflected the stringent financial situation and recognition of the fact that repairs to such machines—which, to a large extent, must necessarily be paid for at overtime rates—cost three or four times as much as in pre-war days. The continued expansion in the use of electrical machines—in the insurance of which the company specialised—had led them to arrange for the company's Scottish electrical business to be controlled from Glasgow, and a large portion of their Scottish *clientèle* had expressed appreciation of the change as it operated in favour of prompt and efficient handling and supervision of repairs, which is of the utmost value to a plant owner. Similar arrangements were made in London a few years ago for handling the electrical business in the South of England. In both Glasgow and London, as well as in Manchester and Birmingham, their subsidiary company, British Electrical Repairs, Ltd., had large workshops for carrying out repairs to electrical machines, and the operations of that company were giving satisfaction to clients by reason of the promptitude with which repair work was executed.

Stewarts and Lloyds. Mr. John Graham Stewart (chairman) presided over the thirty-first ordinary general meeting, held in Glasgow on March 31st. In moving the adoption of the report and accounts, the chairman said that a period of depression was being faced, but full preparations had been made. The strong position of the company was due to the practice they had pursued of putting aside a liberal proportion of each year's earnings for development purposes and reserve. The directors deprecated violently fluctuating dividends, and their policy had been to pay dividends in a conservative manner, which had strengthened the finances of the company. The absorption of the business of Alfred Hickmans had been carried out successfully. All the shares had been acquired with the exception of 745 £1 ordinary shares. The report and accounts were adopted unanimously. At an extraordinary meeting held subsequently the revision of the articles of association was approved.

Waste Heat and Gas Electrical Generating Stations, Ltd. The annual meeting was held at Newcastle-on-Tyne on March 31st. Mr. E. Lloyd Pease presided, and said that the capital expenditure during the year had been £25.739, of which £23.973 was in respect of the new power station at Horden. This station was now completed, but the period of construction had been excessively long, and had, naturally, proved exceedingly expensive, as there had been interest to pay on the outlay of about £76,000, while there had been no revenue. With the severe depression in the coal and iron trades they could not look for full output at present. He drew attention to the fact that their reserve and redemption accounts had been increased by £16,854. The profits for the year amounted to £34,439, which was £5,187 less than in the previous year, due in part to the large interest charge on capital expenditure at both Horden and Weardale, and in part to the higher costs at the latter station. Had the new gas engine there been in continuous operation the increased output obtained by this more efficient plant would have compensated for those extra costs, but their difficulties in getting this plant satisfactorily completed continued through the year. In the aggregate the output from the company's stations had been maintained, so that the whole diminution in the profits for the year was accounted for in the way indicated. The total output, however, was still below the pre-war figures by some 20 per cent., and if it could be brought up to that total the effect on the company's accounts would be considerable. So far as the current year was concerned, the trade depression, he was afraid, would affect the amount of waste heat and gas delivered to their stations, although, so far, only one station showed any reduction.

East Anglian Electricity, Ltd. Mr. P. C. N. Peddar, presiding at the annual meeting of the above company, held at Stowmarket on March 29th, said that the directors were recommending a dividend of 9 per cent. on the ordinary shares and 18 per cent on the workmen's shares, less income tax. This was the largest dividend so far proposed on the ordinary shares, but as the ordinary shareholders had received a 25 per cent. bonus distribution, it really represented 11¼ per cent. dividend to the shareholders at September, 1919. The revenue for the 12 months ending December 31st last was 50 per cent. more than for the previous year. This rapid growth of the business was conclusive evidence that the efforts of the company in the supply of cheap electricity in rural areas had been financially successful, and were appreciated by the inhabitants. In Braintree the Council had entered into an agreement giving the company increased facilities for working. The invitations from other towns for the company to extend its beneficial influence to them warranted the directors in immediately making a further issue of capital.

The list of subscriptions to the issue of 50,000 ordinary shares of £1 each at par will close on or before April 15th.

Stock Exchange Notices.—The undermentioned securities have been ordered to be quoted officially:—

Armstrong (Sir W. G.), Whitworth & Co.—£2,000,000 six and a-half per cent. second debenture stock.

Consolidated Gas, Electric Light and Power Co. of Baltimore.—$222,900 capital stock in shares of $100 each.

Midland Electric Corporation for Power Distribution.—280,000 ordinary shares of £1 each, fully paid, Nos. 1 to 280,000.

Westminster Electric Supply Corporation.—1,170 ordinary shares of £5 each, fully paid, Nos. 350,055 to 351,224.

Western Telegraph Co.—103,965 shares of £10 each, fully paid, Nos. 207,931 to 311,895.

Application has been made to the Committee to allow the undermentioned to be officially quoted:—

Hastings & District Electric Tramways Co.—£104,450 4½ per cent. debenture stock.

Lanarkshire Tramways Co.—373,750 shares of £1 each, fully paid (Nos. 1 to 373,750).

Spain.—The Sociedad Productora de Fuerzas Motrices, which was formed for the purpose of constructing and exploiting waterfalls in the Catalonian Pyrenees for the production of electrical power on a large scale, is issuing 10,000 bonds of 500 pesetas each, bearing interest at the rate of 7 per cent., redeemable at graduated premiums within 40 years from 1922. The rate of issue is 98 per cent. The funds thus obtained will be devoted mainly to the extension of the works at the Pobla de Segur fall and the termination of those at the Cledes fall. These two falls are expected to increase the company's receipts by at least 2,000,000 pesetas.—*Reuter's Trade Service*, Madrid.

Slough & Datchet Electric Supply Co., Ltd.—New capital expenditure during 1920 £10,241, chiefly for cable extensions to Slough, Farnham, and Stoke. The lamps and motors connected during 1920 were 53,793, against 43,355 for 1919. Units sold 2,225,331 for 1920, against 1,571,338 in 1919. Revenue for 1920 £26,664, as against £18,714 in the previous year. Net profit £7,797, to depreciation and reserve £3,000. Dividend 4 per cent., less tax. £2,717 carried forward.

Companies to be struck off the Register.—The following companies are to be struck off the register unless cause is shown to the contrary within three months:—

Colston Electrical Works, Ltd.
Globe Associated Cable & Telegraphic Services, Ltd.
Stolz Electrophone Co. (1913), Ltd.

Anglo-American Telegraph Co., Ltd.—Interim dividend for the quarter March 31st, 1921, of 15s. per cent. on the ordinary stock and 30s. per cent. on the preferred stock, less tax.

Isle of Wight Electric Light & Power Co., Ltd.—Dividend of 5 per cent. on the preference shares for the year ending April 30th, 1918. £2,500 to reserve. £5,000 to reserve. Carrying forward £556.

Canadian General Electric Co., Ltd.—The report for the year ended December 31st last, which was submitted to a meeting of shareholders in Toronto on March 21st, shows a profit of $2,213,731, of which depreciation and interest absorb $857,042, leaving a net balance of $1,356,689. The payment of dividends (8 per cent., and a bonus of 2 per cent. on common stock, and 7 per cent. on preference stock) took $1,014,114, leaving a surplus for the year of $342,575. This, with undivided profits from the previous period, $436,097, and reserve, $5,000,000, makes a surplus, shown in the balance sheet, of $5,778,672. The report states that the growth of the company's business continued at a greater rate, and uncompleted contracts at the end of the year amounted to over 7½ million dollars. The gross profit represents an increase of $595,700 upon that of 1919, and the dividends are correspondingly larger, being 10 per cent. (including bonus), against 8 per cent. It is proposed to capitalise a part of the reserve in the form of a stock dividend of 20 per cent. to the holders of common stock.

Egham & Staines Electricity Co., Ltd.—Mr. Samuel Spencer (chairman) presided over the annual general meeting held on March 21st. It was announced that the accounts showed a profit of £4,309. Of this £1,093 was transferred to reserve, and after payment of interest on loan capital there remained a balance of £1,276 for dividends. The directors recommended the payment of arrears of dividend on the 5 per cent. preference shares from the date of incorporation to December 31st, 1912, a dividend of 7½ per cent. on the preference shares for the last six months of 1920, and of 7½ per cent. for the year on the ordinary shares, by the allotment of ordinary shares. This method of increasing the capitalisation of the company was agreed to.

Paramatta Electric Supply Co., Ltd.—At a meeting of shareholders held recently in Paramatta, the chairman, Mr. J. Shorter, submitted, on behalf of the directors, a scheme of reconstruction in order to allow of an increase of the capital from £20,000 to £60,000, which has become necessary for carrying out certain contracts and various extensions. The directors recommend the liquidation of the present company, the appointment of Mr. W. E. Cullam as liquidator, and the sale, on terms submitted, of the present company to a proposed new one. These proposals were unanimously adopted.—*Sydney Evening News.*

Windsor Electrical Installation Co., Ltd.—During 1920 load equivalent to 3,193 30-W lamps was connected, making a total of 70,098. New capital expenditure £1,899. Profit, including £696 brought forward, £7,108. Debenture and other interest £636, 5 per cent. preference dividend £824, depreciation, reserve and renewal fund £2,500, directors' fees (free of tax) £350. Dividend on ordinary shares 3½ per cent., less tax, £1,574 carried forward. Mr. H. R. de Salis has retired from the directorate. Mr. H. L. Prior, who resigned his seat in 1919 on account of ill-health, has consented to rejoin the board.

Bromley (Kent) Electric Light & Power Co., Ltd.—During the year 1920 the connections increased from 5,111 to 5,479 kW. The gross profit was £12,611, against £10,479 in 1919. After meeting debenture interest, &c., and adding £1,445 brought forward, there is a balance of £11,045, out of which a dividend of 6 per cent. is to be paid, £1,230 is to be placed to renewal reserve, £4,000 to general reserve account, and £1,314 carried forward.

Ramsgate & District Electric Supply Co., Ltd.—Profit £5,356, as against £4,247 for the previous year. After deducting interest on outstanding accounts due to contractors (£1,536) and adding £857 brought forward, the balance is £4,677. Dividend 10 per cent.; £2,200 to reserve; £477 carried forward.

Llanelly & District Electric Lighting & Traction Co., Ltd.—Profit for the year 1920, including £3,016 brought forward, £18,991. Loan and debenture interest absorbed £6,069; £1,162 has been placed to debenture stock redemption; £2,500 to general reserve. Dividend 7 per cent. (less tax) on the ordinary shares, carrying forward £1,341.

STOCKS AND SHARES.

Tuesday Evening.

It would be refreshing were one able to keep out of any article dealing with stocks and shares, or industry of any kind, a reference this week to the position caused by the coal stoppage and the threatened other strikes. Mr. Hodges, in a sensible letter to the *Times* last week, complained that there was an appalling amount of public indifference to the gravity of the situation, but perhaps he did not grasp the true sentiment of the public, which is simply that we are all thoroughly fed-up with a crisis which appears to have so little genuine ground for its development on the part of the miners. Stock Exchange and other business is brought to something like a standstill, and with industry on every side held up by the labour troubles, with unemployment increasing and mutterings of further trouble in the air, it is only natural that investors should prefer to look on rather than to utilise capital in the way of investment. Meanwhile, those who are obliged to part with their securities in order to satisfy the rapacious tax-gatherer, or the more modest cravings of household requirements, find that only by sharp sacrifice can shares be sold at the present time in the great majority of cases.

However, there is a prospect of an immediate reduction in the Bank Rate, and in the labour world, the mere fact of things having drifted into such a serious state, argues that as they cannot become much worse, so the time for their amelioration may be nearer than we expect. Therefore the Stock Exchange is taking a philosophical view of the prevailing situation, and Lord Derby's proposal led to a greatly improved tone in the markets.

Electricity supply shares are keeping up without a tremor. Some depreciation has already occurred amongst gas stocks, although the decline has been of no great consequence. Gossip has it that the electrical undertakings are well supplied with coal, and can carry on without difficulty for some weeks. The introduction of "Summer time" this year is a relief rather than a disability, and the recent dividend announcements from the electricity supply companies have been sufficiently good to encourage holders to retain shares which pay handsomely at the present levels.

The annual report of the American Telephone & Telegraph Company is always interesting from the comparison which it affords between the United States methods and those of this country. The company has a vast capital, considerably over 1,000 million dollars, and controls telegraph and telephone systems in a remarkable manner through the operation of a central organisation, in conjunction with which is worked the Western Electric Company, a manufacturing subsidiary to the parent concern. The dividend for last year is raised from 8 per cent. to 9 per cent., and the profits of the company have been multiplied by ten within the last two decades. The American Telephone and Telegraph Company is taking a close and practical interest in wireless telegraphy, nor is the corporation afraid of spending money on experimental and research work. We hear protests in this country against telephone charges in America, but the financial showing made by our official department for telephone and telegraph work shows up pitifully against the profits made by the American concern.

The increased telephone rates have come into operation during the past week in respect of the services in this country. Rates for trunk calls have increased materially. This is another blow to Stock Exchange business. One reduction is announced, that namely from London to Dublin, but considering the state of Ireland at the present time, and the volume of orders in stocks and shares which emanates from the distressful isle, there is something almost ironical in this change in the downward direction.

Amid no little excitement, Metropolitan Railway Consolidated stock rose from 24 to 26⅛ the other day, on a rumour to the effect that the company was to be completely absorbed by the Underground Electric Railways of London. The possibility of this proving true led to a good deal of buying. The Underground company, however, denied the rumour, with the consequence that Metropolitan Consolidated fell back to 22½, leaving the stock 1½ down on the week. Concurrently with the jump in "Mets.," Underground Electric Income Bonds rose to 72½, from which there was also a sharp reaction to 67½ on the contradiction just mentioned. The ordinary, however, are ⅛ up and the 1s. shares are 6d. higher at 2 and 6s. respectively. Districts keep tolerably steady, and in certain circles of the Stock Exchange there is talk of a possible dividend on the stock in 1922. If this should mature, it will be the first distribution that District stockholders have received on their ordinary capital for forty years. Metropolitan Electric Tramways 4½ per cent. first debenture stock has gained 3 points at 60½.

Changes amongst electricity supply shares are mostly caused by the marking of various shares ex dividend. Brompton's and St. James's have both gone back to 6 xd, which brings the yield once more to the round 10 per cent. on the money. Chelseas pay the same rate, and Westminsters return 9¾ per cent., Charing Cross ordinary just over 10¼. Preference shares continue to be in demand. As illustrating the way in which money is still on the look-out for sound investments, it is interesting to notice the success of the City of Auckland 6½ per cent. Electrical Undertaking Extensions Loan. Of this, there was half-a-million sterling in debentures offered at par, with the principal and interest unconditionally guaranteed by the Government of New Zealand. The money was wanted to provide funds for the extension of and addition to the present municipal undertaking, and subject to existing loans, the new loan is a direct obligation of the city. The issue was promptly subscribed, and the lists closed in advance of the day set. It is expected that when the market starts in the debentures, there will be a premium of about 1 per cent.

The City of London Electric 8 per cent. preference issue of 300,000 shares of £1 each, and also 94,050 ordinary shares of £1 each, have been underwritten this week. The preference will be offered at 20s. and the ordinary at 22s. 6d. As the Central Electric debenture issue was underwritten a week or so earlier, curiosity waits upon which of the two prospectuses will be published first.

Cable stocks and shares show a fair degree of firmness, having regard to the conditions of the times. Globe ordinary are ⅛ up at 15⅞, while Westerns have recovered half of their 5s. dividend and are quoted at 16. Eastern ordinary at 160 is ½ lower. Marconi's have been over 2, but reverted to 38s. 9d. Lively interest canvasses the possibilities of the next dividend, reference to which was made here last week. A rise of 30s. to 22 in Great Northerns makes pleasant chronicling in days of depression such as these. Telegraph Constructions have eased off to 20¼.

Amongst the foreign stocks, British Columbia preference is a point lower, and Mexico Tramway Fives have gone back to 36. On the other hand, Mexican Light and Power Firsts are better at 60, although there is no news from Mexico to cause movements one way or the other. Para Electric preference drooped to 9s.

Metropolitan-Vickers preference at 1¾ have lost ⅛ of the sharp gain they acquired on the satisfactory dividend announcement. The ordinary are also a little lower at 18s. 9d. Siemens receded to 20s., English Electrics to 11s., and Edisons marked down to 9s. Henley's at 1 5/16 and British Insulated at 1 9/16 are both ex dividend; the latter shares show recovery of the dividend and 1/16 in addition. Rubber shares are weak, the price of the raw stuff having gone back to 10½d. a pound. Owing to the coal strike, Vickers and other armament shares have also given way. Upon Lord Derby's proposal that the Government should continue the coal control for another month, so that full discussion of the situation could be entered into by all sides, a part of the previous flatness was wiped out in many markets.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1919.	Dividend 1920.	Price April 5, 1921.	Rise or fall.	Yield p.c.
Brompton Ordinary	12	12	6xd	—	£10 0 0
Charing Cross Ordinary	7	8	8⅜	—	10 6 6
do. do. do. 4½ Pref.	4½	4½	2⅝	—	8 8 8
Chelsea	4	6	6xd	—	10 0 0
City of London	18	14	23/9xd	—	11 16 0
do. do. 6 per cent. Pref.	6	6	18/-xd	+6d	6 13 4
County of London	8	8	7⅝xd	+ ⅛	10 9 10
do. do. 6 per cent. Pref.	6	6	6xd	—	7 10 0
Kensington Ordinary	7	9	4⅛xd	—	10 18 2
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref.	6	6	2¾	—	10 18 2
Metropolitan	8	7	8¼	—	10 15 4
do. 4½ per cent. Pref.	4½	4½	2 1/16	—	7 18 2
St. James' and Pall Mall	12	12	8	— ½	10 0 0
South London	8	—	2½xd	—	9 2 10
South Metropolitan Pref.	7	7	16/9	—	8 17 10
Westminster Ordinary	10	10	5⅛	—	9 15 2

Telegraphs and Telephones.

	1918	1919			
Anglo-Am. Tel. Pref.	6	6	80¼	—	7 9 8
do. Def.	33/6	1½	16⅞	— ⅛	8 8 8
Chile Telephone	8	6	6½	—	*6 8 8
Cuba Sub. Ord.	7	7	8½	—	*10 15 4
Eastern Extension	10	10	16	— ⅛	6 5 0
Eastern Tel. Ord.	8	10	160	+ ½	*6 5 0
Globe Tel. and T. Ord.	8	10	15⅞	— ⅛	6 6 0
do. do. Pref.	6	6	5	—	6 18 4
Great Northern Tel.	22	22	22	+1½	10 0 0
Indo-European	13	10	60	—	8 6 8
Marconi	25	25	1 15/16	— 1/16	—
Oriental Telephone Ord.	10	12	2 3/16	—	*5 9 7
United R. Plate Tel.	8	8	6⅛	—	*6 10 6
West India and Panama	1/3	Nil	¼	—	Nil
Western Telegraph	8	10	16xd	+ ½	*8 5 0

Home Rails.

	1919	1920			
Central London Ord. Assented	4	4	44½	+1	9 0 0
Metropolitan	1½	1½	22½	+1½	6 13 4
do. District	Nil	Nil	14	—	Nil
Underground Electric Ordinary	Nil	Nil	2	+ ⅛	Nil
do. do. "A"	Nil	Nil	6/-	+6d	Nil
do. do. Income	4	2	67½	—4	2 16 0

Foreign Trams, &c.

	1918	1919			
Anglo-Arg. Trams, First Pref.	Nil	6½	2⅝	—	10 9 6
do. do. 2nd Pref.	Nil	Nil	⅜	—	Nil
do. do. 5 % Deb.	5	5	59½	—	8 8 0
Brazil Tractions	Nil	Nil	87	—	Nil
British Columbia Elec. Rly. Pfce.	5	5	55	—	9 1 10
do. do. Preferred	2½	6	64½	—	*8 14 0
do. do. Deferred	Nil	8	61½	—	*11 17 6
do. do. Deb.	4½	4½	56⅝	—	7 10 8
Mexico Trams 5 per cent. Bonds	Nil	Nil	36	—	Nil
do. 6 per cent. Bonds	Nil	Nil	21½	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	18	—	Nil
do. 1st Bonds	Nil	Nil	60	+1	Nil

Manufacturing Companies.

Babcock & Wilcox	15	15	2⅜	—	*6 6 4
British Aluminium Ord.	10	10	17/6	—	11 8 8
British Insulated Ord.	12½	15	1 9/16xd	+ ⅛	9 12 0
Callenders	25	15	1 7/16	—	10 18 2
,, 6½ Pref.	6½	6½	17/6	—	7 8 7
Crompton Ord.	10	10	18/9	—	14 11 0
Edison-Swan	10	10	10/-	—	—
do. do. 5 per cent. Deb.	5	5	70	—	7 2 10
Electric Construction	10	10	15/9	—	12 14 0
English Electric	—	8	11/-	- 6d.	14 11 0
Do. Pref.	—	8	13/-xd	—	9 4 6
Gen. Elec. Pref.	8½	6½	18/6	—	7 0 5
do. Ord.	10	10	1½	— 1/16	*8 18 0
Henley	25	15	1 5/16xd	—	11 8 6
do. 4½ Pref.	4½	4½	⅝	—	6 18 6
India-Rubber	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	1¾	— ⅛	9 2 10
Siemens Ord.	10	10	1	—	*9 15 2
Telegraph Con.	20	20	20¼	— ¼	*5 18 3

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, April 5th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	10d.	½d. inc.
a Ammoniac Sal	per ton	£75	...
a Ammonia, Muriate (large crystal)	,,	£65	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£34	...
a Copper Sulphate	,,	£34	£1 dec.
a Potash, Chlorate	per lb.	6½d.	...
a ,, Perchlorate	,,	10d.	...
a Shellac	per cwt.	£14 10s.	10s. dec.
a Sulphate of Magnesia	per ton	£16	...
a Sulphur, Sublimed Flowers	,,	£20	...
a ,, Lump	,,	£18	...
a Soda, Chlorate	per lb.	4½d.	...
a ,, Crystals	per ton	£7	...
a Sodium Bichromate, casks	per lb.	1/-	...
METALS, &c.			
p Babbitt's Metal Ingots	per ton	£95 to £800	...
c Brass (rolled metal 2" to 12" basis)	per lb.	11¼d.	½d. dec.
c ,, Tubes (solid drawn)	,,	1/1⅜ to 1/2	...
c ,, Wire, basis	,,	11⅜d.	½d. dec.
c Copper Tubes (solid drawn)	,,	1/5⅞	...
c ,, Bars (best selected)	per ton	£116	£2 inc.
c ,, Sheet	,,	£116	£2 inc.
c ,, Rod	,,	£118	£ . inc.
d ,, (Electrolytic) Bars	,,	£78 10s.	50s. inc.
d ,, ,, Sheets	,,	£146	£2 inc.
d ,, ,, Wire Rods	,,	£89 10s.	50s. inc.
d ,, ,, H.C. Wire	per lb.	11⅝d.	⅛d. inc.
f Ebonite Rod	,,	5/6	...
f ,, Sheet	,,	8/-	...
n German Silver Wire	,,	2/9	...
h Gutta-percha, fine	,,	14/- to 18/-	...
h India-rubber, Para fine	,,	10⅜d.	⅜d. dec.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£45	...
g Lead, English Pig	,,	£21 10s.	25s. inc.
g Mercury	per bot.	£12 10 to £12 15	...
e Mica (in original cases) small	per lb.	4d. to 4/-	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
p Phosphor Bronze, plain castings	,,	1/4 to 1/9	...
p ,, ,, rolled bars and rods	,,	2/1 to 2/6	...
p ,, ,, rolled strip & sheet	,,	2/2 to 2/7	...
d Silicium Bronze Wire	per lb.	1/4	...
r Steel, Magnet, in bars	,,	1/8	...
n Tin, Block (English)	per ton	£160 to £161	£3 dec.
n ,, Wire, Nos. 1 to 18	per lb.	4/-	...
p White Anti-friction Metals	per ton	£78 to £800	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd
n P. Ormiston & Sons.
p ————
r W. F. Dennis & Co.

Synchronised d.c. Motors.—The *Electrical World* describes how d.c. motors employed in a paper mill are made to operate at the same relative speeds under varying loads by coupling them with smaller synchronous motors connected in parallel. When the speed of a direct-current motor tends to drop the synchronous motor holds it up. This drive consists of one unit for each section of the paper machine. Each unit consists of a d.c. motor and a synchronous motor of about 20 per cent. of the rating of the d.c. motor, the synchronous motor being coupled with the d.c. motor through a reduction gear and a belt running on a pair of slightly tapered cones, which permit of a total range in speed of 12 per cent. The motors and cones are mounted on a common base and directly connected to one section of the paper machine. All of these synchronous motors are connected to a common bus not tied to any other line. They are excited from an exciter bus. The d.c. motors are all started from one central remote-control panel. The synchronous motors are started at the same time by the belts and gears. Since they are all connected to the same bus they will start and run in synchronism.

Under actual operation any change in the load on a particular section caused by changing the weights or otherwise altering conditions will be absorbed by the synchronous machine. If the load increases, the machine will act as a motor on that particular section and draw its power from the remaining synchronous machines, which will immediately act as generators and distribute the load over the entire drive. If the load decreases, the synchronous machine will act as a generator and supply power to the remaining synchronous machines, which then act as motors. Any change in load on any section is therefore distributed over the whole motor equipment, and may change the speed of the paper machine as a whole but cannot cause any change in the relative speeds of the various sections.

So long as any synchronous machine operates within its rating either as a motor or as a generator it will not be necessary to make any adjustments, but if the indicating wattmeter in the synchronous machine circuit shows too much power it may be easily brought back to zero by turning the rheostat in the direct-current motor field.

THE LABOUR SITUATION AS IT AFFECTS THE ELECTRICITY SUPPLY INDUSTRY.

By T. W. COLE (Joint Secretary, Home Counties Industrial Council).

(*Continued from p. 426.*)

In the previous article I referred to the increasingly coherent organisation of the trade unions and the tendency towards industrial unionism, meaning by this term the case where one union covers the whole of an industry as contrasted with the case now usual where a dozen or so craft unions each have members in the same industry. I claimed that this had a sociological as well as an industrial significance. This brings us to the next consideration, namely, the definite political programmes which seek to realise themselves in and through industry. Broadly, these various programmes are covered by the one general term "socialism." This term is used to cover a wide variety of political schemes, ranging from a diluted kind of Government control up to complete State ownership of everything and State direction of pretty well the whole of life, and it includes a number of intermediate hybrid kinds evolved more or less as by-products. The typical forms may be classed as State Socialism, Guild Socialism, Syndicalism, and Anarchism. There is practically only one of these forms that immediately concerns the electricity supply industry, and that is Guild Socialism; but it may be well, for clearness, to define roughly the tendencies of the whole four.

State Socialism is the original and classic form of socialism wherein the "State" itself functions as a fairy godmother, owning everything for the common good, and ministering to everyone's needs as they severally require or deserve or earn (according to the particular scheme under consideration at the moment). The experience of the war exercised a profoundly modifying influence on State Socialism. This "State" ordering of life, even in the limited manner which obtained during the war, disposed of any "fairy godmother" illusion. The workman found that to change the capitalist employer for the State employer was of very doubtful benefit. Hence, through this and other prior influences, a most material modification crept into the schemes, and at length Guild Socialism emerged fully fledged. In this form of socialism there is still State ownership of "capital," and all that "capital" stands for or involves, but each industry is managed, run, controlled, and all else, by the workers. This same dislike of an autocratic State, however, had many years before also found expression among "socialists" in the evolving of *syndicalism*. In this variety of socialism the workers both own the capital and manage and run the whole show—the "State" being consigned to limbo so far as industry is concerned as frankly as was the capitalist. Guild Socialism is, therefore, as it were, a hybrid or half-way house between State Socialism and syndicalism. Anarchism, the last of the well-defined forms, is too theoretical a system to warrant consideration, and by its nature too incoherent ever to become a social force—its final logical expression being, as the term most fitly explains, nihilism.

Now trade unionism, as such, as a whole, is very far indeed from being wedded to any form of socialism. At most it only coquettes with it; it may flirt, indeed, with it to the extent perhaps of almost compromising itself, but it still remains well outside the permanent partnership of a marital union. In a word, trade unions fight shy somewhat of the "State" in any of its manifestations, appreciating dimly that when once even a socialistic state became all-powerful, the trade unions would manifestly tend to become very "small beer" indeed. Of course, in a general and vague sort of way, the trade unionists often indulge in phrase-mongering wherein the "State" is set off as an alternative to the iniquitous capitalist, but by this they by no means intend to commit themselves to all the implications of State Socialism. Coming to the other two forms, Syndicalism has no hold, in so far as directing any policy is concerned, and is indubitably a dwindling factor, while anarchism is altogether outside the field of practical politics. Moreover, these three forms of socialism do not touch industry directly, but aim at altering the *political* machinery of the country, that is, they work from the top, not from the bottom, through industry. But when we come to Guild Socialism, this works through industry, and we have here a force whose incidence on trade unionism may possibly, in time, be very considerable indeed, and which is particularly interesting in connection with the ambitions of the Electrical Trades Union.

Guild Socialism frankly leaves the political machinery almost alone, and sets out to revolutionise society in and through industry. In other words, it seeks to realise its social scheme by means of trade unions. The furtherance of Guild Socialism, indeed, depends entirely, so far as one can see, upon the capture of the trade unions. But for the purposes of Guild Socialism the unions must be reorganised as industrial unions. Now since industrial unions are obviously more powerful than craft unions, this initial part of the programme of Guild Socialism is much in harmony with the immediate ambitions of the leading or dominant trade unions, and organisation of the union on an industrial basis is, as we have mentioned, the declared policy of the E.T.U. This reorganised machinery opens the way for the next step that Guild Socialism urges, viz., "encroaching control" by the employés in the several industries, which again is a proposal entirely in accord with the trade union programme. I do not mean, of course, for an instant that the Electrical Trades Union or any other union has consciously formulated its policy on the lines of Guild Socialism—far from it. I dare say many even of its leaders know little of it, and care less. The union is merely developing itself in its own interests as a trade union, in fact doing what anyone with brains would do in its place who wanted to make his union "Cock of the walk"! But, none the less, the coincidence with the programme of Guild Socialism is worth considering. Another feature I might mention in this connection is the insistence that Guild Socialists place on the necessity of not only the workmen, but the technical, clerical, and supervisory grades being included in the "workers' union." Here again the recent emergency of the Electrical Power Engineers' Association as a solid representative union covering the upper technical staff is of special significance, especially in view of its "understanding" for purposes of offence and defence with the other unions. In a word, there is already in the electricity supply industry very nearly a complete organisation of the workers' side, that is, one fragment of the Guild Socialist's dream. All this, however, has "happened," but not designedly.

The obvious retort to the foregoing is: If it is only an accidental coincidence, what does it matter? This brings us to the fact that all theoretical ideas sooner or later, unless inhibited, work themselves out in practice. Now the present state of unionism in the electricity supply industry is indisputably fertile ground, unless my previous contentions are wrong, for the seeds of Guild Socialism. It will be urged, perhaps, that it is a far cry before we could get to any possible even remote approximation of Guild Socialism. I agree; but there are in the dogmas of Guild Socialism certain lines of thought which are immediately of concern to industry. It must be realised that this form of socialism is diametrically opposed to Fabianism (that is, a working out of ideas by gradually transforming existing institutions, and so on). It is frankly revolutionary. I do not mean this as abuse, but as describing the uncompromising attitude which is a part of its faith. One tenet that immediately concerns the industry is the one dogmatising that the interests of the workers are utterly and for ever irreconcilable with capitalistic industry—that anything which tends to establish peace and working agreement between the two is indefensibly bad, or worse than uselessly postponing that revolution in industry for which every worker should fight to the utmost. Guild Socialism preaches that it is the duty of every worker to widen in every way the breach between capital employer and employe, with the idea of making industry under the present capitalistic system unworkable. Here, then, is an issue which is obviously of vital concern from an industrial point of view. Guild Socialism indeed frankly makes every works an arena wherein its ideas are to be worked out in this fashion, and its everyday programme is to foment discord until all continuance of industry as at present constructed is impossible. The moral of all this is that it is of immediate concern to the electricity supply industry whether or no the unionism related to the industry adopts Guild Socialism as its ideal social theory.

The foregoing indicates, therefore, the way in which definite political movements seek to realise themselves through industry, and how susceptible is the electricity supply industry to such movements, owing to its very special circumstances.

Of the points remaining for consideration, the chief is the incidence of the Whitley Councils as now operating in the industry, and finally, of course, there is the important question whether it is possible to come to any determination of policy in view of the important part which, as a key industry, electricity supply plays in the industrial organisation of the country.

(To be continued.)

ITALY OVERCOMING ITS DIFFICULTIES.

Though Italy does not at present constitute an important British market for electrical and allied material, there is much to interest the electrical manufacturer in the trend of affairs in that country since the war. Labour problems have arisen, more difficult than those which have been faced in this country, and still await a satisfactory solution, although much progress has been made towards a settlement. The high price of coal has diverted attention more keenly than ever to the generation of electricity from water power, great sources of which abound in Italy. They are being utilised on a considerable and a growing scale, but on the most hopeful estimate many years must elapse before their development can produce anything like a revolution in the industrial position of the country. These and other matters are dealt with in the report by the Commercial Counsellor and Commercial Secretary to H.M. Embassy, Rome, which has just been issued by the Department of Overseas Trade (price 1s.).

Railway Electrification.

The economic importance to Italy of its railway electrification schemes has often been explained, and our readers have been made aware of the details of the programme. While little progress has been made in actual construction during the past twelve months, an important step has been taken by placing the project in the hands of a special department of the State railways administration, constituted for the purpose. This department has issued plans for the electrification of 4,500 kilometres, in the proportion of 61 per cent. by the State railways and 39 per cent. by private undertakings. Decisions have been taken as to the system to be adopted, and a beginning has been made with the work.

As to the material required for the execution of this programme, the report does not commit itself to any statement regarding the goods that can be supplied by home manufacturers and those which will be needed from abroad. The dominant factor at the moment in Italian foreign trade is the rate of exchange, and therefore the British commercial representatives justifiably excuse themselves from any analysis of the market requirements and of the methods of business best adapted to it, since the question is not what the country would like to buy, but what it can afford to buy. In a recent report from Turin the Consul states that little trade is being done in British machinery, machine tools, and accessories, owing to the excessively high prices quoted, and that even if the exchange were normal, the cost of British articles would preclude any important business. Theoretically, the effect of the exchange on Italian import trade should be counterbalanced by the advantage to her export trade, of being able to sell at a low price in foreign currency, but in practice this is nullified by the comparatively small amount which she is able to export.

Foreign sellers are demanding more stringent conditions with regard to payment, and cases are reported where cash against documents is asked for in place of the 30 and 90 days' credit which was formerly allowed, and where exporters are even refusing to make consignments on any terms at all. Italian buyers are protesting against the new conditions on the ground that they are not justified by the circumstances, and in some cases have refused to place orders in consequence. The action of the sellers is due in part to the distrust engendered by the recent industrial disturbances. As a general rule it may be said that greater care is required in selecting risks than at a time when conditions are normal, but that if this is exercised, trading with Italy is not more difficult than before the war. In this connection reference may be made to the work of the British Chamber of Commerce in Italy, which, through its extensive local connections, has frequently been in a position to render valuable assistance to British traders.

American and German Competition.

The most important American commodities which during the period under review had been competing with British products were, after coal, metals and metal products, machinery, and scientific instruments. Germany, which formerly came first among the countries with which Italy traded, at present occupies sixth place, with a volume of trade which is one-sixth that of the United States, and one-quarter that of Great Britain. Her principal imports from Italy during the first eight months of 1920 were hemp, silk (raw thrown), and citrous fruits, and her principal exports machinery, iron and steel, dyes, and small hardware goods with which the shops are filled. Articles have appeared in the Italian commercial Press commenting very severely on the post-war German methods of business, and on their disregard of their obligations, as shown in cases of refusal to deliver at the stipulated price. At the same time, it would appear that they are making rapid progress in regaining their position on the Italian market. The value of the machinery which Germany supplied to Italy in the first half of 1920 was equal to that which came from America and nearly three times as great as that coming from the United Kingdom.

Co-operative Movement.

The co-operative movement in Italy continues to extend, and is receiving active support from the Government, in accordance with the view, more than once endorsed by Parliament, that co-operation appears to be the most efficient instrument for promoting production, checking speculation, and establishing satisfactory relations between capital and labour.

The application of the co-operative principle to large industrial enterprises is, however, still at the experimental stage. As has happened elsewhere, it is condemned by the extreme socialists on the ground that it is only another method of putting profits into the pockets of the capitalists. Even more open-minded observers are doubtful of its suitability, at the present moment, in the case of undertakings which require a vast amount of capital and a widespread commercial organisation, both for the purchase of the raw materials and for the marketing of the products. Still, the experiment is being made, the most notable instance being the Italian Metallurgical Co., which owns 16 workshops, including foundries, arsenals, and engineering works, and which is fitting out ships, turning out railway material, and carrying on works costing tens of millions of lire.

Future Prospects.

Exhaustion, disorganisation, and impoverishment are disasters which the war has brought on almost all the combatant nations, and on Italy in a special degree because she was at the outset less well equipped to bear the strain. But the chief obstacle to her recovery is labour unrest.

A special danger arises from the fact that the labour movement in Italy is in the hands of the Communists. There are indications, however, that the constitutional parties, with which the remedy lies and which have hitherto been apathetic, are beginning to organise themselves for resistance.

If to the settlement of the labour question can be added the efficient administration of the carefully considered legislative programme which has been framed to meet the emergency, the future will be clear. Before the war the economic position of Italy was sound and her credit stood high. Her natural resources and advantages, with perhaps the exception of cheap labour, are still what they used to be. Weakened though she is by the efforts which she has made, there is no reason why she should not regain the position which she formerly occupied.

COST OF ELECTRICAL RESISTANCE WELDING.

By L. E. WILSON.

(*Abstract of paper read before the* Liverpool Sub-Centre *of the* North-Western Centre *of the* Institution of Electrical Engineers.)

The installation of electric welding machines has been regarded generally from the point of view that they are machines for special purposes only, and that there must be sufficient work of a specific nature to keep them more or less fully employed. In the majority of cases, in addition to the standard or repetition work for which they were primarily intended, welders may be used for jobbing work with considerable advantage and economy. This is apparent to users of electric welders, but to those who have the matter under consideration it is a point which should bear greater influence on their final decision. There are cases where this does not apply, but they are in the minority.

There is every reason why welders should not be looked upon as machines for special purposes only, but as machines to be installed in a similar manner to lathes, drilling machines, &c., upon which definite operations within the scope of the machines may be carried out, and it would be to the advantage of all engineering works to instal a butt and spot welder as part of their general equipment. The earning power of an electric welder is very much higher than that of the usual machine tools; the period in which the profit earned equalled the capital expended in special cases has been from 3 to 16 weeks, but when welders are engaged for general purposes the period will be much longer.

Seam welders are not so universal in their application, and are usually installed for special purposes only, although great improvements have recently been made, which will increase their sphere of application considerably. It is only recently that seam welders have been made which will weld steel sheets without their having to be cleaned to remove the scale, although without cleaning the speed of welding is reduced. Against this is the saving effected by the material not having to be pickled which, under the best conditions, is not a pleasant process and has to be carried out within a few hours previous to the welding operation.

Where resistance welding can be applied, the cost of manufacturing is reduced considerably, which will subsequently lead to modifications in designs so that as much work as possible will be done on the welders with a corresponding reduction in the cost of the article produced; this results in a greater demand, and although there may not be sufficient work to keep the welders in operation the full number of working hours, to commence with, the periods when the welders are not in use will be reduced automatically. Generally speaking, the larger the size of welder installed, the greater the return on the capital invested. This will be apparent when it is remembered that the actual time required to make a weld varies from a fraction of a second up to, say, one minute for a section of 9 sq. in. Sections of 3 sq. in. have been welded in 5 seconds, and the total time required to place the article on the welder, carry out the operation, weld, unclamp and remove from the machine is 15 seconds. The fastest time for making a similar weld in a blacksmith's fire was six minutes; this was upon a plain rectangular section, but for other sections, whereas the time for electric welding is practically the same, blacksmith's welds take much longer. In one particular case 30 minutes was required to make one weld with highly skilled labour against six minutes for the same section with semi-skilled labour in the case of the electric welder. The cost of making welds of large area on electric welders is about 10 per cent. of that of fire-made welds.

If one examines closely the number of jobs which at the present time are done in a general engineering shop which could be carried out on electric welders at a fraction of the present cost, it will be seen that such machines are necessities and not luxuries. For instance, in one case special joints in tubes cost 19s. 8d. to make mechanically against 10d. electrically, and no maintenance required. Other general jobs are the welding of bolt heads on to stock bar, building up forgings, repairing broken shafts of various descriptions, and other jobs peculiar to any particular work. Say a butt welder were installed at a total cost of £500, after jobs which cost roughly £600 by the usual method have been welded the welder will have paid for itself. A standard spot welder was installed for general work including fixing of stiffening bars on to moulds. It was imperative that there should not be any projections on the inside of the mould; this would have necessitated the use of countersunk headed rivets and screws, whereas by welding the strips on, no special precautions had to be taken. The cost of the welder, including fixing, was approximately £170, and the reduction in labour cost alone was more than 50 per cent. in addition to the saving in rivets. There were no cases of failure due to poor welding. In addition to the reduction in cost of production, there is another important point to remember, that is, the output from a given space is increased.

One of the largest installations of heavy butt welders is engaged on the welding of foundation bands for solid tires. This proposition was an ideal one from a welding point of view, and one which lent itself to systematic organisation. The stock is sheared to a standard length and rolled to the required diameter, the ends of the band being left flat. This is of great advantage, as it facilitates clamping in the welder, and does not necessitate the provision of special blocks for different diameters of bands. The rolling scale is removed from the ends of the material for a few inches to ensure a good contact between the lower blocks and the band. The question whether it is necessary to clean the material on any job resolves itself into whether the cost of such cleaning is lower than the cost of the renewal of contact blocks; in this case it is more economical to clean the ends of the stock. The bands are fed into the machine from one side, placed in position on the lower blocks, the clamps closed, and the ends brought slowly together by means of the hydraulic rams; as the ends come in contact the metal is burnt away until there is contact the full width of the section. When this has taken place, further pressure is applied, the material on either side of the joint heats up rapidly, and then when the correct temperature has been reached, the valve controlling the hydraulic ram is opened and the full pressure applied to the material, and the weld is upset. Then the clamps are opened, the slide returns to the first position, and the band is removed from the welder, the superfluous metal being sheared off immediately, and later the joint is ground. All bands are then placed on a machine and elongated to the correct size, which incidentally tests the weld. As an experiment a 36-in. diameter band was stretched, and the increase in circumference without fracturing was 13 inches.

The average speed of welding 1,000 bands was 40 bands per hour. For a short period 19 bands were welded in 15 minutes. The actual time taken to weld the bands was very small.

The results of tests taken on 20,847 bands showed that 0.28 per cent. were slightly cracked and 0.187 per cent. broken. Of the broken bands, 17 were directly due to defective material; the actual percentage of broken welds was, therefore, equal to .11 per cent. In addition to the elongation test, one per cent. of all bands manufactured is subjected to a shock test; a 60-lb. weight is arranged to fall 18 in. at the rate of 45 strokes per minute for 10 hours. There have not, however, been any failures under this test. Welded bands picked out indiscriminately are submitted to the National Physical Laboratory for test, and the following is the result of one of them:—

"The microscopic examination shows that the sample of weld submitted is of excellent quality. It is quite sound and free from any appreciable quantity of oxide or other inclusion. It is one of the best examples of welding of this kind which has yet been examined in this laboratory."

The actual cost of labour (one operator and one assistant) works out at 1.75 pence per band, and taking electricity at 1d. per unit, the approximate cost for energy per weld of 2.75 sq. in. section equals 0.3d., or a total of 2.05 pence per band, which is many times lower than the cost of ordinary smith's welding. The cost of removing the upset is more than the cost of the weld; the actual cost for labour for trimming and grinding being 2¼d. per band.

There is another item on all welders to which great consideration must be given, that is, the type of contact block to be used. The life of the blocks on band welders is from 40,000 to 50,000 welds, and the surfaces required re-machining every 4,000 welds. This life may seem rather short, but an exceedingly heavy clamping pressure must be used to ensure that there will not be any slipping when the weld is upset. Copper is the best material for making these blocks, as far as electrical properties are concerned, but mechanically it is not good, and this accounts for the comparatively short life of the blocks.

In the case of the welds made when building up forgings or a piece which can be machined easily afterwards, the upset is not of such importance, but when its removal is difficult it must be considered carefully; also it is sometimes necessary for a weld to be produced so that there is no increase in the size of the finished material. In this case the welders are fitted with swages and a trimming box. Welders for making chain and welding wire preparatory to drawing through dies are the chief machines with this attachment.

One of the necessary evils attached to butt welding is the removal of the surplus metal after the weld is made. When the minimum current at which it is possible to make a weld is used, there is considerably more swelling at the weld than with a higher current. This is due to the fact that with the lower current the operation takes longer, and the heat spreads along the metal being welded, consequently when the upsetting pressure is applied, there is a certain increase in area, whereas with a higher current the metal is heated much quicker, and consequently the heat does not spread along the bar, and the increase made is confined to a shorter length, the time required to make a weld varying with the square of the current.

This question of the form of upset is a serious one, and must be considered with every butt welding proposition, as it is sometimes more economical to use a higher welding current for a given section, as by so doing the upset of the weld is much easier to remove than if a lower current were used.

THE LONG-DISTANCE TELEPHONE SYSTEM OF THE UNITED KINGDOM.

Discussion in London.

Dr. J. A. Fleming, in opening the discussion at the Institution of Electrical Engineers on Sir W. Noble's paper, which was abstracted in our last issue, said that it would not have been possible to apply thermionic valves to telephonic purposes if they had not been developed in connection with wireless telegraphy beforehand. He exhibited a number of valves of historic interest, and after pointing out how they differed in construction, said that the author had not mentioned the results obtained over the Chicago-Los Angeles line, which were entirely due to the use of valves. He also missed any reference to oxide-coated valve filaments in the paper, and he asked the author whether the P.O. had made any investigations in connection therewith or with helium-filled valves; the latter had been largely used during the war period. Dr. Fleming mentioned that recently a telephone conversation had taken place between two ships, one being in the Pacific and the other in the Atlantic Ocean, the message having been relayed by means of valves and transmitted partly by wireless and partly overland across the American continent.

Mr. A. J. Stubbs, after referring to the success of the Liverpool-London cable mentioned in the paper, said that the results showed that the Post Office authorities were not asleep; the achievements of their engineers had been great, but they were not appreciated because it was not sufficiently realised what they had done. Their work was not known generally.

Mr. A. Jones, of the Western Electric Co., New York, briefly referred to transmission problems, and explained that the testing equipment of the American Bell system had been standardised to a high degree. He had thrown on the screen a lantern slide showing the transmission gain frequency of a two-wire repeater set, and explained that they now possessed apparatus by the use of which they could determine those curves in commercial service in less than an hour. He was of the opinion that in the near future they would be operating in the U.S.A. trunk telephone circuits of a length of 1,000 miles.

Mr. J. E. Kingsbury read extracts from a memorandum dated 1905, which was issued on the occasion of the inauguration of a certain new telephone line. Attached to the memorandum was a map similar to that in the author's paper, but the significant point was that the 1905 map did not show a single piece of underground cable; a comparison with fig. 10 would indicate the enormous development that had taken place. After pointing out the advantages obtained from the use of underground cable, the speaker recalled that the first standard cable could only be used over a distance of 20 miles, say, between London and Croydon, whereas modern cable with attachments could easily be used between, say, London and Rome, another indication of the advance that had been made. The thermionic valve was a marvellous piece of apparatus, and it would lead to very great results being achieved.

Mr. Ericsson referred to line characteristics and their effect on repeater operation, and thought it was unfortunate that 70-lb. cable had been chosen to produce the curves shown in fig. 4 because the results might be misleading. He showed lantern slides illustrating frequency/impedance curves for loaded 20-lb. per mile cable, and explained how the good differed from the bad curves.

Mr. F. Gill, former chief engineer to the National Telephone Co., showed slides which clearly indicated the effect of loading and of repeaters on the total weight of copper that was required in the case of both overhead wire and underground cable. Other slides showed the carrier circuits and terminal boards used on the New York-Chicago line.

Another speaker, in referring to the difficulties encountered in designing the testing transformers, thought that the telephone repeater transformer and valve could be made a very much better piece of apparatus if it were considered as a whole. In connection with valve design, when studying characteristic curves, they should beware of curves which only gave part and not the whole story. Different characteristics were required according to the conditions under which the valve was called upon to work. For telephone purposes the valve was put to very refined use, and it should be remembered that in that case it was not adjustable and under constant skilled attention as was the case when it was used in a wireless telegraph station.

Sir W. Noble, in briefly replying to the questions asked during the discussion, said that many experiments had been carried out by the P.O. in connection with valves, but he had not referred fully to the subject because other authors had done so already; his object was to describe the long-distance telephone system of the United Kingdom, not the valves used.

Discussion at Edinburgh.

On March 8th, Mr. J. E. Sayers, chairman of the Centre, presiding, Sir W. Noble's paper was read and discussed at Edinburgh by the Scottish Centre of the Institution.

Mr. R. Waring thought that to an old telegraph engineer the paper was of peculiar interest. The early troubles with short lengths of air spaced cables, due to lightning, were a real difficulty at the time, but some of them were due to workmen following the practice which had obtained when gutta percha covered conductors were in general use, *i.e.*, if there was a foot or two to spare, it was left in a coil in the joint box at the foot of the pole. At any rate, it was at places such as those that the speaker had found one or two faults caused by lightning. Throughout the whole range of the work on underground cables, a dogged struggle with difficulties had been waged. Sir William had shown the edifice as it stood to-day, but had left out the scaffolding; while the technical information in the paper would be of value there was the other side which at the moment was of special interest. Scotland had had since 1906 a stable telegraph service to England provided by means of the Edinburgh—Glasgow—London underground cable. They now saw a similar stability in sight for the telephone service. With a stable and prompt service there would surely be marked development in traffic which should belie the author's figures relating to Scotland which showed that Glasgow, with six circuits to London at present, was expected to need twelve only in 1930, as compared with 80 between London and Liverpool. Sir William's officers would require to modify that installation.

Mr. J. R. M. Elliott explained that in recent years improvement had followed on improvement almost before the intermediate stages of construction or installation had had time to reach maturity, and before the comparatively recent process of loading had been developed to anything like its maximum extent. Sir William had shown the marvellous development which would be possible (with minimum expenditure) by the employment of valve amplifiers. At a recent lecture which the speaker had attended in Newcastle (on the properties of the thermionic valve) the lecturer complained of the want of rigidity in valves of British manufacture, and expressed the opinion that modern German-made valves were much superior in the matter of rigidity. If that was the case it behoved British manufacturers to lose no time in attending to that serious defect. The present trunk centres had grown up by degrees and through force of circumstances had become situated in large towns. In adopting the most economical lay-out of route, new trunk centres might have to be established, but in some cases they might not coincide with the large towns as in the past, and might actually be thrown into country areas. With reference to the temporary repeater station installed at Leicester, it seemed to be unfortunate that a special effort could not have been made to provide the buildings at Northampton and Derby in time for the completion of the cable. Temporary expedients, particularly in the matter of premises, had nowadays a tendency to become more or less permanent and, so long as it was possible to carry on, the question of efficiency or otherwise was apt to fall into the background when the costs of new premises were under consideration. Sir William made no reference to the insulation resistance of cables, rather an important matter; he might have had some good reason for that omission, but in circuits such as were shown in fig. 10 was it necessary to maintain any minimum standard of insulation for such circuits?

Mr. W. Wood said how unfortunate it had been that merely through ignorance certain sections of the Press and public had recently so unjustly complained about the telephone system generally. As a railway engineer, the speaker probably worked as closely with the Post Office engineering department as anyone, and he took that opportunity of saying that, considering the most difficult conditions that the Post Office engineering staff had had to contend with owing to the war, their achievements in overcoming difficulties and keeping the telephone system going as they had done had been nothing short of marvellous. Serious attention would have to be given by Post Office and railway engineers to inductive interference from power circuits, especially in view of the development of high-power overhead transmission in various parts of the country which would take place in the near future. In America the question had been gone into most thoroughly, and a committee had reported in the greatest possible detail and recommended rules for the construction and operation of power and communication lines for the prevention or mitigation of inductive interference. Close co-operation would be required between telephone and power engineers, and unless definite instructions and rules were recognised by both, the problem would be well nigh insoluble. As in the case of disturbance from neighbouring telephone and telegraph circuits, which the author had stated had to be treated to suit varying conditions, so would different conditions obtaining on power lines of different formation and loads have to be separately considered, and the special methods of transposing agreed upon between both parties. Residual voltages and currents were a principal cause of inductive interference, and it was interesting to notice the effect of wave shape on interference. Wave shapes on different power systems in practice were found to have very wide variations; an unfavourable wave shape, that was, one having a high proportion of harmonics, was most likely to make telephone circuits inoperative, pointing to the importance of strict attention being given to the design of machinery. At the present time it was almost impossible to tackle the problem satisfactorily unless rules were laid down. The Post Office had a research department of very high standing, and that organisation had been set up to deal with matters of that kind.

Mr. J. D. Taylor pointed out that in 1896 Edinburgh was connected to the outer world by eight long-distance telephone circuits; in 1912 the number of such circuits had increased to 97; and in 1920 to 164 circuits carrying about 8,000 long-distance calls per day. In spite of that heavy load of long-distance traffic, in addition to the large number of local calls, 99 per cent. of all telephone calls which originated at Edinburgh were effected without delay. The speaker exhibited two drawings showing the growth of the telephone service in the East of Scotland. The following comparative details of the long-distance telephone service of the United Kingdom indicated how the service had grown: In 1898 the number of working trunk circuits was less than 1,000; to-day it was nearly [illegible],000. The mileage of trunk circuits in 1896 was less than 50,000, but was nearly doubled in the two years from 1896 to 1898. It had been increased by 15 times between 1896 and 1920; from 1898 to 1920 the increase was eight times, and the total mileage was now nearly 450,000. The increase in the average value of calls between 1898 and 1920 had been one and a half times. The revenue from trunk circuits in 1896 was about £130,000 per annum; it was now £1,860,000 per annum. The number of trunk calls had risen from 5,000,000 in 1898 to between 50 and 60 millions to-day. With stable, almost fault-free underground telephone loops, it should be possible to provide satisfactory call, or service circuits, by superimposed telegraph circuits in cases where the very costly and important main circuits were loaded with revenue traffic.

Mr. Hart, referring to Mr. Ellio[illegible]'s remark about German valves, said that the glass work in the German valves was of a very high order, perhaps better than anything we could do, but as regarded the efficacy of the valves, he believed that we could produce valves in this country that were equal to any produced in the world. Soon after the armistice Sir William Noble sent him across to Cologne. They heard that the German administration had set up some very wonderful telephone circuits at Constantinople, Vienna, Berlin, Brussels, and in France, and had linked them all up by some very wonderful circuits which was effected by means of some very fine telephone repeaters, of which one was said to be stationed at Cologne. He went to Cologne, and with the very kind assistance of the officer commanding there brought back the important parts of that German telephone, and they examined them in London. They found they were a little bit worse than their own. The British Flying Corps had seen some very fine samples of valves, but when they were compared with the valves which were being produced in this country at the rate of thousands per day by several firms, the German valves were found to be in no way superior to British ones except that the glass blowing was certainly admirable. In Sir William's table referring to a test of an underground telephone cable, the leakage factor was given as "unreliable" at the high frequencies. The speaker said he had something to do with these tests (although he was unaware that they had been put down as unreliable), and he explained that the apparatus with which the tests were made was the best apparatus that could be obtained in England or anywhere. At 30,000 the figures would have been negative, that was to say, showing an insulation which had a negative value.

Sir William Noble, in briefly replying to the discussion, explained that the German valve at first sight looked a first-class article, but on further examination and test it was found not to be so good as their own, although the glass was better. They would try, if possible, to get repeater stations in or near towns, because the facilities were much greater, and it was much better for the staff to be near towns. In connection with all the development of the telephone repeater and so forth, the Post Office would not be called upon to pay a penny piece in royalty, because its own officers had pretty well anticipated anything which had been done.

THE SAFEGUARDING OF INDUSTRIES.

The following are the proposed ways and means resolutions which have been presented to Parliament:—

Resolution I.—That for a period of five years from the passing of an Act for giving effect to this resolution there shall be charged on any of the following articles imported into Great Britain or Ireland a Customs duty of an amount equal to 33⅓ per cent. of the value of the article, that is to say:—

(*a*) Optical glass and optical elements, whether finished or not, microscopes, field and opera glasses, theodolites, sextants, spectroscopes, and other optical instruments.

(*b*) Beakers, flasks, burettes, measuring cylinders, thermometers, tubing, and other scientific glassware and lamp-blown ware, evaporating dishes, crucibles, combustion boats, and other laboratory porcelain.

(c) Galvanometers, pryometers, electroscopes, barometers, analytical and other precision balances, and other scientific instruments, gauges and measuring instruments of precision of the types used in engineering machine shops and viewing rooms, whether for use in such shops or rooms or not.

(*d*) Wireless valves and similar rectifiers, and vacuum tubes.

(*e*) Ignition magnetos and permanent magnets.

(*f*) Arc-lamp carbons.

(*g*) Hosiery latch needles.

(*h*) Metallic tungsten, ferro-tungsten and manufactured products of metallic tungsten and compounds (not including ores or minerals) of thorium, cerium and the other rare earth metals.

(*i*) All synthetic organic chemicals (other than synthetic organic dyestuffs, colours, and colouring matters imported for use as such, and organic intermediate products imported for their manufacture), analytical reagents, all other fine chemicals and chemicals manufactured by fermentation processes;

including any articles comprised in any list which may from time to time be issued by the Board of Trade for defining the articles which are to be taken as falling under any of the general descriptions set out above.

Resolution II.—There shall be charged on any of the following articles imported into Great Britain or Ireland, in addition to any other duties of Customs chargeable thereon, a Customs duty of an amount equal to 33⅓ per cent. of the value of the article, that is to say:—

Articles of any class or description in respect of which an order by the Board of Trade has been made under any Act of the present Session for giving effect to this resolution, if manufactured in whole or in part in any of the countries specified in the Order, or deemed to be so manufactured.

Any such Order as aforesaid may be made on the ground that articles of the class or description in question are being sold or offered for sale in the United Kingdom:—

(*a*) At prices below the cost of production thereof; or

(*b*) At prices which, by reason of depreciation in the value in relation to sterling of the currency of the country in which the goods are manufactured, are below the prices at which similar goods can be profitably manufactured in the United Kingdom;

and that by reason thereof employment in any industry in the United Kingdom is being or is likely to be seriously affected.

For the purposes of this resolution, "cost of production" in relation to goods of any class or description means the current sterling equivalent of:—

(*a*) The wholesale price at the works charged for goods of the class or description for consumption in the country of manufacture; or

(*b*) If no such goods are sold for consumption in that country, the price which, having regard to the prices charged for goods as near as may be similar when so sold or when sold for exportation to other countries, would be so charged if the goods were sold in that country.

ARTIFICIAL ILLUMINATION FOR KINEMATOGRAPHY.

By J. C. ELVY, A.M.I.E.E.

(*Abstract of paper read before the* Illuminating Engineering Society.)

There are a number of points to be considered in the lighting equipment of a kinema studio. The essential factors are the actinic values of the various lighting units available, the amount of electrical energy required to operate them, the initial cost of the equipment, and the cost of maintenance.

The first desiderata to be considered are the illumination, its manipulation, and the photographic facilities. Then comes the secondary question of housing, which is a constructional engineering job.

What we have lacked in this country is a sufficiency of efficiently designed and equipped studios, the illumination equipment being mobile in every way, with flexibility and ease of control. The amount of electricity demanded may reach a figure too high for ordinary networks, necessitating new cables or special generating plant on the premises.

Only those promoters who attack this question boldly on broad, sound lines, by obtaining the advice and guidance of experts in each branch of the industry can hope to hold their own.

Eyesight Troubles in Kinema Studios.

There seems to be a general impression that the main source of eyesight trouble in studios, when it occurs, is the exposure to sources of very great intrinsic brilliancy. It is possible that the strong ultra-violet component in some lights, which is highly desirable from the photographic standpoint, may accentuate a tendency to inflammation of the eyes, as it has been remarked in other processes, *e.g.*, in arc-welding, &c. Inflammation or scorching of the skin which accompanies eye-irritation in some cases is also a well-known result of excessive exposure to ultra-violet light. Again, prolonged exposure to light of a peculiar colour may lead to subsequent derangement of colour vision.

It is impossible for artistes to act naturally under the blinding glare of points of high intrinsic brilliancy.

I understand that a film production studio does not come within the scope of the Factory Acts. In one particular case where I advised on a scheme, I considered it the safest policy so to frame my specification that all requirements of the

Factory Acts were complied with, including safeguards against fire risk, and also risk of shock or burns to persons, which may conceivably arise from trailing cable without adequate protection.

Apart from the tragic side of this abundance of light, it is uneconomical for black and white work, a great deal of electricity being wasted in the photographic sense.

A point of very great importance in the lighting of kinema studios is the distinction between visible and ultra-violet light. For photographic purposes, that is, for actinic rays, the visual light is practically of no value as a guide. From the photographic standpoint it is desirable to select an illuminant with a strong ultra-violet constituent, a certain amount of which is necessarily absorbed by the camera-lens. All varieties of ultra-violet light are not equally injurious, and it would be a useful inquiry to ascertain whether the rays which are chiefly needed from a photographic standpoint fall within the range of wave-length that is liable to cause eye trouble.

Dr. Mees, the director of research of the Eastman Kodak Co., remarks that for kinematograph work it is an advantage to use for ordinary (photographic) materials, light of an average wave-length as near as possible to 400 millimicrons. He gives the photographic efficiency of the enclosed arc as 62 per cent.; flame arc, 52 per cent.; mercury vapour (not quartz type, quartz is transparent to ultra-violet rays), 47 per cent.

The 220-volt arc seems radically different in many of its properties from the 110-volt enclosed arc. From the standpoint of speed 220-volt enclosed arcs were considered the best in commercial use in 1915 for photographic work not involving colour-quality. Tests appear to have shown that the enclosed arc was four times as powerful as the open arc, using ordinary carbons, and gave at least twice as much photographic light as the open lamp using white flame carbons.

The Lighting of Scenes in Studios.

As a rule the three-sided enclosure in which the piece is acted has a greater width at the front, facing the operator, so that the two enclosing sides slope outwards. Masses of lights are arranged at the front on either side of the stage. It may also be desirable to supplement this front lighting by overhead units. In some cases concealed lights towards the rear of the stage are needed to show up the background.

Much remains to be done in the design of special reflectors and shades, and in the selection of the positions of light, which may have a considerable effect on the energy consumption. The reflectors at present provided have usually a very simple contour, and much light may escape outside the actual boundary of the stage where it is needed. It is conceivable that by using a polished reflector, giving a narrower beam, and then subsequently screening this light, the desired reduction in intrinsic brilliancy might be gained, without efficiency being unduly sacrificed.

One of the chief objections to be taken to modern lighting methods in studios is the use of "flooding" lights, which impair the artistic qualities of the film-picture. Extreme black and white contrasts are fatiguing to the eyes. The "floodlights" used to produce these effects involve the concentration of light in an almost parallel beam, as in a searchlight. It is obviously better to get the desired result by accentuating the actinic value rather than by concentration of great amounts of relatively inefficient visible energy.

Wasteful illuminants involve unduly large generating plant and excessive consumption of energy. Maintenance costs of illuminants must also be considered (*e.g.*, mercury vapour lamps require no recarboning, open arcs require recarboning at more frequent intervals than enclosed arcs, &c.).

The suggestion that illuminants using white lights should be covered with blue glass cannot be approved. Such screening involves a loss in efficiency. One merely absorbs a considerable amount of visible light, and some ultra-violet. What is desirable is to produce a source which itself emits radiation of the requisite quality.

Photographers generally agree that a uniform white sky—Nature's own diffuser—is the ideal condition. Therefore, why not, when producing exterior scenes inside a studio, imitate diffused daylight as closely as possible, or for a room scene in daylight, why should not the illumination appear to come through the window, with a certain amount reflected from the ceiling or room? Not as in some cases, without any ceiling, judging by the "glare" overhead. With a uniform white sky soft pictures are obtained.

Wolfram in Queensland.—The Commonwealth Government is being urged to take over the Thermol Co.'s properties in the district of Cairns, Queensland, in order to safeguard the supply of wolfram. At a recent meeting of the Townsville Chamber of Commerce, Mr. S. M. Hopkins said that wolfram was essential for munition making, and it was estimated that to keep the company's plant in working order would only cost about £2,000 per annum. There was no doubt about the necessity for tungsten during the war, and it was also a great commercial necessity. The Chamber passed a resolution in favour of Federal assistance, and other commercial bodies have done likewise.

IMPORTS OF NEW ZEALAND.

The following table shows the values, and in certain instances the quantities, of electrical and allied goods imported into New Zealand in 1919, according to the recently issued official trade returns. The figures for 1918 have been given for purposes of comparison, and notes of increases or decreases added.

		1918	1919	Inc. or dec.
Electric batteries and cells.—				
Total	£	30,000	43,000	+13,000
From United Kingdom ...		1,000	6,000	+ 5,000
,, United States		28,000	36,000	+ 8,000
Generators, motors and transformers.—				
Total	£	61,000	103,000	+12,000
From United Kingdom ...		20,000	34,000	+14,000
,, United States		39,000	68,000	+29,000
Insulated cable and wire.—				
Total	£	39,000	122,000	+83,000
From United Kingdom ..		12,000	70,000	+58,000
,, United States		1,000	9,000	+ 8,000
,, Japan		25,000	40,000	+15,000
Electric lamps.—				
Total	£	65,000	77,000	+12,000
From United Kingdom ...		16,000	16,000	—
,, Netherlands		26,000	21,000	− 5,000
,, Japan		2,000	3,000	+ 1,000
,, United States		20,000	36,000	+16,000
Carbon in blocks.—				
Total	£	11,000	23,000	+ 9,000
From United Kingdom ...		2,000	8,000	+ 6,000
,, United States		8,000	14,000	+ 6,000
Other electrical material.—				
Total	£	136,000	191,000	+55,000
From United Kingdom ...		21,000	41,000	+20,000
,, United States		102,000	135,000	+33,000
,, Japan		9,000	8,000	− 1,000
Electricity meters.—				
Total	No.	9,700	6,000	− 3,700
	£	19,000	12,000	− 7,000
From United Kingdom .	No.	1,890	1,200	− 690
	£	7,000	3,000	− 4,000
,, Switzerland	No.	496	800	+ 304
	£	457	1,140	+ 683
,, United States	No.	7,337	3,900	− 3,437
	£	11,800	7,750	− 4,050
Recording and testing instruments and meters.—				
Total	£	4,000	6,000	+ 2,000
From United Kingdom ...		2,000	3,000	+ 1,000
,, United States		1,000	3,000	+ 2,000
Telephones and accessories.—				
Total	£	42,000	112,000	+70,000
From United Kingdom .		7,000	14,000	+ 7,000
,, United States		29,000	98,000	+69,000
Copper wire, bare.—				
Total	£	15,000	26,000	+11,000
From United Kingdom ..		2,000	21,000	+19,000
,, Japan		6,000	2,000	− 4,000
,, United States		7,000	2,000	− 5,000
Iron telegraph and telephone wire.—				
Total	tons	346	141	− 205
	£	15,000	5,360	− 9,640
From Canada	tons	250	136	− 114
	£	10,800	5,030	− 5,770
,, United States	tons	93	5	− 85
	£	4,000	330	− 3,670

REVIEWS.

A Text Book of Electrical Engineering. Translated from the German of Dr. Adolf Thomaelen by George W. O. Howe, D.Sc. Pp. 482; 482 figs. Fifth edition. London: Edward Arnold. 1920.

Thomaelen has been a favourite with English students ever since the first edition (translated from the second German edition by Howe) appeared 13 years ago. The translator told us then that his reason for undertaking the work was the demand of his own students at the Central Technical College for a text book on electrical engineering. He had himself intended writing such a book, but when his attention was drawn to Thomaelen's he saw that his own book would necessarily have to cover much the same ground, and for this reason decided to translate the existing book, making, however, such amendments as seemed advisable to suit the requirements of his own classes. The success of his translation is proved by the fact that we have now the fifth edition.

The number of books on the market and still appearing on this subject is very large, but beyond a few standard works, among which Thomaelen-Howe must be reckoned, only a limited number are of real merit. Some are even in a sense misleading, because they give the student an impression that the first and foremost object of study is the passing of examinations. Especially in recent publications one comes across books in which the text is prominently illustrated by examination questions set by various examining boards, and the solutions are given. Some of the questions are rather abstruse and not likely to arise in practical work, but they look learned and a correct solution will, therefore, carry high marks in a degree examination. The author and translator of the work under review had certainly no intention to bribe the student by showing him an easy way of passing examinations, but to give him a thorough understanding of fundamental principles, and to show him how these should be applied in practical work; in fact, to cultivate the faculty of thinking "electrotechnically," as Thomaelen calls it. Such thinking necessarily involves a certain amount of mathematical reasoning, but the mathematics used do not go beyond the more simple forms of the calculus, and these are set out so clearly that the reader will not have much difficulty in following them.

The desire to make all abundantly clear has led author and translator (more especially in the early pages) into a method of treatment which some readers might characterise as verbose, but from the student's point of view this kind of verbosity is no fault. A beginner would rather have the same idea explained to him in two or three different ways than merely once in a short passage which he has to read over and over again before he can puzzle out and grasp the real meaning. To the experienced engineer certain conceptions, with their mathematical expressions, and possibly their mechanical analogies, have become a kind of second nature; he habitually forms mental pictures of the natural phenomena such expressions represent. To him, what he might term long-winded explanations may seem superfluous, only increasing the bulk of the book. Not so the student. He is grateful for the long-winded explanation, provided it is clear and relieves him from the mental worry of having to puzzle out the inner meaning of some elegant mathematical statement. As an example, we may take the demonstration that the area of the hysteretic loop represents energy. A mathematical physicist of the elegant and terse school after having developed the formula

$$dW = \frac{Al}{4\pi} \times HdB$$

would simply tell us that the integral of dW extended over the whole cycle "of course" represents ergs required to carry the volume of iron of Al cubic cm. through a complete cycle. Thomaelen is more considerate; he shows on p. 77 four parts of the same hysteretic loop with the areas representing energy shaded, and thus enables the student to piece the parts together and satisfy himself that the statement is true. It is this careful attention to and consideration for the mental capacity of the beginner which makes the book a favourite with students. Incidentally, it should be noted here that at the end of the chapter the "figure of loss" is given for stampings as 3 to 4 watts per kg at 10,000 induction and 50 frequency. This may have been correct at the time of the first edition, but it is too high for the modern brands of alloyed iron.

The first four chapters deal with fundamentals more from the physicist's than the engineer's point of view. They contain the usual statements and explanations concerning current, electromotive force, Ohm's law, Kirchhoff's rules, Wheatstone's bridge, Joule's law, primary cells, standard cells, accumulators, forces between magnets and conductors, self-induction, and cognate matters. Chapter V is devoted to units in the c.g.s. electromagnetic system and their relation to practical units, but c.g.s. units in the electrostatic system are only briefly mentioned. In the following chapter we come to the subject of the book from a more specifically engineering point of view, such as armature windings, field magnets and excitation, commutation, special types of dynamos, efficiency, regulation and temperature rise.

Chapter X is an introduction to the study of alternating currents, whilst the following chapter deals rather too briefly with transformers. Upon this follows an elementary chapter on alternators, but a more detailed theory is given in the following chapter. Here the translator has added an interesting section (101 on p. 320) dealing with polar leakage. He shows how the leakage field is altered on load, and gives a simple graphic method for finding the correction which must be made in the O.C. characteristic if this is used in the investigation of the condition of the machine on load.

In Chapter XIV we come to the graphic theory of alternators supplying power to infinitely strong bus bars. For a machine without armature losses the locus of torque and power is a semi-circle and their magnitude depends on the point of intersection between the vector of induced e.m.f. and this semi-circle. The author shows how, by reason of resistance and other losses, the construction must be modified. Since there are losses the input must be greater than the output. We thus get two curves, both still circular but of different radius and position. The reasoning is admirably clear, and the mathematics quite simple. A graphic method is also shown (p. 327) for finding the locus curve (this time not a circle) for the current.

Next follow sections in which synchronising power, phase swinging, and parallel operation, V curves, dampers, and cognate subjects are discussed.

The treatment of synchronous motors is rather scanty, only eight pages being devoted to this, but in the next chapter (XVI) we come to a very detailed discussion of the asynchronous motor. This is mainly descriptive, and since the conception of concatenated currents presents some special difficulty to the student, we find the author once more reverting to the principle of generous diffuseness already mentioned. Having thus helped the student over initial difficulties the author, in subsequent chapters dealing with detailed theory, becomes more terse in his treatment. Readers will be pleased to see that the translator has adopted the symbols recommended by the International Electrotechnical Commission and also a counter-clockwise rotation of vectors. One wishes that all authors would do the same. The habit of many authors to use any symbol for which they may have a fancy and let their vectors rotate clockwise imposes an unnecessary mental effort on the reader, and if in addition an author mixes up inches and centimetres, grams and pounds, speed in feet per minute and in metres per second, British thermal units and calories, degrees F. and degrees C., the study of a book in which such heterogeneous units are used becomes anything but a pleasure. It is unfortunately the case that many professional men, teachers as well as practical engineers, cling even nowadays tightly to the so-called English system of units, and to please these persons an author may have an excuse for using these units in his book, but he has no excuse for avoiding the metric system. He should use it throughout, and if he wants to please readers of the old school, add the equivalent in English measure in brackets. Then the person accustomed to the metric system will not be troubled by the additional figures, because being distinguished by brackets he can easily ignore them. The use of English units is not so objectionable in other branches of engineering (provided the metric equivalents are added in brackets to facilitate reference to Continental works), but electrical engineering being based on the c.g.s. system, the use of the metric system becomes imperative and mixing this with English units intolerable. In this respect no fault can be found with the translator. He has wisely abstained from making his book more palatable to the old school by substituting English for metric measure.

In Chapter XVIII we come to the circle diagram; first in its simple form commonly known as the Heyland circle, and later in the improved form due to Osanna. The latter is more accurate, but when only one motor is in circuit the accuracy of the original diagram is quite sufficient for practical purposes. The case is different when we have to deal with cascade working. The Heyland circle becomes inadequate, and thus on the Continent, where variable speed motors for general use (and especially for electromotives) have found considerable application the more accurate graphic treatment by the Osanna circle has been adopted. Although at the present time there does not seem to be in this country any large demand for cascade motors there is no knowing what the future may bring, and for this reason as well as for the scientific interest generally, the translator has done well to include also this subject in the English edition.

In Chapter XIX we find a general explanation of the single-phase induction motor based on the Ferraris conception of two magnetic fields rotating in opposite sense, and this is followed by a discussion of various types of single-phase commutator motors, such as the straight series, the repulsion motor, and the Winter-Eichberg motor. Chapter XX deals with converters, including the type invented by La Cour.

In an appendix a brief exposé is given on the use of the symbolic method for solving alternating current problems. This book of nearly 500 pages, and as many diagrams conveniently placed to the text, is not, and does not pretend to be, a book for the designer; it is simply a hand book of electrical engineering, but a very useful one, especially to the student, since both as regards the matter it contains and the manner of treatment, it will give him a firm grasp of fundamental principles.

Gisbert Kapp.

Telephony Without Wires. By Philip R. Coursey, B.Sc. Pp. xx+414; 249 figs. London: The Wireless Press, Ltd. 1919. Price 15s.

The author of this work has quite a good excuse for putting yet another wireless text book on the market. He claims that a book dealing fully with wireless telephony as distinct from telegraphy meets a requirement of the day. There can be no doubt that the contents justify its appearance on the market, for the book is well compiled, and forms a very interesting account of up-to-date progress in this rapidly developing application.

A particularly valuable feature is the very complete bibliography of references to original papers and articles covering in all 695 items. A little revision is, however, required here as some duplication of entries exists, as, for instance, numbers 313 and 352. There is very little in the text to invite criticism, though possibly unmerited prominence is given to some methods or systems for which too much has been claimed by their authors. A particularly interesting chapter deals with the important subject of interference prevention, and elimination of static troubles, in which the various methods that have been proposed or tried up to date are clearly explained. The omission, however, of the rather obvious scheme for reducing static interference by the use of separate aerials for transmitting and receiving and making the receiving aerial much less lofty whilst adding to the spread and height of the transmitting one, is notable. A loop or frame aerial for reception combined with a lofty aerial of the heavily radiating type for transmitting is a development on similar lines.

The book contains some 400-odd pages, and is well and profusely illustrated with 219 well prepared figures. It can be recommended for the use of the student and for general information.

J. E. T.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

8,635. "Testing insulation of electrical materials." C. C. Needham and J. Noddings. March 21st.

8,661. "Earthing-clip for electric conductors." J. E. Franks, C. G. Maisey, A. E. Read and Walsall Hardware Manufacturing Co., Ltd. March 21st.

8,663. "Electric bells." J. T. Wright. March 21st

8,683. "Telephone-call recorder." H. E. Smithers. March 21st.

8,689. "Sparking plugs." A. E. Heath. March 21st.

8,713. "Ignition systems for internal-combustion engines." R. A. H. Lewin March 21st.

8,715. "Electric arc-welding apparatus." L. C. R. Marks (Siemens Schuckertwerke). March 21st.

8,725. "Sparking-plug testing-device." F. M. Denton. March 21st.

8,730. "Means for generating continuous electric oscillations." C. S. Agate and P. W. Willans. March 21st.

8,731. "Means for supporting electrodes of thermionic devices." W. J. Picken and H. J. Round. March 21st.

8,736. "Electric storage or secondary cells." F. Vogel. March 21st.

8,744 "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. March 21st. (United States, March 29th, 1920.)

8,758. "Retaining-devices for overhead trolley collecting wheels of electric tramways." J. Ellis and R. F. Ellis. March 22nd.

8,775. "Electric starters for internal-combustion engines." Z. R. Del'a Veneria. March 22nd. (Italy, March 23rd, 1920.)

8,780. "Electric-fuse holders." J. Ellershaw. March 22nd.

8,798. "Automatic regulation of internal-combustion engine driving an electric generator." British Arc Welding Co., Ltd., and H. Ogden. March 22nd.

8,802. "Dispatch of electric messages." E. Oldenbourg. March 22nd.

8,822. "Radial-type commutators for dynamo-electric machines." Metropolitan-Vickers Electrical Co., Ltd., and G. A. Juhlin. March 22nd.

8,823. "Rheostats." N. G. Langrish and Metropolitan-Vickers Electrical Co., Ltd. March 22nd.

8,832. "Electric relays for wireless telegraphy." P. Boucherot. March 22nd. (France, March 24th, 1920.)

8,862. "Dynamo-electric machines." Sachsenwerk Licht-und Kraft Akt.-Ges. March 22nd. (Germany, March 22nd, 1920.)

8,872. "Sparking-plugs." T. Morrin. March 22nd.

8,875. "Electrically-controlled safety cranking-device for high-speed engines." G. T. Craker and H. Ward. March 23rd.

8,876. "Automatic electric time switch." A. J. Wheeler. March 23rd.

8,883. "Renewal of filaments in metal-filament electric lamps." A. H. S. Colebrook, S. Coxon and W. A. Williams. March 23rd.

8,943. "Process for manufacture of photo-electric cells." T. W. Case. March 23rd.

8,944 "Photo-electric cells." T. W. Case. March 23rd.

8,948. "Portable switchboard." C. C. Berryman and J. McCloskey. March 23rd.

8,955 "Engine starters." V. Bendix. March 23rd. (United States, March 21st, 1919.)

8,962. "Circuit making and breaking device." E. Schattner. March 23rd.

8,971. "Bobbins for electro-magnetic apparatus." M. L. Magneto Syndicate Ltd., and E. A. Watson. March 23rd.

8,973. "Electric-lamp holder." E. Kemper. March 23rd. (Germany, September 13th, 1920.)

8,974 "Electric meters." W. Lawson. March 23rd.

8,981. "Starting-devices for electric motors." British Thomson-Houston Co., Ltd., and J. Sugden. March 23rd.

9,007. "Auxiliary spark-gap devices." P. Bernard. March 23rd. (France, January 7th.)

9,017. "Electric switches." D. McGregor. March 23rd.

9,024. "Manufacture of storage batteries." H. Wade (Hazelett Storage Battery Co.). March 23rd.

9,033. "Accumulator cases for motor-cycles, &c." R. H. Playfoot. March 24th.

9,039. "Electric heating resistance elements." H. J. Dean-Osgood. March 24th.

9,046. "Sparking-plugs." H. B. Cornish. March 24th.

9,080. "Portable hand-operated electric coal-drilling machines." J. G. Henderson and T. Hindson. March 24th.

9,089. "Electric insulators and insulating material." W. A. Fairgrieve and A. Reyrolle & Co., Ltd. March 24th.

9,095. "Electrically-driven trollies, tractors, &c." H. J. Carey and Roadcraft, Ltd. March 24th.

9,105. "Magneto-electric generators." M.-L. Magneto Syndicate, Ltd., and E. A. Watson. March 24th.

9,107. "Casings for voltmeters, ammeters, &c." E. W. P. Lines and Tubes, Ltd. March 24th.

9,125. "Electro-magnets." Relay Automatic Telephone Co., Ltd., and W. D. Edwards. March 24th.

9,132. "Carrying out electro-chemical reactions." H. Plauson (née G. Hildenbrandt). March 24th.

9,132. "Carrying out electro-chemical reactions." H. Lauson (née G. Hildenbrandt). March 24th.

9,133. "High-frequency cable telegraphy." H. A. Gill (Deutsche Telephonwerke Ges.). March 24th.

9,139. "Signalling for mines." M. F. Bell. March 24th.

9,143. "Electrical apparatus for disinfecting, diffusing, and heating air." W. E. Siday. March 24th.

9,146. "Electric regulating systems." British Thomson-Houston Co., Ltd. (General Electric Co.). March 24th.

9,155. "Sparking-plug." J. R. Watkins. March 24th.

9,176. "Holders for electric lamps." F. O. Monkhouse and G. L. Tate. March 24th.

9,180. "Electric oscillation generator." L. Levy. March 24th. (France, March 29th, 1920).

9,185. "Employment and production of polyphase currents for wireless telegraphy, telephony, &c." J. H. Whittaker Swinton. March 24th.

9,18[illegible] "Regulating degree of vacuum in X-ray tubes, &c." British Scientific Instrument Research Association, Sir H. Jackson and A. J. Philpot. March 24th.

9,191. "Heating material in electrical furnaces." F. C. R. Mark (Aktiebolaget Kvafveindustri). March 24th.

9,193. "Electric motors." R. Minicus. March 24th.

9,195. "Process for suppressing upper harmonic anode currents in metal vapour rectifiers." Akt.-Ges. Brown, Boveri et Cie. March 24th. (Switzerland, April 1st, 1920.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1914.

13,335. "Electric relays." Soc. D'Electricite de Paris. June 21st, 1913.

1915.

16,364. "Arc lamp electrodes." Planiawerke Akt. Ges. fur Kohlenfabrikation. December 31st, 1914.

1919.

20,537. "Electric fuses." Simplex Conduits, Ltd., L. M. Waterhouse, and H. F. McLaughlin. August 21st, 1919. (159,524.)

23,4[illegible]. "Insulators for overhead transmission lines such as telegraph and telephone line wires." E. A. Chantler. September 25th, 1919. (159,528.)

26,433. "Electric lamp holders or attachments." F. Shaw. October 28th, 1919. (159,544.)

26,444. "Fastening or attachment device for use in connection with lamps, generators, and other containers or members." Stamping and Spinning Works, Ltd., and A. J. Cooper. October 28th, 1919. (159,545.)

29,141. "Thermionic devices." H. M. Dowsett. November 22nd, 1919. (159,564.)

29,276. "Electric resistance switches." G. K. Jensen. November 24th, 1919. (159,570.)

29,395. "Magneto-electric machines." E. A. Watson. November 25th, 1919. (159,572.)

29,521. "Electric switches." W. F. M. Rose. November 26th, 1919. (159,573.)

29,523. "Automatic switching mechanism for use more particularly in telephone or like systems." Automatic Telephone Manufacturing Co., Ltd. (Automatic Electric Co.). November 26th, 1919. (Addition to 151,698.) (159,574.)

29,740. "Automatic or semi-automatic telephone systems." Automatic Telephone Manufacturing Co., Ltd. March 13th, 1919. (140,367.)

29,746. "Electric water-heating apparatus." A. Verdun. November 28th, 1919. (159,591.)

29,820. "Time element switch devices for controlling electric circuits." British Thomson-Houston Co., Ltd. (General Electric Co.). November 29th, 1919. (159,598.)

29,935. "Directional wireless receiving systems." E. F. W. Alexanderson. April 18th, 1919. (142,074.)

29,936. "Electric signalling systems." British Thomson-Houston Co., Ltd. (General Electric Co.). December 1st, 1919. (159,603.)

29,978. "Magneto starters." J. R. M. Stanfield. December 1st, 1919. (159,607.)

30,047. "Microphones." H. J. Palmer and Telephone Manufacturing Co., Ltd. December 2nd, 1919. (159,609.)

30,134. "Electric switches." R. C. S. Jamie. December 3rd, 1919. (Cognate application, 23,282/20.) (159,614.)

30,158. "Apparatus for remagnetising magnetos." S. Wood, J. Hague, and T. Hague. December 3rd, 1919. (Cognate application 11,445/20.) (159,616.)

30,185. "Plugs and sockets for electrical fittings." E. Jones. December 3rd, 1919. (159,618.)

30,212. "Cores of electrical transformers and like apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). December 3rd, 1919. (159,620.)

30,231. "Electric battery lamps." E. Alber. December 13th, 1918. (136,539.)

30,385. "Signalling or indicating devices." W. Morton and G. D. Morgan. December 4th, 1919. (159,628.)

30,608. "Electric safety fuses." S. J. Knudsen. December 6th, 1919. (Convention date not granted.) (140,054.)

30,691. "Aerial electric conductors and supports for the same." E. A. Claremont and W. T. Glover & Co., Ltd. December 8th, 1919. (159,644.)

30,744. "Balancing the voltages in a three-wire direct current system by means of static balancers." R. D. Archibald. December 9th, 1919. (159,647.)

30,834. "Apparatus for heating liquids electrically." L. G. Abogado. December 9th, 1919. (159,653.)

30,835. "Process of heating liquids electrically." L. G. Abogado. December 9th, 1919. (159,654.)

30,957. "Apparatus for obtaining variable speeds and the inversion of the direction of rotation in alternating current motors." G. Paratore. December 11th, 1918. (136,559.)

31,263. "Electric miners' lamps." E. E. Gardner. December 13th, 1919. (159,665.)

31,500. "Electric relays for signalling." M. J. Railing and J. J. V. Connaughton. December 16th, 1919. (159,675.)

31,572. "Thermionic valve apparatus for telegraphic and telephonic purposes." R. M. Radio, Ltd., A. Williams, and H. St. J. De A. Donisthorpe. December 16th, 1919. (159,679.)

31,580. "Manufacture of arc-welding electrodes." Wilson Welder & Metals Co., Inc. July 21st, 1919. (148,265.)

31,665. "Dynamo-electric machines." British Thomson-Houston Co., Ltd., and H. P. Whitaker. December 17th, 1919. (159,681.)

31,674. "Wireless reception apparatus." J. Robinson and H. L. Crowther. December 17th, 1919. (159,683.)

32,295. "Thermionic amplifiers." J. Robinson and H. L. Crowther. December 24th, 1919. (159,694.)

32,425. "Housings of electrical switchgear." Igranic Electric Co., Ltd., and A. H. Curtis. December 24th, 1919. (159,696.)

32,670. "Electromagnetic devices for operating signals and for like purposes." H. J. Hankee. December 30th, 1919. (159,706.)

32,763. "Electrodes for oxidising nitrogen." F. H. Loring. December 31st, 1919. (159,709.)

1920.

1,306. "Medical electrodes." J. S. D. Duthoit. January 15th, 1920. (159,732.)

2,303. "Electrodes for electric arc welding." H. Ogden and British Arc Welding Co., Ltd. January 24th, 1920. (159,742.)

4,501. "Automatic telephone systems." Automatic Telephone Manufacturing Co., Ltd. May 31st, 1919. (144,252.)

6,249. "Electric cables." British Insulated & Helsby Cables, Ltd., and F. A. Bayles. March 2nd, 1920. (159,760.)

7,363. "Generation, transmission, or distribution of electricity." H. Hawkins, W. H. Hanstock, A. H. Higgs, and Ferranti, Ltd. March 11th, 1920. (Addition to 155,095.) (159,764.)

10,669. "Telephones." C. Kearton and G. B. Riley. December 19th, 1919. (Divided applications on 31,940/19.) (159,776.)

11,936. "Electric switches." G. Gallo and F. Villarhoito. April 29th, 1919. (142,495.)

12,399. "Signalling apparatus for railways and the like." J. H. Atkinson. May 4th, 1920. (159,781.)

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THE MINERS' STRIKE.

As we go to press the position remains uncertain with regard to the prospects of peace and the resumption of work at the collieries, but we believe that the greater catastrophe—a "Triple Alliance" strike—if not completely averted, has at any rate receded from the immediate foreground, and may yet be avoided altogether. We earnestly hope that milder and saner counsels will prevail, for immense injury has already been done by the miners' strike, at a most unfortunate moment—when signs of the long-awaited revival of trade were accumulating, and the nation's hopes of a return of prosperity were gaining strength.

The question at issue is simple enough, and its true significance has been realised by the people of this country. The miners were determined that, come what might, they should retain their privileged position, at the expense of their fellow-citizens, the cost under present conditions being over 1¼ millions sterling every week. Why one section of the community should be subsidised by the rest to the tune of £70,000,000 a year is not apparent; how the miners reconcile their present attitude with their somewhat unctuous protestations of solicitude for the interests of the consumers of coal last autumn is equally obscure—perhaps they have a short memory. They seem to have forgotten, too, that they were issuing a challenge to the British nation, and that the Briton, slow to anger, and quick to forgiveness, is endowed with infinite tenacity when his fighting spirit is aroused. They said in so many words by the mouth of their President: We will ruin the mines by stopping the pumps unless you agree to our demands. That is to say, they demanded surrender as a preliminary to negotiation, and thus left no alternative to any Government worthy of the name but at once to make preparations for dealing with the national emergency.

Not only are some of the pits already permanently ruined; in others, which can be retrieved, the damage done to the electrical apparatus submerged by the rising waters will entail a delay of weeks or months before working can be resumed. Coal-cutting machines, haulage motors, transformers, pump motors, and other electrical apparatus, which play so important and essential a part in coal-getting, were being drowned out. Never before had this senseless course been adopted by the miners, who would not even permit volunteer workers to save their means of livelihood from destruction.

The decision of the Triple Alliance on Wednesday to defer strike action until Friday may be regarded as proof of the existence of differences in their ranks. However that may be, the longer such disastrous action is deferred the brighter are the hopes of settlement being reached. A coal strike is harmful enough not only to production, but also to the foreign trade which is so necessary to our national existence: by a transport strike nothing would be achieved but a further impoverishment of the country, with the added risk of civil turmoil or even a social upheaval which could have but one end—stern repression—and would be utterly disastrous to the future of trade unionism. This country will never tolerate the ascendancy of any revolutionary body, which always means the control of a minority; government by popular suffrage is bred in its bones, and would be defended in case of need with a determination that would sweep away all opposition. For that alone is a guarantee of freedom.

BEAMA Progress.

We publish elsewhere in this issue an account of the work accomplished by the British Electrical and Allied Manufacturers' Association during the year ended December last. The year under consideration was hardly more satisfactory for manufacturers acting in co-operative organisation than for individual concerns. The conditions were difficult enough for everybody, but it may be regarded as a certainty that if the Association had not been hard at work the interests of individual members would have suffered, for there is no room for doubt that if the policy of co-operative action be practised within proper limits, and with reasonable recognition of the merits of elasticity, the well-being of the industry is promoted.

When the "price-adjustment" clause necessitated by the extreme buoyancy of costs of labour and raw materials was found to be an "added discouragement to buyers" who sought elsewhere for firm deliveries and prices, the B.E.A.M.A., after conference with other trade associations, discountenanced its use as from January 1st this year. The members had been some of the worst "involuntary sufferers" under a device "invented elsewhere," and in the interests of the British electrical and allied trades the withdrawal was decided upon. Organisations and private individuals alike are well advised when they profit from experience, and especially so when they are not too tardy in accommodating themselves to the developments in the general situation. Allusion is made in the report to the crushing burden of taxation under which the British manufacturer has been suffering, to the dangers of currency inflation, and to Parliamentary proposals for the regulation of imports, and it is remarked "how these things will work out the present Parliamentary session alone will show," but whatever decisions may be reached at Westminster, we have all got to remember that something cannot be got out of nothing, and in the opinion of the Council we cannot escape from the circumstance that "more strenuous work and higher effective production for lower rewards are the inevitable results of war."

Alterations have been made in the constitution of the Overseas Committees, and the belief is expressed that these committees will be materially strengthened for work in their respective territories. It will be seen, too, that progress has been made in the matter of scholarships to encourage technically trained students to fit themselves for posts on the higher staffs of engineering concerns and research institutions, and with the measures for receiving overseas students in British works. As already recorded in our pages, considerable advance has taken place recently in the organisation of electrical research and standardisation. The B.E.A.M.A. Traffic Committee has been busily occupied with the subject of railway rates and classification, and its labours are not yet ended. Negotiations have proceeded with Government departments with regard to their adoption of standard conditions of contract, and in a variety of other ways the Council, its director, its committees, and its large staff have been serving the industries which they represent. It is considered that the satisfactory state of the finances of the organisation is a testimony to members' appreciation of its work. Numerically the membership is practically unaltered at 224, 14 new members having been admitted while 15 have resigned; these resignations were due "in many cases to amalgamation, reconstruction, or dissolution."

Members possess for the present a greater freedom with regard to displays at exhibitions not wholly or mainly electrical, but it has not yet been possible to fix a date for holding a large electrical exhibition under the auspices of the B.E.A.M.A. owing to difficulties in obtaining the necessary space. The customary annual dinner is not to be held this year, as it is felt that it may very well be dispensed with owing to the general situation.

The "Registration" of Contractors.

For a long time past we have had letters from various sources advocating the registration of contractors, in order to protect both the *bona-fide* contractor and the customer from the depredations of the *mala-fide* contractor. In vain have the contractors themselves urged registration, the Board of Trade apparently being unwilling to grant this.

Now, however, from Swansea comes a report of a new development. Contractors in that district, having failed to achieve registration, are about to have it thrust upon them. The local branch of the E.T.U., from purely altruistic motives, intends to issue a list of contractors who have secured its approval. Members of the Corporation referred to the fact that a "fair wage" clause was inserted in all municipal contracts; the Union, however, gave as its reason a desire to protect customers from faulty installations and consequent fire risk, therefore it was rather indelicate to mention wages at all.

British Chances in the Canadian Market.

Our Canadian correspondent has lately obtained the views of several Canadian electrical engineers regarding British-made electrical apparatus, such as switchgear, &c. It has been pointed out to him that one of the main objections to the purchase of such is the difficulty of getting spare parts or of having repairs carried out at short notice. The fact that Canada's proximity to the United States places her in a unique position as regards trade which is not occupied by any other part of the Empire, has been referred to on many occasions in these pages. Unquestionably this places Home manufacturers at a decided disadvantage compared with the great country to the south of the Dominion, as anything can be obtained so much quicker by rail from New York, Buffalo, &c., than by boat from England. Our correspondent has suggested in some quarters in Canada that it might be a good thing for some of the smaller British firms (whose interests are interdependent, and who could not afford, individually, to keep an organisation for the purpose in Canada) to combine and establish a central warehouse and repair depot to surmount the handicap referred to above. A case can be mentioned where, after several years of successful operation, certain electrical equipment supplied from England was discarded and American equipment installed instead, solely because it was felt that with the latter repairs, &c., could be handled more expeditiously. The reason is given by the users of the equipment.

Collapse of the Dutch Supply Monopoly Scheme.

After having been before the country for a period of two years, the scheme for the establishment of a Dutch electricity supply monopoly vested in a semi-State company has been abandoned by the Government, the Minister for Public Works having now withdrawn from the States General the Bill to authorise the execution of the project. Three weeks ago a Dutch news agency reported that the Bill was not to be proceeded with, but it is only now that the newspapers are able to confirm the fact. The proposal to create a monopoly evoked considerable opposition in trading and industrial circles, and among those local authorities who own supply works and who perceived in the monopoly scheme a proposal to expropriate their rights without the prospect of any benefit being conferred upon the general community. In the Second Chamber of the States General the Bill was also opposed, and as a result of a resolution which was adopted by the Chamber the Minister for Public Works is said to have reached the conclusion that it would be advisable to drop the Bill; this, as already mentioned, has now been done.

I.E.E. Nominations.

In our last issue we gave a list of the nominations of the Council of the Institution of Electrical Engineers to fill the vacancies that will occur next September, from which it will be seen that Mr. J. S. Highfield will occupy the presidential chair. The choice was almost a foregone conclusion, for Mr. Highfield has long been on the "short list" for that honourable position, and in tendering him our congratulations on his receiving the highest distinction in the power of the electrical industry to confer, we venture to add that his election also does honour to the Institution and the manifold interests for which it stands. That he will fill the presidential chair with 100 per cent. efficiency goes without saying, and we trust that his year of office will witness the return of prosperity to this country and the cessation of those disputes which have so long harassed our industries.

The new vice-presidents are Prof. E. W. Marchant and Mr. C. C. Paterson, O.B.E., to whom also we extend our congratulations on their well-earned honours.

So far no nominations for Ordinary Members from outside the Council have been announced, and we do not anticipate that any will be made. The Council, as the result of successive reforms both in constitution and procedure, is so thoroughly representative of the membership in all branches of the industry that few will be disposed to find fault with its personnel. In this respect, as in others, the Institution has advanced far beyond the sister Institutions, and the effect of its progressive policy is reflected in its huge membership and growing influence.

Fire Prevention.

A timely communication elsewhere in this issue draws attention to the attitude of the Fire Offices Committee towards the adoption of fire preventive devices by their clients. The complaint against the Committee is that, in spite of the unquestioned efficiency of such devices in giving warning of incipient fires, the rebate allowed on the normal premium is absurdly inadequate in comparison with the enormous advantage accruing to the insurance companies.

This is obviously a most short-sighted policy on the part of the fire offices, whose interests undoubtedly lie in the direction of fire prevention; and it involves a heavy burden on the owners of insured premises, tending to deter them from installing protective devices. In the case of sprinklers, it is true, a liberal reduction is made, of the order of 60 per cent.; but electric alarms are recognised only to the meagre extent of 12½ per cent., regardless of the fact that the very essence of successful fire-prevention is tackling the fire *at the earliest possible moment*; many cases are on record where the outbreak has been notified to the fire brigade station by the alarm, and in due course extinguished before any appreciable damage had occurred, whereas the sprinkler cannot act until the fire has gained headway, and when it does act, it is bound to cause heavy damage by water to the goods in store and to the building.

There is, however, another aspect of the matter which should be kept in view—the national aspect. It is easy to dismiss a fire with the remark that the insurance companies will pay for it, but that is not the sum of the matter; every fire which does damage to property constitutes a dead loss to the nation, whose visible assets are thereby reduced, and the reimbursement of the owner by the fire office in no way affects that fact. The State, therefore, has a right to intervene in the direction of preventing fires *ab initio*, and would be justified in exercising control over the rates of premium if it could be shown that the existing rates deterred the adoption of automatic alarms or resulted in excessive profits to the insurance companies. We therefore cordially support the view that these rates should be reviewed by an impartial authority, which should also take into consideration the extent to which the risk of fire is diminished by the use of electricity for lighting and power.

Domestic Electricity Supply.

The difficulty which many supply station engineers are experiencing in connecting new consumers, for want of plant, &c., can only be overcome by removing the obstacle; but that is no reason why they should neglect the opportunities of development which remain open to them. Obviously, where the capacity of the generating plant is fully taken up, attention must be confined to off-peak loads; one of the best of this class, not only in that it helps to improve the load factor and increase the output, but also because of the satisfaction it gives to the consumer, is that provided by the extended use of small electrical apparatus and accessories in the home. The adoption of these appliances is not likely to exercise any appreciable effect on the maximum demand either at the generating station or at the service end, and there is enormous scope for profitable development of this branch of the business. It does not require the slightest increase in the capital outlay of the undertaking—it simply improves the revenue, and as the energy consumed is mostly paid for at lighting rates, it is a most desirable addition to the income.

As we have pointed out more than once, there is nothing like the electric iron for winning the affection and esteem of the housewife. It would be well worth while to make a present of an iron to every suitable consumer—the results obtained would amply justify the small outlay. But this policy would doubtless be somewhat too progressive for a municipal committee, and the next best thing is to lend an iron on trial; this course very frequently leads to the purchase and permanent employment of this most useful device. Electric kettles, toasters, hot-plates, and fans are also excellent media for the development of the domestic load.

The convenience and comfort derived from the use of such devices can only be realised by trial. Once the "do it electrically" idea has taken root, it needs no cultivation, and the "plant" grows until it may include a suction cleaner, and a washing machine; beyond that stage come the radiator and the cooker, which do not fall within the category of appliances that can be added to a lighting installation without due provision for their supply. But there is abundant scope, as we have said, for development within that limit, and it is up to the central-station manager to educate his consumers in electrical methods.

The French Electrical Industry.

The annual report for 1920 issued by the Union des Syndicats de l'Electricité, of 7, Rue de Madrid, Paris, states that 30,000 workpeople are employed in the French electrical manufacturing industry and 16,000 in the branch of generation and distribution of electricity. In 1913 the capital invested in the former was 307,000,000 fr., which amount has been considerably increased in the meantime. The value of the total production reached 193,000,000 fr., of which 66,000,000 fr. represented electrical machinery and 45,000,000 fr. apparatus; cables, wires, &c., were valued at 40,000,000 fr., batteries, insulators, and carbons at 21,000,000 fr., and lamps at 21,000,000 fr. The electrical industry imported goods to the value of 33,000,000 fr. in 1913, while the exports were worth 34,000,000 fr. The total amount invested in the electrochemical and electrometallurgical industries in 1913 was 480,000,000 fr. The production of aluminium in that year was 13,000 tons, and that of steel in the electric furnace was 20,000 tons, which was increased to 58,000 tons in 1918. It is calculated that the output of cyanamide, which was 7,500 tons in 1913, could now reach 100,000 tons. Concerning the hydro-electric works it is pointed out that a sum of 800,000,000 fr. was employed in this branch in 1913, and the amount had increased to 1,460 millions down to the end of 1919, when about 1,900,000 h.p. was in use our of a total estimate of 9,200,000 h.p.

FUSES FOR SUB-STATIONS.

By A CENTRAL-STATION ENGINEER.

Progress in technical matters takes place broadly in three steps: First, the work is carried out somehow, then it is done well, and finally, it is done well and efficiently. The word efficiency, among other things, denotes commercial efficiency. This has come home to electrical engineers more perhaps than to some other departments of technics, because the electrical men have got into the useful habit of working out costs.

The present shortage of money is fluttering the dovecots and making many people wonder if we have not been unduly extravagant in the past. What with the cost of transformers, of pilot and telephone wires, of expensive protection gear, and of buildings which the bricklayers build a brick at a time, laying them as though loath to part company with their friends, we have come to a time when costs threaten to turn down many schemes which ought not to be turned down. We shall doubtless soon see outside sub-stations without buildings, and with simpler means for protection of the mains.

One thing, that must strike one as extravagant, is the use of oil breakers on the low-pressure distributors. In the old d.c. days, fuses were good enough, but with a.c. supply, oil switches have displaced them to a large extent, with bad results to the financial side. The reason for the change is that, when fed from a large station, a transformer may give an immense amount of current in case of a short circuit near the busbars. A transformer which will give 1,000 amps. at full load, may give 20,000 amps. or more in case of a dead short, and it is the somewhat uncomfortable property of a fuse to be able to pass such hefty currents for a short time, with unpleasant results in many cases. On test, a one-amp. fuse with a 4-in. break was put right across a 550-volt supply, and it arced over, passing probably over 50 amps. of current, a surprising result. All the same, in the present financial situation, we have got to consider the use of fuses in sub-stations, because they are cheap, and it is the object of this article to open up the subject in the hope that others will take the matter up and show how it can be done.

It is evident that fuses for a.c. supply must be designed with some care. Recently I saw a 500-amp. fuse for use in a sub-station, for protecting distributors at 440 volts. It consisted of a substantial porcelain handle of the clip replaceable type, the whole thing being well made. The fuse was made up of six lead wires, in parallel with a copper wire which passed through a tube. The idea was that in case of a fault the lead wires would melt, and the break would be taken by the copper wire. Such doubtless would occur in case of a moderate overload, but it would not happen in case of a really severe fault. In such a case, with the instantaneous passage of, say, 5,000 amperes, the whole mass of the fuse metal would melt together, and under the intense heat, it would explode, and probably blow the porcelain handle to pieces. The explosive power of fuses under such conditions is only understood by those who have had the good fortune to see experiments tried! An inventor brought to one station, which possessed a big battery, a well-made magnetic blow-out fuse. The staff agreed to test it, and, therefore, put it right across the battery, taking the precaution to include a long fuse in the circuit. The test went off so well that the inventor left the fuse behind; in fact, there was nothing left to take away!

In another case, an engineer had a meeting with his directors when loud bangs were heard. "What is that?" asked the chairman in alarm; "have the boilers exploded?" "Oh, they are testing silent fuses," was the answer.

These things are less amusing when they occur in a small sub-station with the attendant near. Indeed, the whole subject of fuses requires research, and no doubt it will get it when we get sufficient sense to work these things out scientifically, instead of by rule of thumb! Enclosed fuses have been placed on the market to overcome the difficulties, and personally, I have not known them to arc over or to explode, but they have other troubles. In one case, a 20-amp. enclosed fuse was put in the pilot wire to a voltmeter. The current was microscopic, but the fuse used to go after a time. In another case, some 500-amp. enclosed fuses were run in an underground box, and one blew. On replacing the blown fuse with a spare, that also blew. On putting in a 250-amp. fuse, it stood without heating. The fact seems to be that the enclosed fuses contain a powder to damp out the arc, and this powder sometimes attacks the fuse wires and causes deterioration.

Enclosed fuses have certain other defects. Engineers always like to see the "innards" of their apparatus, and they also want to inspect them from time to time to see if there is any deterioration. Enclosed fuses won't submit themselves to this ordeal, and it is necessary for the inspector to take their condition on trust. Likewise, they cannot be rewired in the station, but must be replaced by new fuses, a most expensive arrangement if a large number are in use, particularly if they are all renewed once a quarter or even once in six months, as is desirable. One also may be let down if one happens to run out of a particular size at an inconvenient time, by no means an impossible contingency! One must also allow for the possibility of the makers ceasing to supply the pattern most in use, an event which may cause elaborate but vain correspondence between them and the engineer! This side of the question may have painful results.

The January number of the *English Electric Journal* deals at length with the "Zed" enclosed fuse, and it is well worth reading in this connection. The principles of the "Zed" fuse are that a very small quantity of silver wire is used, this being carried by a strong porcelain cylinder. It is claimed that the fuse blows without arcing, and in a safe manner. The writer does not deal with what happens if the circuit is inductive, an important point. The fuses are very short, being only 2½ in. long for 750 volts. They are, however, only made up to 150 amps., and this limits their use for distributor protection, for which purpose 300 amps. is required, even for a distributor of quite small sectional area.

Generally speaking, if makers will supply enclosed fuses which can be opened for inspection, and which can be rewired in the station, there will be a market for them, provided that a guarantee is given that patterns will always be available for replacements in old designs. The fuses should also be of substantial design for use in sub-stations. These demands should not be difficult of fulfilment. Let us hope that the British firms will meet them, and that we shall not be driven to accept patterns supplied from abroad.

A possible pattern of open fuse would consist of a clip, replaceable type, used horizontally, with a horn break. This could be mounted high up, on a slab, and should be reliable and safe. The horns could very well be fitted to the fuse handle, and should not add much to the cost.

Another type of fuse which has been used a good deal is the clip replaceable, with the fuse wires run through the handle. This has stood up to some severe tests, and is promising. The fuse wires should preferably be of small section, several being used in parallel, and it would probably be an advantage if each wire was separated by being run in its own tube. This would help to extinguish the arc after a severe "short," and also to reduce the explosion.

A further design consists of several fuse wires fixed to pillars which separate them from the board. The question of covering the fuses with asbestos stockings is important. The asbestos makes the blowing point somewhat uncertain, as up to a point it may cool the fuse, and with an additional load on, it may prevent the escape of the heat, and tend to make it blow sooner, particularly if the overload persists for some time. This does not seem of great importance, however, as the function of a fuse is rather to protect mains in case of short circuits than to go with loads not very much higher than normal full load. The asbestos ought to reduce, and help to extinguish, the arc, and to keep the metal from flying. If it does this efficiently it will be of considerable value. Fuses should be protected by some kind of cover, preferably of an insulating nature.

It seems probable that porcelain is not the best carrier for fuses. It is brittle, and may fly on severe short circuit. Fuse carriers would be safer if made of something of a tougher nature, which would tear and not splinter.

Fuses, of course, require switches in series. If clip replaceable fuses are used, the fuse may be on the live side of the switch. The fuses should be high up, well above the head of the attendant when he is closing the switch, it being assumed that he keeps his head well down. Sometimes fuses are put low down and the switch is placed above, but this arrangement has caused accidents when the switch was closed on a bad short, as fuse parts have been known to fly and hit the limbs of the attendant, with unpleasant results.

It would be of some advantage if the switches could be operated by a long portable handle. With some such arrangement and a good design of fuse, there seems to be no reason why sub-station fuses should not be quite satisfactory, even at 500 amps. capacity, with large power behind them.

TELEPHONE CABLES FOR USE IN POWER SCHEMES.

By AN EXPERT.

With the advent of much larger power supply areas, the subject of communication between the central station and distant points, such as sub-stations, assumes greater importance, and the following notes on telephone cable will probably interest those dealing with power distribution.

To prove satisfactory, a telephone cable used with a power scheme must meet the following requirements:—

1. It must be absolutely reliable under all conditions of service.

2. For economic reasons the first cost should be low, the maintenance costs negligible.

3. The design of the cable should be such that it will give reasonably good speech transmission over the longest distance for which it would be used.

Of these requirements, the first is by far the most important, since it is obvious that if communication cannot be relied on at all times the system is worse than useless. The second and third requirements will be discussed later, although it may be pointed out now that the question of speech transmission is not likely to cause trouble over the distances normally required, especially if good quality instruments be used.

There are three types of telephone cable in general use for the purpose under consideration:—

1. Dry core, lead-covered telephone cable.

2. Telephone cable in which the insulation consists of impregnated paper loosely applied, lead covered.

3. Telephone cable in which the insulation is of solid impregnated paper, lead covered.

All of these types are used with different kinds of external protection when this is necessary.

The *dry core cable* is the standard type for use on telephone systems, and is constructed as follows:—

The conductors are insulated with one or more loosely applied wrappings of dry paper. These insulated conductors are twisted into pairs, and the required number of pairs is built up in layers to form a round core. A final binding of dry paper is next put on over the core, which is then enclosed in a lead sheath. While this type of cable is admirably suited to large telephone systems where the staffs are well trained in its installation and maintenance, it has two big disadvantages when used in connection with power supply systems. First, owing to the ease with which the paper wrapping will absorb moisture, special precautions have to be taken while the cable is being jointed, and unless the jointer is used to this class of work, low insulation will result. This will necessitate special drying apparatus to clear it. In the second case, should the sheath become punctured after the cable is laid, moisture will penetrate for long distances on either side of the joint. This effect takes place very rapidly, and if there is much moisture in the ducts or soil surrounding the cable, replacement will be necessary. The length to be replaced in this event will be considerable, thus precluding anything in the nature of a quick repair. Of course these troubles occur also in large telephone systems, but here the failure is not vital, since spare circuits are generally available. In these systems the advantages of increased transmission efficiency outweigh the disadvantages, especially as the latter are minimised by the skilled staffs and special apparatus available.

Cables with the loose impregnated paper type of insulation are of similar construction to the dry-core type, except that for insulating the conductors, impregnated paper is used instead of dry paper. A double spiral wrapping of paper is usually employed on each conductor. This type is probably the best of all for the use under consideration. Joints are simple to make, and the jointers employed would be quite familiar with this kind of insulation, since it is similar to that on power cable. Also, since the cable is filled with impregnating compound, any moisture penetrating the sheath is not likely to travel far up the cable. Repairs in this case can, therefore, be quickly effected by cutting out and replacing a short length. As to mechanical and electrical strength, there is no doubt that this type of cable, when properly made and laid, can easily withstand any conditions likely to be met in normal use. In addition, it has the advantage of being the least expensive type.

The best description that can be given of the third type, *cable with solid paper insulation*, is to say that it is a miniature power cable. In this type the conductors are insulated with lappings of impregnated paper applied so as to form a solid core. These cores are laid up together either as singles or pairs, lapped with more paper, and lead covered. Either method gives a very bulky, and therefore uneconomical, telephone cable, especially when pairing is required. This type of cable is frequently specified when there is very little justification for doing so, since a cable of the second type will stand any induced voltages likely to be met with normally. In the unlikely event of a telephone conductor coming into contact with a high-pressure circuit a breakdown is inevitable, whatever type of insulation is used.

To complete the comparison, the relation between the costs of these types must be taken into consideration. As would be expected, there is little or no difference between the costs of the dry core and the loose impregnated paper types, while the cost of the solid impregnated paper type is from two to three times that of the other two types, depending, of course, on the thickness of insulation specified.

The reasons, therefore, for selecting the second type of cable as the most suitable for use on a power scheme are as follows :—

1. While it is no cheaper than the dry-core type, it is easier to lay and maintain, since it requires no special training on the part of the jointer, and no special apparatus to keep it in working order.

2. It costs from one-half to one-third the amount of the solid insulated type, and while its factor of safety from an electrical and mechanical point of view is not so high as that for the solid type, it is ample for the purpose under consideration.

Having arrived at a conclusion as to the type of cable required, it is now necessary to see what size of conductors, and how many of them, are necessary. The standard sizes of conductors used for telephone work in this country are stated in pounds per mile. The diameters are as follows :—

10 lb. p.m.—.025 in. 70 lb. p.m.—.066 in.
20 lb. p.m.—.0355 in. 100 lb. p.m.—.079 in.
40 lb. p.m.—.050 in.

When considering a telephone cable these sizes should be adhered to as far as possible, since all telephone cable manufacturers have machines equipped for dealing with these sizes. They also hold stocks of these wires, and it is therefore reasonable to expect a saving in cost and a quicker delivery if these sizes are specified. There is very little reason for specifying stranded conductors in telephone cables. A stranded conductor, of the small size necessary for this class of work, gains little in strength or flexibility over a solid conductor, and is more expensive. To enable a decision to be made as to the size of wire necessary, the following table gives the distances over which good commercial speech is possible with a given size of conductor :—

Miles. Miles.
10 lb. p.m.—5 70 lb. p.m.—30
20 lb. p.m.—10 100 lb. p.m.—40
40 lb. p.m.—20

These figures make allowance for any instrument and terminal losses that are likely to occur.

When fixing the size of conductors and the number of pairs required, possible future extensions should be borne in mind. Regard should be paid to the fact that a one-pair telephone cable is rarely economical, since a two or three-pair cable may be obtained for little extra outlay. Even if only one circuit is wanted, with no probability of increasing this number, a two-pair cable should be considered. Provision is then made for a stand-by circuit should the one in use happen to fail.

The only remaining point now left to consider is the thickness of sheath required. This naturally depends on the diameter of the cable, but to obtain the necessary mechanical strength the radial thickness of sheath should not be less than .065 in. This is the usually accepted figure in this country for a minimum lead thickness on any lead-covered telephone cable, however small. The reasons which cause some engineers to specify exaggerated lead thicknesses are difficult to understand. Of course, this may lessen electrolytic action by reducing the current density in the sheath, but it will not prevent electrolytic action entirely. Attacking the problem from the point of view of taking precautions to prevent electrolysis would seem to be a cheaper and more logical method. The same argument applies to chemical corrosion. Increasing the lead thickness simply delays failure and does not prevent it entirely. A protective covering designed to meet the particular case where chemical corrosion is expected, would prevent failure, and would offer a much cheaper solution of the problem.

Wages in the Clyde Area.—Forty-one firms in the Clyde area have agreed not to reduce the wages of the contracting members of the Electrical Trades Union by 3d. an hour. Many of the employers who are observing Union terms are federated firms. —*Daily Herald.*

CURRENCY AND BANKING.

Mr. H. G. Williams, M.Sc., M.Eng., A.M.Inst.C.E., secretary and general manager of the Machine Tool Trades' Association, recently delivered two lectures under the auspices of the Manchester Engineering Council on the subjects of currency and banking, and foreign exchanges and foreign trade. He dealt with these important subjects clearly, and on orthodox lines, explaining in the first instance the use and growth of currency and how it came to supplant, almost everywhere, the older method of barter. He pointed out the essential qualities of money, first as a medium of exchange, and second, as a measure of value. He pointed out the advantages of a metal coinage, carrying intrinsically its own face value over a paper currency such as we now possess.

Banking operations and the natural limitations to credits were next dealt with, and it was shown how a bank must always keep sufficient reserves to deal with emergencies.

We think, however, that Mr. Williams momentarily relapsed into pre-war thinking, when he remarked that "if anything cause alarm, the people who possess notes may present them and demand gold."

With regard to paper money, he remarked that its value depended upon the faith reposed in it by the people; but that in most countries the present cause of depreciation was not lack of their faith, but was due to the creation of credit by inflation of paper money, which automatically put up the price of commodities. At the same time he admitted that the manufacture of credit was not the sole cause of the rise in prices above the purchasing power of the people, with the disastrous slump that followed.

The pressure on the banks to carry the burden of the stocks, the heavy taxation, and other factors, all aggravated the slump.

Mr. Williams thinks that with a reasonable sacrifice of wages on the one side and profits on the other, trade may soon be restored; but he suggests as one remedy a "hair of the dog that bit us," viz., a little more judicious inflation of credit to get business on the move again.

His second lecture was devoted to the question of foreign exchanges. Mr. Williams attributed our adverse exchange in the U.S.A. almost entirely to our adverse balance of trade, viz., "that we are constantly importing more from America than we are sending to her." He dealt with this matter very clearly; but we hardly think he gave due weight to political considerations, which, of course, have a great influence.

He pointed out how the exchange could be rectified by movements of gold, but, of course, this presupposed gold available to be moved.

The rates of exchange as between this country and the U.S.A., and France and Germany, were fully considered, and also the important question of the Indian and Eastern exchanges was touched upon.

Mr. Williams concluded with the expectation that, as soon as we get the New York exchange to $4.86—that is, to the normal figure—we could restore the gold standard at once.

In our opinion, it is of great advantage that the trading community, and especially engineers, should understand at least the principles underlying these great questions of currency and exchange, and not leave them entirely to the money experts; and Mr. Williams did a very useful service to the engineers of Manchester in presenting them with these two excellent lectures, which at least put forward the generally accepted views clearly and concisely.

To any of our readers who may feel inclined to follow up the subject, we would venture to recommend a book entitled "Inflation," by Prof. J. Shields Nicholson, of Edinburgh, which gives a very interesting and masterly account of the present position; or rather we should say (as the position changes so fast) the recent position. He lays bare the disastrous course of our Governmental borrowings and spendings, and shows clearly enough how the present financial position has been reached.

Unfortunately, neither he nor any other exponent of the "dismal science" seems able to show how or when we are to get back to a satisfactory basis. They all say return as soon as possible to the gold standard, or, in other words, restore the convertibility of our paper currency into gold; but how, or when, is not indicated.

After all, we think it is possible to overstate the importance of the currency, which is only the medium.

The worthlessness of Russian paper is not only inherent in the reckless quantity that has been printed. If people had confidence in the Russian Government things might soon be altered even there.

However, the great bulk of our trade is carried on by cheques and bills of exchange, and the measure of our credit is the measure of the confidence reposed in us that we will, as heretofore, keep to our bargains.

If we could only get our political and industrial problems solved, and settle down to steady production, our credit, and eventually our foreign trade, would soon be back at a high level.

SMALL ACCUMULATOR DEFECTS AND THEIR REMEDIES.

By "VOLTMAN."

The class of small portable accumulator, ranging in type and size from that used for automobile lighting and starting down to the miniature single cell employed in pocket lamps, requires special treatment and handling to obtain the best results—this has been the writer's experience. One cannot successfully apply the same rules that should be observed in the case of large fixed batteries. With every part made on so small a scale, and with very limited clearances, not to mention a certain fragility of material, it is inevitable that a number of minor troubles are likely to arise, which are absent from the large fixed battery. The small accumulator also gets a good deal of knocking about by inexperienced hands.

In general, small cells seem to be very susceptible to incorrect specific gravity of the acid, and if neglected have a strong tendency to sulphate. The quantity of acid per cell is necessarily small, and regular testing of the specific gravity is advisable. Frequently it will be found that the acid is too weak, as users of these batteries generally overdo the adding of water to make up for loss by evaporation. The most convenient form of hydrometer for testing the specific gravity is the pipette having a rubber bulb and a float inside the glass vessel.

Breaking away of the active material from the plates is very common, due to vibration chiefly, and as the plates are very close together, and not always provided with a complete separator, loose active material becomes wedged in between them. A narrow strip of whalebone, very thin and flexible, which can be inserted through the vent, is very useful for dislodging these troublesome fragments of active material, and causing them to fall to the bottom of the cell. A very puzzling defect the writer has experienced is that of a leak in the dividing piece between the cells, thus causing a slow but sure running-down on open circuit. It is only detected by emptying one cell, when the acid will be found to percolate through from the other. This defect is only repairable by opening up the case and recementing the leaky joint with celluloid cement (celluloid dissolved in acetone). Repairs to celluloid cases on the outside are quite easy to effect with thin sheet celluloid and cement (for this purpose worn-out season ticket cases answer admirably, as patches and angle pieces are readily made thereof). For similar defects in ebonite cases nothing is so good as the ever-useful Chatterton compound.

The bugbear of terminal corrosion is not so common nowadays, but short of using all-lead connections it is always prone to occur. The old dodge of vaselining the terminals is only a temporary remedy. If the defective rubber gland cannot be renewed the acid will inevitably creep up and attack the brass. The writer recommends painting round the gland and lower part of the terminal with anti-sulphuric enamel, and coating the terminal head, by first heating it and then rubbing the surface with a piece of shellac or sealing wax. This produces a durable acid-proof coating.

Instances of small accumulators slowly discharging on open circuit may often be traced to current leakage due to a conducting film of acid forming on the upper surface of the case. By flowing some melted paraffin wax thereon, this surface leakage is greatly reduced, as the wax has a repellant effect on acid tending to settle on the surface.

Lug fractures inside the cell are sometimes a puzzling source of trouble, as the break may not be visible nor yet completely interrupt the circuit, but will produce a bad contact. A good repair can generally be made by the manufacturers by burning on a new lug. Outside connections also sometimes break at the point where the weld has been made, and this is not always noticed. Such connections appear to be too rigid to withstand the vibration that some batteries are subjected to. It is, however, a simple matter, on locating such a break, to remove the connector bar and solder a strip of thin lead to the lugs, making a bend or loop in the strip to provide sufficient flexibility.

ELECTRICAL MACHINERY IN THE MALAY PENINSULA.

In the past the amount of electrical plant that has gone to the Malay Peninsula has not been very great; but with the development of the industries of the country and its gradual opening up to civilised conditions there is reason to believe that its requirements of machinery of all sorts will increase. The statistics of the Straits Settlements show the value of imports and exports of electrical machinery for three years as follows:—

	Imports.	Exports.
1917	£60,525	£18,795
1918	55,189	22,191
1919	153,590	31,795

Though classified as exports, the electrical goods sent out of the Straits Settlements do not leave the Peninsula but find their way into the Federated and Unfederated Malay States—in 1917 to the value of £14,823; in 1918, £10,317; and in 1919, £22,818.

It will be interesting to merchants and manufacturers in this country to know whence British Malaya draws its supplies of electrical goods, and this is shown in the following table:—

	1917.	1918.	1919.
United States of America ...	£17,293	£9,179	£74,593
United Kingdom	28,569	17,028	50,430
French India	—	—	16,643
China	422	7,674	4,651
Australia	796	792	1,074
Italy	1,753	933	857
Japan	8,195	13,806	811
Hong-Kong	1,231	1,688	592

The most remarkable feature of the above statistics is the supply of goods of this description from Asiatic countries, especially French India. The imports from Hong-Kong and the China coast ports may be merely transhipments from Japan, the United States or elsewhere.

In the Federated Malay States, the supervision of electrical machinery is entrusted to the Senior Warden of Mines, and from Mr. W. Eyre Kenny's report for 1919 it appears that the number of installations of generating plant in these States was as follows:—1917, 100 installations (8,976 kW); 1918, 106 (9,360 kW); 1919, 109 (9,544 kW.). In addition there were 20 self-contained lighting plants installed in private houses, plant to about 1,300 kW was in course of installation at the end of 1919, the aggregate horse-power of motors employed was 9,320 as against 9,660 in 1918, and a census taken in December showed that motors totalling 3,400 h.p. were available as spares but were not connected.

A classification of all electrical generating plant employed in the Federated Malay States in 1919 was given in kW as **follows:—**

	Power.	Light.
Mining	8,758	189
Agriculture	68	216
General	110	146
Government	131	2,537
Total	9,067	3,088

The horse-power of motors employed for all purposes aggregated 11,560, as compared with 11,900 in 1918.

It is regrettable, writes Mr. Eyre Kenny, that so many different frequencies and voltages are in use on mines. Mine owners would be well advised to adopt British Standard frequencies and voltages. For three-phase power installations a frequency of 50 and a voltage of 400 or 500 at motor terminals will meet requirements in the majority of cases; for continuous current plant a voltage of 500 is in general use and may well be adopted. For lighting, a voltage of 115 or 230 is practically in standard use in the Federated Malay States and the Straits Settlements, and although not British Standard, it would be advisable to adhere to these pressures.

In the Malayan collieries at Rawang, in Selangor, three new 300-kW steam-driven generators were installed, a ninety-eight inch "Sirocco" ventilating fan was brought into use, two storage battery electric locomotives for underground use were imported and have rendered good service, and a long wall electrically-driven coal cutter with an electrically-driven coal conveyor were being installed at the end of the year.

In the report for 1919 of the Director of Public Works (Mr R. O. N. Anderson) it is stated that the Gombok section of the Kuala Lumpur electric light installation gave a great deal of trouble during the year, and there were many stoppages, the chief reason being the "wearing-out" of the generator coils. "It has been impossible to get new ones anywhere," wrote Mr. Anderson, "and there is no apparatus for carrying out repairs satisfactorily here," but doubtless this has since been remedied. Sale of energy brought in £23,567, against £24,047, and the gross profit was £12,519.

RECENT DEVELOPMENTS IN TURBINE PRACTICE.

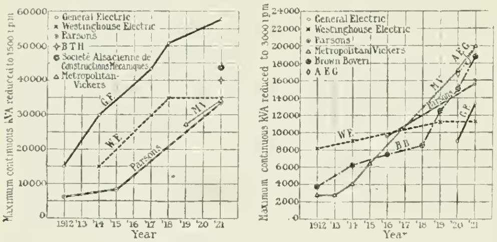
By K. BAUMANN.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

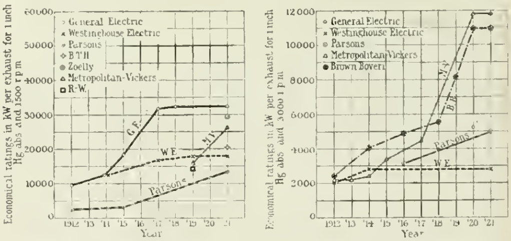
In 1912 the author read a paper before the Institution describing the development of the steam turbine up to that date.* The present paper generally outlines turbine practice during the interval, reviews the circumstances which resulted in developments which can be best described as the "race for the maximum output at the highest possible speed," describes how progress has been made possible, and deals in detail with the problems connected with the large turbines required for electric power stations of the future.

Part I.—Summary of Development.

From a list of turbo-alternators built by various makers during the past ten years it appears that the largest alternator with a speed of 1,000 r.p.m. was built by the A.E.G. in 1918. This 50,000-kW set was very expensive, and future progress will be towards increasing the output of 1,500-r.p.m. machines rather than developing 1,000-r.p.m. sets. The largest 1,500-r.p.m. machine at present in operation has a capacity of 35,000 kVA (maximum continuous rating), and most manufacturers are willing to build an alternator of this size. A 35,000-kVA alternator has been built for a speed of 1,800 r.p.m., and the capacity of this machine is equivalent to 50,800 kVA at 1,500 r.p.m., on the basis that the maximum possible capacity varies inversely as the square of the speed (r.p.m.). Fig. 1 shows the growth of the maximum continuous kVA rating reduced to 1,500 r.p.m. diagrammatically.



Figs. 1 and 2.—Growth of Max. Cont. kVA Rating of Alternators, Reduced to 1,500 r.p.m. (left) and to 3,000 r.p.m. (right).



Figs. 3 and 4.—Growth of Economical Rating of Turbines in kW per Exhaust, Reduced to a Vacuum of 1 in. abs. (Hg) and 1,500 r.p.m. (left), and to 3,000 r.p.m. (right).

A list of turbo-alternators running at high speeds (2,400 r.p.m. and above) which have been built during the last ten years shows that the capacity has increased in this country from about 3,000 kVA in 1912 to 17,200 kVA maximum continuous rating in 1921. Fig. 2 shows the growth of the maximum continuous kVA rating reduced to 3,000 r.p.m. diagrammatically.

The d.c. generator driven directly from the turbine has disappeared from the market, its place having been taken by the moderately low-speed generator driven by mechanical reduction gear, up to units of 4,000 kW, and for larger units by turbo-alternators in conjunction with rotary converters. The development of the reduction gear is also responsible for the disappearance of the direct-driven 25-period alternator running at 1,500 r.p.m. up to capacities of 4,000 kW, and has completely revolutionised turbine practice for small outputs; the time is not far distant when even the 1,000-kW, 3,000 r.p.m. turbo-alternator will be replaced by a turbine running at a high speed and driving the alternator through gears.

The most economical arrangement of the geared turbine for large capacities is the "two-pinion" arrangement, one pinion being driven by the h.p. and the other by the l.p. turbine. In such a case the output which can be transmitted through the pinions very nearly approaches the maximum output which can be obtained from the turbine when designed for a 29-in. vacuum.

The development of the economical rating for each exhaust is of particular interest. This rating reduced to a basis of 1 in. abs. back pressure and a speed of 1,500 r.p.m. is shown in fig. 4, and fig. 5 shows corresponding particulars of high-speed turbines (above 2,000 r.p.m.) of relatively large capacities.

Regarding the development of the reaction turbine, in 1910 the combined Curtis-Parsons turbine was introduced by Messrs. Brown, Boveri, and has since become their standard design, built as a single-cylinder unit in every case. The l.p. end is built up of disks, the peripheral speed of the rotor being too high for the use of drums. In this country, and in America, development has proceeded on different lines. Parsons in this country standardised the two cylinder design for large capacities, the h.p. and l.p. elements being arranged in separate cylinders, arranged in tandem for driving a single generator. In order to cope with large volumes of exhaust steam, the l.p. element is generally of the double-flow type. Fig. 6 shows a representative design of Parsons 11,000-kW, 2,400-r.p.m. turbine.

The Westinghouse Electric & Manufacturing Co., Ltd., in America has further developed the sub-division into separate cylinders to improve the efficiency and deal with the demand for increased capacities; some of its units were built for driving more than one generator.

The first Ljungström turbine of 1,000-kW capacity was installed in 1912 by the North Metropolitan Power Co., London, and since then considerable progress has been made. A Ljungström turbine of 30,000-kW maximum continuous capacity is at present under construction in the works of the General Electric Co. at Schenectady.

A conspicuous feature of the development of the impulse turbine is the increase in the output per cylinder. The prominent firm in this connection is the General Electric Co. of America. The necessary leaving area in this single cylinder unit has been obtained by increasing the diameters of the last stages and increasing the length of the blades. The great difference in overall length, and the additional cost involved in the two-cylinder construction, are no doubt responsible for the early change-over to the single-cylinder construction. Experience has shown, however, that single-cylinder construction possesses serious inherent disadvantages due to disk and blade vibrations.

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* Elec. Rev., Feb. 23rd, 1912; p. 317.

In the A.E.G. 3,000-r.p.m. turbine of 30,000-kW capacity in one cylinder, the last stage is srranged on the double-flow principle, the exhausts from the two halves facing one another. The steam passages from the last but one row to one half of the last stage are arranged around the last stage, and the exhaust steam is caused to flow around these passages before entering the exhaust proper. The flow of steam outside the last stage is very complicated, and will result in a considerable drop in pressure between the last row of blades and the condenser, and also between the last but one stage and the extreme half of the last stage.

A number of 16,000-kW turbines designed to run at 1,500 r.p.m. have been built by the A.E.G. for large super-power stations such as Golpa. This design is conspicuous for its small number of stages and for the large diameter of the last three stages. The length of the blades on the last wheel is very small, the ratio of blade length to mean diameter being only 1 : 9. The shape of the turbine exhaust is very unsatisfactory from the point of view of flow of steam through the exhaust, inasmuch as 50 per cent. of the exhaust opening is covered by the turbine cylinder which is overhung into the turbine exhaust.

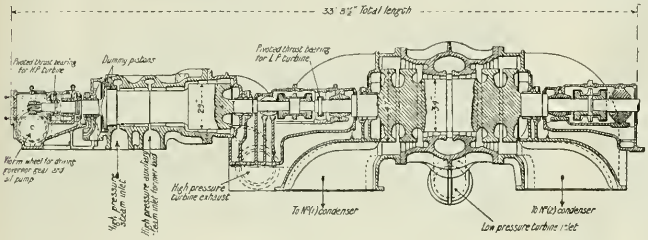
33' 8½" Total length
Pivoted thrust bearing for H.P. turbine
Dummy pistons
Pivoted thrust bearing for L.P. turbine
29"
34"
Worm wheel for driving governor gear and oil pump
High pressure steam inlet
High pressure auxiliary steam inlet for over load
High pressure turbine exhaust
To Nº(1) condenser
To Nº(2) condenser
Low pressure turbine inlet

Fig. 5.—Parsons Tandem Reaction Turbine at Carville, Newcastle-on-Tyne, 1916.

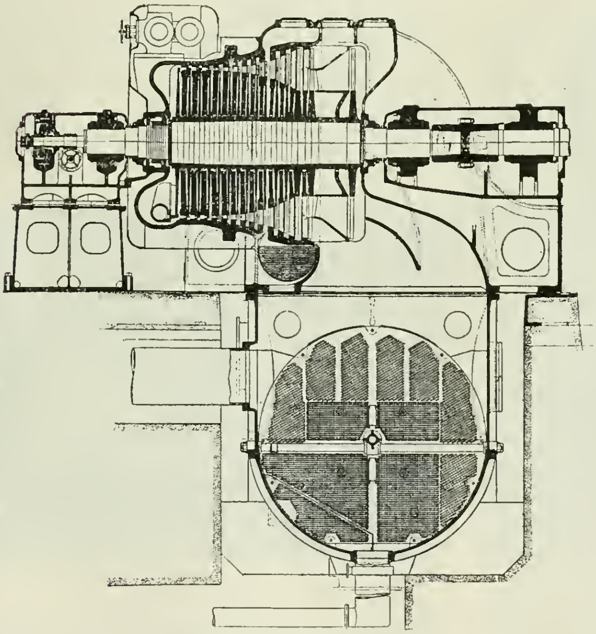

Fig. 6.—Metropolitan-Vickers Turbine with Heater and Condenser, at Dalmarnock, Glasgow, 1919.

During the period under review no designs of Zoelly turbines which differ materially from the construction described in his paper of 1912 have come to the author's notice. It has been reported that 10,000-kW turbines running at 3,000 r.p.m. are under construction, but no details of designs have been published.

Modern Rateau turbines are built by the Metropolitan-Vickers Electrical Co.,* and figs. 6 and 7 show a multi-exhaust, 18,750-kW, 1,500-r.p.m. turbine with other novel features.

The stream-line exhaust secures a simple flow of the steam, thus reducing to a minimum the pressure-drop between the last row of blades and the condenser. It also ensures uniform distribution of steam over the whole condenser-tube surface, thereby effecting a reduction of pressure-drop in the condenser itself. A surface-type feed-water heater is arranged within the turbine cylinder, the tubes in which the condensate is heated being exposed to steam which is tapped from the main turbine at a relatively low vacuum. The incorporation of the heater as an integral part of the turbine avoids the necessity of additional heater casings and pipe connections which would complicate the lay-out of the plant to a considerable extent. The exhaust casing is rigid in construction and is placed directly on the foundations, thereby dispensing with the use of heavy foundation girders. The condenser inlet flange is bolted directly to the turbine cylinder. The h.p. end of the turbine is flexibly connected to the rigid portion of the casing, the extreme end of the h.p. cylinder being supported from a pedestal. In the old-fashioned design heavy foundation girders are usually required to provide side supports for the turbine, which increase the cost of foundations and interfere seriously with the accessibility of the joint between the turbine and the condenser. The pipe type of nozzle box and steam chest combined with nozzle control is such that the highest steam pressures and temperatures can be used without fear of distortion of the turbine cylinder due to variations in load and steam temperature.

A comparison of the commercial development of impulse and reaction turbines shows that prior to the war the position, as far as European countries are concerned, was roughly as follows: Impulse: Number of makers, 30; number of turbines, 900; output, 1,400,000 kW; and average size of turbines 1,550 kW. Reaction: Number of makers, 9; number of turbines, 250; output 500,000 kW; and average size of turbines, 2,000 kW. Similar information for this country for 1919 is: (Orders in Great Britain for turbines above 200 kW capacity) Impulse: Number of turbines, 143, output 411,568 kW; and average size of turbines, 2,870 kW. Reaction: Number of turbines, 46; output, 112,407 kW; and average size of turbines, 2,440 kW.

Concerning machines for special purposes the demand for low and mixed pressure turbines has considerably decreased, but there has been an increased application of back-pressure and reducing turbines to mills and factories. The sizes of units required are moderate, and the practice has not changed appreciably during the period under review.

Part II.—Factors Affecting Development.

The author discusses all the points in design which affect reliability, and gives such data as will enable the power-station engineer to appreciate the merits of any particular turbine design.

The progress made in steam conditions shows that at present steam pressures as high as 350 lb. per sq. in. (gauge) are being adopted and temperatures as high as 750 deg. F. The vacuum has been increased from 29 to 29.1 in.; the heat drop from 407 to 485 B.th.u. per lb., and the ratio of expansion from 418 to 828. Higher steam pressures than 350 lb. per sq. in. are at present not justified except in power stations where economy is of extreme importance, where coal is very expensive and the load factor very high. A steam temperature of 700 deg. F. is the present standard.

The basis of calculations for the improvement in heat consumption possible with improved steam conditions is explained and improvements due to higher steam pressures, temperatures, and vacua are discussed in turn as well as those due to reheating and feed-water heating. Finally, the author turns to thermo-dynamic efficiency, and points out that the advantages of the velocity wheel are outweighed by the increased efficiency of single Rateau stages, except in cases where the diameter used for the first stage is relatively small. There is a tendency for the h.p. end of reaction turbines to be replaced by impulse stages not necessarily of the velocity-wheel type, but also of the ordinary Rateau type. For the middle portion and the l.p. end both impulse and reaction blading continue to be used, but reaction blading has largely given way to impulse blading.

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* Elec. Rev., Apr. 30th, 1920, p. 571.

Part III.—Economic Rating.

It is possible to design a given turbine frame for any rating within a given range, and the economical consumption at such designed ratings will lie along a curve D, fig. 8, which is defined as the "economical consumption characteristic" for the given turbine frame for given steam and vacuum conditions, and the problem is the determination of the particular point along curve D at which the economic rating can be fixed for a given load factor, fuel costs, capital charges, &c.

The manner in which the losses vary with the rating of a given size of turbine for given steam and vacuum conditions is shown in fig. 8 [steam pressure 200 lb. per sq. in. gauge, superheat 200 deg. F., and 29 in. vacuum].

Curve A shows the variation of the steam consumption s_b in lb. per kWh at the blading if c^2 losses do not exist. This consumption is independent of the rating, and curve A is, therefore, a horizontal line. Curve B shows the variation of the mechanical losses expressed as a percentage of the output measured at the coupling. In the case considered [20,900 kW at 1,500 r.p.m.] the mechanical losses $K_m = 835$ kW. Curve C shows the variation of the c^2 losses expressed in percentage of the total heat drop available for a back pressure of 1 in. abs. These losses vary approximately as the square of the rating. Curve B plns C shows the variation of the total losses expressed as a percentage of the output at the turbine conpling. Curve D is the economical consumption characteristic, and shows the variation of the economical steam consumption for the various designed ratings referred to the outputs at the turbine coupling.

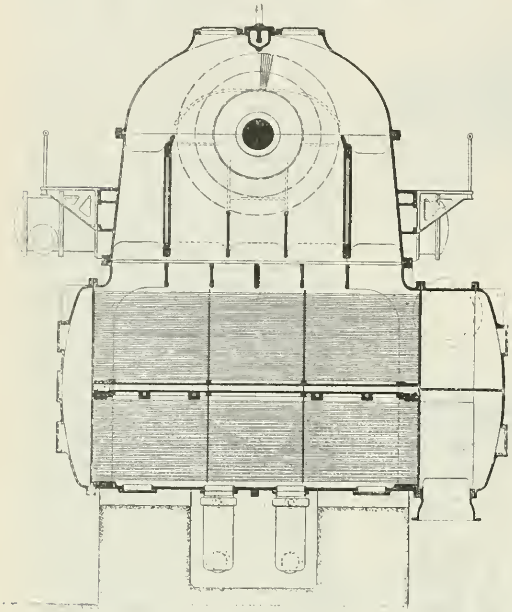

Fig. 7.—Metropolitan-Vickers Multi-exhaust Turbine at Dalmarnock.

In actual practice it does not pay to design a given turbine frame for the rating which gives the lowest possible steam consumption, because the turbine will be too expensive for such a rating. In order to determine the commercial economic rating of a given turbine frame (the "economic" rating), it is necessary to consider the relative influence of the fuel and capital cost charges per kWh on the generating costs. The capital cost of the turbine itself varies inversely as the rating, whereas the fuel charges increase from the point of maximum efficiency with the rating.

The effect of the fuel and capital charges is such that for a back pressure of 1 in. abs. the rating becomes $K_c = 32{,}500$ kW, *i.e.*, 1.55 times the minimum steam-consumption rating of 20,900 kW. The corresponding outlet losses become $l_o =$ 4.6 per cent. For a back pressure of 2 in. abs. the rating becomes 45,000 kW or 1.38 times the economic rating for a back pressure of 1 in. absolute. The corresponding outlet losses for 2 in. abs. are $l_o = 3.19$ per cent. or 69.3 per cent. of the corresponding losses for a back pressure of 1 in. abs.

For a load factor of 25 per cent. the economic rating of a given frame is 20 per cent. larger than for a load factor of 50 per cent., the outlet losses being 40 per cent. larger; on the other band, if the load factor is 75 per cent., the rating would be reduced by 10 per cent. and the outlet losses by 20 per cent. The economic rating varies approximately inversely as the fourth root of the load factor, and the losses vary inversely as the square root of the load factor, and similarly it follows that the economic rating varies: Inversely as the fourth root of the cost of coal; or directly as the fourth root of the interest factor; or directly as the fourth root of the evaporation; or finally, directly as the fourth root of the initial cost of the turbine.

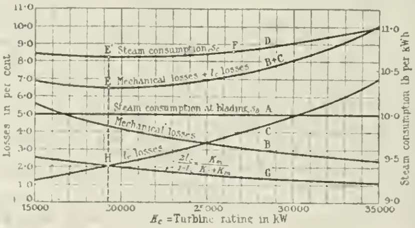

Fig. 8.—Variation of Losses and Steam Consumption with Rating.

Thus, for an increase of 20 per cent. in the cost of the turbine, the rating of the turbine should be increased 5 per cent., provided that the cost of coal remains the same. It will generally be found, however, that the cost of the turbine increases with the cost of coal, these factors being industrially interdependent. The rating of the turbine would accordingly remain unchanged.

The leaving losses vary, inversely as the square root of the cost of coal; or directly as the square root of the interest factor; or directly as the square root of the evaporation; or finally, directly as the square root of the initial cost of the turbine.

In the cases considered above, no account is taken of the fact that, by installing a more efficient turbine, the boiler-house plant may be made smaller, resulting in decreased interest and depreciation charges for the boiler plant, and of charges for maintenance and operation. The same applies to the condensing plant, the size of which depends, amongst other things, on the quantity of steam discharged from the turbine. Moreover, an increase in turbine efficiency reduces the heat content per lb. of steam. For every 1 per cent. improvement in steam consumption, the amount of heat to be dealt with per kW capacity of the installation is decreased by about 1.4 per cent., which is the amount by which the capital cost of the condensing plant will be decreased.

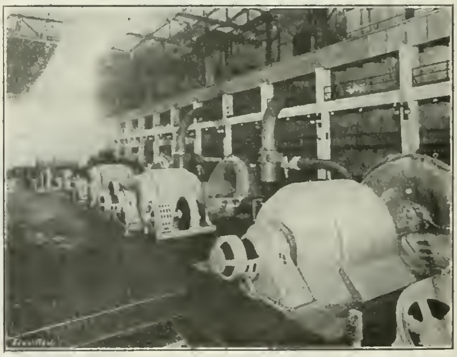

Fig. 9.—Three 20,000-kw. and one 45,000-kw. Turbo-Generators at Connor's Creek (see p. 475).

It may be urged that such fine limits cannot be obtained in actual practice. It is clear, however, that even if the sizes of the various parts of the plant are fixed by other considerations, considerable advantages can be obtained since, for an increase in turbine efficiency, the boiler plant will be more easily rated in actual operation, thereby effecting a reduction in maintenance charges and also an increase in boiler efficiency. The same remarks apply to the condensing plant where a decrease in turbine consumption results in a higher vacuum and, consequently, in a further improvement in economy.

For the best commercial rating of the boiler or condensing plant the saving in capital cost for a given increase in rating is equal to the extra fuel cost entailed by the same increase in rating. Therefore, the financial gain resulting from the use of a more efficient turbine is equivalent to that which would have resulted had correspondingly smaller boiler and condensing plant been installed.

The saving resulting from the reduction in the steam-capacity costs is of the same order as the direct saving in fuel costs, and both factors must be considered in determining the economic rating of the turbine.

Thus, for a back pressure of 1 in. abs. the most economic rating becomes 28,400 kW, and the outlet losses are 3.54 per cent. For a back pressure of 2 in. abs. the rating becomes 41,000 kW, or 1.42 times the rating for 1 in. abs., the corresponding outlet losses being 2.52 per cent., or 0.7 times the losses for 1 in. abs.

When allowance is made for the steam-capacity costs the effect of such factors as cost of coal, initial cost of turbine, &c., on the rating becomes smaller, simply because the influence of such factors is offset to some extent by the influence of the steam capacity. The variation of the overall economic rating with coal cost, load factor, &c., is only about one-half of that which is obtained in the case of the economic rating.

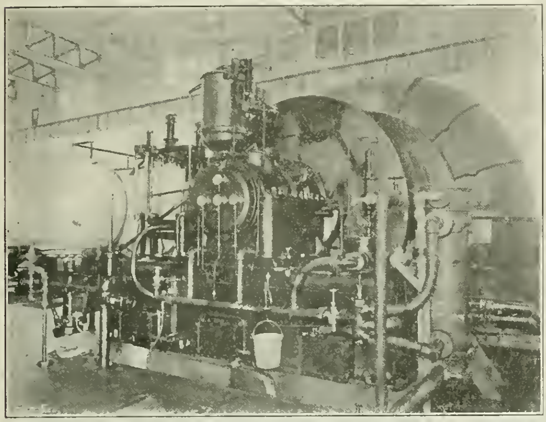

Fig. 10.—Steam End of 45,000-kw. Turbine

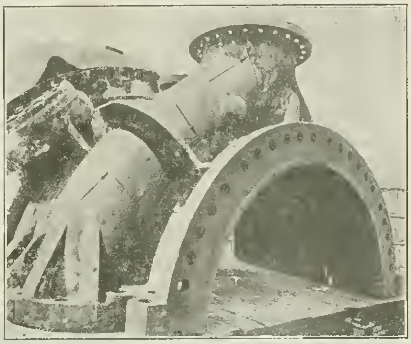

Fig. 12.—Cracked Semi-steel Casing.

It is evident from the foregoing that if too high an average cooling-water temperature is given to the manufacturers, as is often the case, the turbine will be large enough as far as load-carrying capacity, *i.e.*, steam-chest and nozzle capacity, is concerned, but the exhaust end will be too small, thereby impairing the efficiency of the turbine. On the other hand, if too low a temperature is given, the turbine will be unnecessarily expensive. American practice has standardised turbine ratings on the basis of a vacuum of 29 in. (barometer 30 in.) although the average cooling water temperature would justify a vacuum slightly higher than this.

[*To be continued.*]

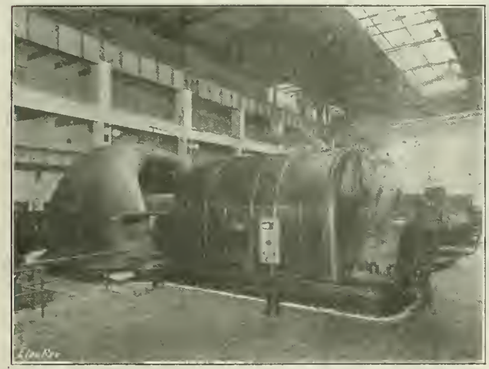

Fig. 11.—Generator and l.p. End of 45,000-kw. Machine.

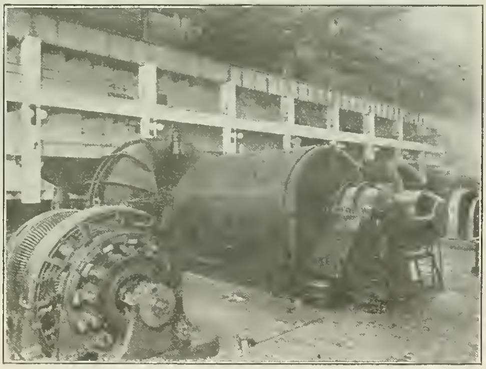

Fig. 13.—Generator and Ribbed 45,000-kw. Turbine.

Discussion in London.

Mr. W. H. Patchell opened the discussion by referring to some of the large machines he saw during his recent visit to America. He had a number of lantern slides thrown on the screen (from which our illustrations have been reproduced), and explained that fig. 9 was a view down the engine room of the Detroit Edison Co.'s Connor's Creek station showing three 20,000-kW machines in the foreground and one of the 45,000-kW (1918) sets in the background; the latter machines were the largest single-shaft turbo generators in the U.S.A. Fig. 10 showed the steam end of the large machine, and some idea of its size might be gained from the fact that the distance between the centre line of the shaft and the floor level was 7 ft. The machine was a 21-stage turbine, running at 1,200 r.p.m., with a maximum tip speed of about 726 ft. per second; its overall length was 64 ft., and the weight of the stator, which the speaker saw placed in position, was 115 tons. The heavily-lagged steam pipe was 22 in. in diameter. As an illustration of the station's war-time troubles, the speaker mentioned that the 20,000-kW sets had had to be overrun and, owing to delay in getting the second 45,000-kW set commissioned, overhauling was unduly postponed. Consequently the wheels of one of the 20,000-kW sets failed, and was followed by the fracture of the h.p. steam casing (as indicated by the arrows in fig. 12) of the 45,000-kW turbine (1918) which, in the absence due to war conditions of steel, had been made of "semi steel." The reduction of the July peak load from 200,000 to 160,000 kW was managed in a magnificent spirit of co-operation on the part of 150 large consumers and the supply company. The day peak load was removed and replaced by evening and night shifts, after which the load was gradually allowed to increase again until November 1st, by which date it was again normal. Meanwhile, splendid work had been done by the station staff, and also by the contractors; a 20,000-kW set weighing 350 tons was removed and a 10,000-kW set installed in its place; the latter machine weighed 150 tons, and was erected in seven days while the speaker was in Detroit. The faulty 45,000-kW turbine was returned to its makers, and both it and the second set were in place again by November 1st. Fig. 11 showed the l.p. and generator end of the 45,000-kW (1918) set, while fig. 13 was a similar view of the 1920 machine with the former set behind it, and it would be noticed that the turbine casing of the newer machine had been heavily ribbed. As regarded the use of large sets, the speaker remarked that the peak of the Detroit Edison Co.'s load curve doubled every five years! At present 30,000 kW, of which size the Detroit Co. had two sets, was a more fashionable size than the 45,000-kW one. Fig. 14 showed another type of large machine, a 60,000-kW (or on a two-hours' rating 70,000-kW) three-shaft set in which the steam divided from the high to the l.p. cylinders so that 60,000 kW could be developed by all three cylinders, or 40,000 kW by two of them. Should any one of the three machines fail it would be cut out automatically, and by means of other automatic valves boiler steam could be passed through a reducing valve on to either or both of the l.p. machines. That set was in one of the two New York stations of the Interborough Rapid Transit Co., one of the most interesting stations in America. The company originally used the "Manhattan" type of engine, which was used later by the London County Council at Greenwich. Some were replaced by two-spindle 30,000-kW machines shown in the background of fig. 14, the 60,000-kW set being in the foreground with its h.p. cylinder between the two l.p. ones; each set ran at a speed of 1,200 r.p.m., the l.p. turbines were of the double flow type, and the shaft between the two halves was provided with a labyrinth packing. In that connection the speaker mentioned an interesting accident that had occurred. After the machine had been in its maker's hands for some three months for overhaul, it was started up, and when it had run for three-quarters of an hour the shaft seized. It was fortunately tripped in eight seconds and pulled up almost "dead," otherwise there might have been extensive wreckage. Fig. 15 showed the extent of the damage, which was purely local, and fig. 16 was a more detailed view of the failure.

Mr. A. A. **Carnegie** was rather disappointed in the paper inasmuch as no test results of impulse machines had been included in it. The author had stated that only one result of such a test had been published, but the speaker recalled that he himself had given figures and information in the course of the discussion on Mr. I. V. Robinson's paper on "Power Station Design in Relation to Thermal Efficiency," on the occasion of the 1920 Convention of the Incorporated Municipal Electrical Association at Ilkley. He then exhibited steam consumption test curves of 20,000 and 10,000-kW Parsons turbo-alternators,* which tests were made after the machines had been in operation from one to thirty months, all with the same satisfactory results. The figures lay quite snugly along the line, and there was no deterioration even after the machines had been working for two years. Those results showed two things; first, that the efficiency obtained was not a matter of luck, and, secondly, that the method of testing could be relied upon, because it had been proved that the tests could be repeated with accuracy. The use of fine blade tip clearance was avoided in modern reaction turbines by the adoption of "end-tightened" blading, which made it possible to employ a radial clearance as large as desired.

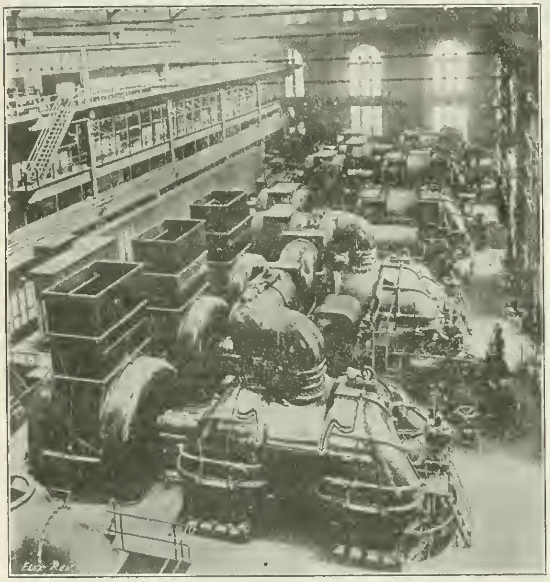

Fig. 14.—A 3-shaft, 70,000-kw. Set at New York.

Mr. R. A. **Chattock** thought that high speeds cut into the reliability of machines, and reliability was the first thing that the user considered. The thermo efficiency came next, but it must not be developed at the expense of reliability; he was of the opinion that they were justified in going to any reasonable expense to obtain reliability, and for the same reason gears should be eliminated as much as possible. Turbine makers would experience difficulties on account of the fact that generator manufacturers not infrequently required the machine to be run through its critical speed; however, whenever it was possible to do so they should keep within the critical speed. With regard to the erosion of turbine blading, the elimination of CO_2, &c., was very desirable, but in the speaker's opinion erosion was chiefly due to moisture in the steam itself, and he thought there would probably be more risk of erosion taking place in cases where high steam pressures were adopted. The speaker mentioned a certain bearing failure which had not been heralded in any way by an increase in the temperature of the lubricating oil; the cause of the failure had never been discovered, but he thought that such an accident could have been avoided by the use of temperature indicators, which would show the actual temperature of the metal itself and not that of the lubricating oil. In the case of large machines, two thrust bearings should be provided.

Mr. H. L. **Guy**, by the aid of lantern slides, considered the subject of the gain in heat consumption with increased pressure at different speeds a step further than the author had done.

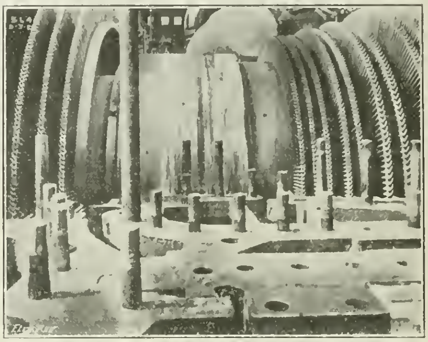

Fig. 15.—Labyrinth Packing Failure.

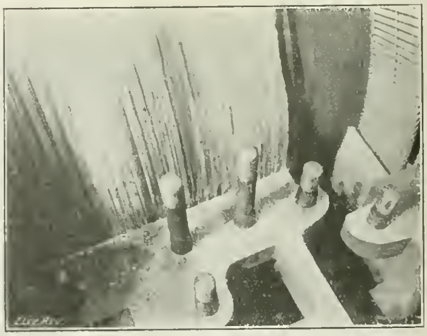

Fig. 16.—Labyrinth Packing Failure.

Mr. S. E. **Fedden** considered that the paper had been very fairly written, and in connection with geared machines, mentioned that he had two such sets running for some two years: their consumption was guaranteed at 15 lb., but they operated regularly at ½ lb. less than that figure. How long could an impulse machine run without it being necessary to reblade it? However, he thought that the reaction type of blade obtained the best results so far as steam consumption and other factors were concerned. If the author's statement that "as far as efficiency is concerned, a turbine of 10,000-kW capacity running at 3,000 r.p.m., would be equivalent to a turbine of 20,000-kW capacity running at 1,500 r.p.m." was correct, it would appear from Mr. Carnegie's remarks that the 10,000-kW machine was the better one to use. He was glad the author did not agree with the by-passing of steam, because it was undesirable to pass steam from one part of the turbine into another for which it was not designed. They did not hear of any great catastrophes occurring to reaction turbines as to impulse type machines of both large and small capacities. The different manner in which various makers advised that turbines should be started up was puzzling, and the question appeared to be: Were they "progressing" at too fast a rate?

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* Elec. Rev., July 9th, 1920, p. 39.

Mr. B. **Pochoeradsky** pointed out that turbine development had proceeded in two classes; one, as in the U.S.A., adopted a large number of stages of small diameter, and the other just the reverse. On the Continent the practice was to increase the diameter as far as possible and reduce the number of stages, a policy which resulted from long research and experiment, and good results had been obtained. He did not agree with the author that turbine development had reached a critical stage. Accidents could generally be classified; for instance, those due to no provision having been made for expansion, to interruption of the oil supply, to small clearances, &c., were not new, and every form of heat engine had been subject to them from the earliest days. On the other hand, disk failures were "more modern" troubles, but they also could probably be avoided by more careful inspection of materials as they were passing through the shops.

Mr. A. **Jude** was of the opinion that the leaving losses were nothing like so important as the author appeared to imagine. Long blades were also very undesirable, and those who used them must expect to get trouble; they could, in fact, well afford to countenance some extra loss if by so doing they could reduce the length of the blades. The author's multi-exhaust system was a perfectly ludicrous affair; he appeared to have entirely overlooked the fact that the leaving losses were not confined to the last stage of the turbine, but that the last stage but one also had leaving losses.

Mr. R. J. **Kaula** appreciated the author's ingenious double exhaust idea, but thought that such like things were only what might be termed a "passing phase" of development, and that sooner or later they would return to the simple flow design. Meanwhile, the difficulty was to obtain some reliable disk material. Another problem was the nebulous subject of disk vibration in connection with which the speaker mentioned a case of disk failure in which a new disk of carefully selected steel was made, but did not reduce the vibration at all. As it was a special case where they could not afford to have the machine out of commission for any length of time they had had to adopt the remedy of making the disk strong enough to withstand the vibration instead of eliminating the cause of it. Later, however, when the case was more fully investigated, it was found that resonance had a considerable influence on the matter. Each pole change of the generator caused an impact on the shaft, however slight, which was transmitted along the shaft to the turbine disk.

Mr. A. B. **Field** pointed out that the machines tabulated in the author's first table illustrated American practice, whilst those in the second showed European practice which was due, he thought, to the different frequencies in use in the various countries. At the outbreak of the war manufacturers had anticipated being called upon to furnish sets of 50,000-kW capacity and over, but that demand for large individual machines had now entirely disappeared in Europe, at least for the present. In the U.S.A. conditions differed on account of the periodicity of 60 cycles per second used there. The author's statement that a 30,000-kW Ljungström turbine was in course of manufacture in America would have been equally true five years ago.

A PRACTICAL WAGE SUGGESTION.

[Issued by authority of the National Alliance of Employers and Employed.]

Much of the present industrial difficulty is due to the fear on the part of organised Labour—a fear carefully exploited by the unofficial extremists' movement within trade unionism—that employers are endeavouring to make very drastic cuts in wages at once.

Actually, specific instances of this are difficult to find. On the contrary, it can, with substantial accuracy, be stated that although the opportunity exists at the moment for employers to take advantage of the industrial situation, in the great majority of cases they are carefully refraining from doing so.

It is perfectly true that those who control the industrial situation can reduce the social system to chaos, and there is little doubt that, if organised Labour endeavours to retain all that it has obtained during, and since, the war, in the teeth of a falling cost of living; or if the organised employers use the weapons of international competition and unemployment, in an endeavour to force the workers' standard of life back, suddenly, to that of 1914, or even lower, social chaos will result.

The alternative is to meet not as opponents, but as partners, and agree to some general scheme whereby wages accompany the cost of living on the downward scale.

The economists allege that wages are a substantial cause of rising prices, and must fall before the cost of living falls, but in view of the fact that the cost of living has fallen from 179 per cent. to 141 per cent. without any marked drop in wages, the economist theory, though technically sound, is disproved by facts. The fall could be immediately reflected in lower wages, and the lower wages might then again be reflected in a lower cost of living, and so on.

One might illustrate by presuming that a craftsman's wage prior to the war was 11d. per hour, but that it has since risen to 2s. 3d. An agreement could be accepted on national lines that the 2s. 3d. should stand, down to the point of 150 per cent. in the cost of living.

After that for every drop of six points in the cost of living, averaged over a period of three months, the craftsman's hourly rate should drop ½d. as follows:—

Cost of Living Figure.		Wages.	Cost of Living Figure.		Wages.
150 per cent.	...	2/3d.	72 per cent.	...	1/8½d.
144 per cent.	...	2/2½d.	66 per cent.	...	1/8d.
138 per cent.	...	2/2d.	60 per cent.	...	1/7½d.
130 per cent.	...	2/1½d.	54 per cent.	...	1/7d.
126 per cent.	...	2/1d.	48 per cent.	...	1/6½d.
120 per cent.	...	2/0½d.	42 per cent.	...	1/6d.
114 per cent.	...	2/0d.	36 per cent.	...	1/5½d.
108 per cent.	...	1/11½d.	30 per cent.	...	1/5d.
102 per cent.	...	1/11d.	24 per cent.	...	1/4½d.
96 per cent.	...	1/10½d.	18 per cent.	...	1/4d.
90 per cent.	...	1/10d.	12 per cent.	...	1/3½d.
84 per cent.	...	1/9½d.	6 per cent.	...	1/3d.
78 per cent.	...	1/9d.	0	...	1/2½d.

These figures are merely used to illustrate the method, and can be changed for the different types of workers.

It is to be noted that at every point the cost of living would drop before wages fell, and would fall more than wages, and at each point the individual's real wages as expressed in purchasing power would be increased. When the cost of living reached the point at which it stood in 1914, his wages per hour would be 1s. 2½d. instead of 11d.—that is to say, his standard of life would have risen nearly 15 per cent.

The scheme is very far from being watertight. There is, for instance, the case of those trades in which the workmen received no rise in wages until the war had been on for two years, or even longer; it is not suggested that this scheme should be applied to them.

Then there are a series of trades in which wages, although they rose, did not rise to an extent commensurate with the rise in the cost of living. There are difficulties, too, produced by workmen receiving incidental rises, such as the 12½ per cent. which, apparently, had no relationship either to the cost of living or wage rates.

There is no doubt that there are a great many industries where, in an exact way, this scheme could not be applied, but the principle embodied in this scheme is one which, if carefully considered and amicably discussed by meetings of employers and trade unionists who have at heart the interests of the community rather than any narrow or personal motive, and if carried into practical effect, presents a method of negotiation in the face of present difficulties as an alternative to industrial strife.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Wire Connector.

From Mr. W. Quax, 80, Ashley Lane, Moston, Manchester, we have received particulars of an ingenious little device for connecting two, three, or four wires of small electrical circuits, as shown in the accompanying figures. This consists of four parts: A brass tubular member with axial slots at one end: a soft brass cap; a brass cap with two threads, one for screwing into the tubular member and one to fit the porcelain cover which forms the fourth part. When wiring, the ends of the wires are bared for about half an inch, and are pushed through the tubular brass member and bent over into the slots. The soft brass cap is then placed over the

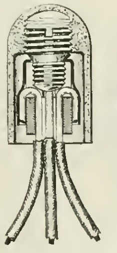

Fig. 1.—A New Connector. (Section.)

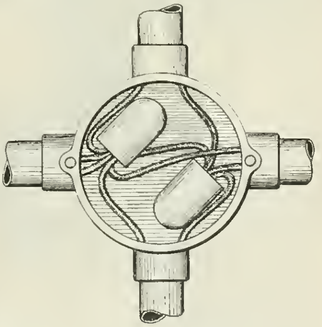

Fig. 2.—Arrangement in Box.

wires, and the screw is fitted into the tubular member and screwed in tightly, when the brass cover will conform to the shape of the wires and clamp them in position. The porcelain cover is then placed over the whole fitting. This is a Dutch device, and is to be manufactured in England if the demand justifies this.

The "Nilfisk" Suction Cleaner.

Messrs. Gillespie & Beales, Amberley House, Norfolk Street, Strand, W.C.2, have sent us particulars of the "Nilfisk" suction cleaner (fig. 3), which is manufactured in four sizes. This consists of a cylindrical dust chamber above which is mounted a vertical spindle commutator motor having a two-stage turbine fan of special design mounted direct on the motor shaft. The motor and turbine are encased in a strong copper and nickel-plated steel housing terminating in a substantial base-plate. The motor is mounted on ball bearings. A filter is fitted which entirely cleans the air before it passes through the turbine, and the dust is retained in a cloth receptacle which may be easily removed and emptied. The ordinary accessories comprise 10 metres of flexible cable with the necessary adapters, 3 metres of suction hose—rubber-covered flexible steel coil—and six nozzles of different types for a wide range of uses.

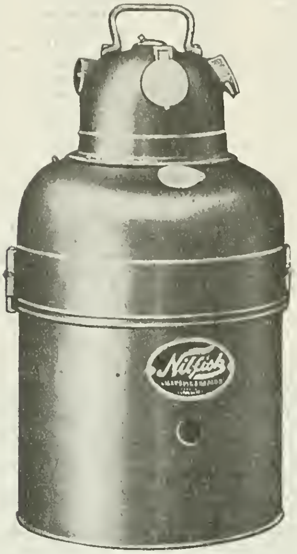

Fig. 3.—The "Nilfisk" Suction Cleaner.

The smallest type of "Nilfisk" cleaner weighs 17 lb 7.7 kg), and has a consumption of 175 watts; the largest size weighs 51 lb. (23 kg), and consumes 600 watts.

Longitudinal Lighting Lanterns.

A short time ago Mr. Haydn T. Harrison brought out a new system of street lighting by means of special lanterns which direct their beams in a horizontal direction as opposed to the usual mode of distribution. These lanterns are made in various types, one of which can be adapted to existing electric lighting globes shown in fig. 4, another which can be applied to the usual gas-light lantern, and a special "Canterbury" type.

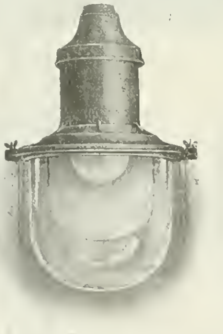

Fig. 4.—"Longitudinal" Street Lantern.

The design is such that the lower hemispherical luminous flux from the light source is not interfered with, so that it fulfils its function of illuminating the immediate vicinity of the lamp. The upper half of the flux, which is generally wasted, or only partially used, is collected by a specially designed reflector into a solid angle of the desired divergence. This light would normally shine directly below the lamp, but in this system it is directed up and down the street by two or more plane mirrors. The angle of these mirrors is adjusted so that the light begins to fall on the road or street at the point where the direct light fails to bring the illumination up to the required standard, and increases in power until it meets the light from adjacent lamps; this ensures a more even illumination throughout and eliminates dark patches. The sole licensees for the manufacture of these lanterns are the General Electric Co., Magnet House, Kingsway, and the Electric Street Lighting Apparatus Co, The Foundry, Canterbury.

LEGAL.

James Pitkin & Co., Ltd., v. Aladdin Renew Electric Lamp Corporation, Ltd.

Mr. Justice Salter, in the King's Bench Division, on April 6th, commenced the hearing of this action. The claim was for damages in respect of an alleged breach of contract to pay for 20 special winding machines used for the purpose of renewing filaments of electric lamps, and failure to accept delivery of 46 other similar machines, the remaining portion of the contract to make 100 such machines.

The defence was a denial of the alleged breach and an affirmation that the contract was that the machines were to be delivered at the rate of 20 per month or as defendants might require them. Defendants said that on February 23rd they wrote to plaintiffs to defer delivery until they sent definite instructions as to destination. Defendants also put in a plea that the machines were defective, and they counter-claimed for damages, and asked for an injunction restraining plaintiffs from selling the machines to any lamp manufacturers other than the defendants.

Mr. Disturnal, K.C., for the plaintiffs, said they were well-known manufacturers of scientific and electrical instruments, and in 1919 they were approached by a company known as Seymour, Gordon & Co., to manufacture a number of machines for the purpose of winding the filaments of electric lamps. The company apparently had a scheme for the renewing of the filaments of lamps, and had an idea that plaintiffs would manufacture the machines for the purpose. Seymour, Gordon & Co. were also connected with a company called the Renew Electric Lamp Co., and they were now represented by the present defendants. It was not necessary, said counsel, that his Lordship should know the relationship between these three companies, because the contract that was ultimately entered into was disputed by the defendants. The action was brought to recover the price of 20 of these machines at £52 10s. per machine, and damages for refusal to take the balance of the machines arranged for under the contract. Thirty-four of the machines had been delivered and paid for, so that with the 20 additional there had been a total delivery of 54. As to the remaining 46, defendants had refused to take them, and plaintiffs accordingly sued for non-acceptance. Plaintiffs, in the course of the development of the machines had made certain inventions for which they took out provisional protection, and there was a dispute between the parties as to who had a claim to the patent rights. That dispute was settled by agreement, and one of the defences set up by the defendants was that the agreement had been broken by the plaintiffs. The plaintiffs said there was absolutely no foundation for that, it was entirely a misconception. He submitted that the contract meant that defendants should take delivery of the machines at the rate of 20 per month, or as defendants might reasonably require them; they were not entitled to put off delivery for ever if they liked. As to the defence that the machines were defective, counsel said that no suggestion of defects was made before the writ in the action was issued. They had, in fact, received and paid for 34 machines without any question.

Mr. R. L. Lee, managing director of the plaintiff company, gave evidence that the machines had been made and could have been delivered.

On the continuation of the hearing, Mr. Lee, in cross-examination by Mr. Watt, for the defence, said he obtained a provisional patent protection for everything included in the machine on December 10th, 1919. The nine months' grace for completing the patent protection had lapsed, and the specifications had not been completed. His firm was to have the right of selling the machine for purposes apart from refilling electric lamps. He thought the machine had possibilities for other purposes. His firm had introduced new devices, and they were entitled to a patent on those devices.

Mr. Watt: Then why did you let it lapse?

Witness: I came to the conclusion about June or July that it was not worth our while to spend money in patenting this. The defendant company objected to the firm patenting it on three grounds: First, they wanted other people to make it; secondly, some of the shareholders in the Aladdin Co. were able to make it themselves, and would object to plaintiffs making it; and thirdly, the people in France would insist upon having it made in France. He would not agree to that. He was keen on keeping the whole thing, but as a concession he gave the defendants the power of renewing.

Witness was further cross-examined as to certain "advertisements" which it was said had appeared in the Electrical Review in relation to the machine; he said he had never advertised, nor had he seen advertisements in relation to the machine—but it might have been commented upon by that journal in its news columns.

The case was continued on Friday, when evidence was given on behalf of the defendants relating principally to the terms of the contract and the construction of the machines and the alleged defects found in them.

Mr. Compston, K.C., counsel for the defence, argued that in order to maintain an action for non-acceptance there must be proof of an agreement to deliver after the contract date, and in this case there was no such proof. The plaintiffs were not, he said, ready to deliver, and there was no evidence that a tender had been made. No damages could, therefore, be claimed. As to the patent question, he contended that there was no obligation to renew.

His Lordship in the result reserved judgment until the report of experts had been received with regard to the machines and their alleged defects, for which purpose a period of fourteen days was allowed.

Sheppard v. Glossop Corporation.

In the Court of Appeal, before Lords Justices Bankes, Scrutton and Atkin on April 7th, the hearing was concluded of the case of Sheppard *v.* the Corporation of Glossop upon the appeal of the Corporation from the judgment of Mr. Justice Greer awarding the plaintiff, W. H. J. Sheppard, a carter, of Glossop, £279 10s. damages for personal injuries sustained by him owing to the alleged negligence or breach of duty of the defendants as the lighting authority for the district.

The facts were these: The plaintiff on the night of Christmas Day, 1918, after visiting a friend, was returning home at 11.30 p.m., intending to go there by Dun Lane and Mary Road. Dun Lane was a highway repairable by the defendants, as surveyors of highways. Mary Road was a public footway belonging to Lord Howard of Glossop, but had not been taken over by them as highway authority. For a considerable time there had been a lamp in Quarry Road placed above a retaining wall on Lord Howard's land. This place was dangerous to foot passengers on a dark night if the lamp was not lighted. The plaintiff, walking along Quarry Road, owing to the darkness, missed his way and got in front of the lamp and fell from the top of the retaining wall, fracturing his skull and receiving other injuries. The light in the lamp had been extinguished at 9.30 in pursuance of instructions of the defendants, who by a resolution previously passed by the Lighting Committee, had determined for reasons of economy that the lights in the borough should be extinguished at 9 p.m. Plaintiff accordingly brought the present action, with the result before stated.

Lord Justice Bankes, in giving judgment allowing the appeal, said the case raised a question of importance to local authorities outside the Metropolitan district. Plaintiff's case was that the defendants were liable to him in damages for the injuries he received owing to their failure to keep a lamp alight at a dangerous spot within their area. There was no doubt, said his Lordship, that the spot was a dangerous place, but so far as the evidence went not a dangerous place made dangerous by the Corporation. It was dangerous since it came into existence when it was carved out of the adjoining ground. Mr. Justice Greer had found that if the lamp had been alight the accident would not have happened. The first thing to consider was what was the statutory duty of the Corporation with regard to the lamp. The defendants' statutory authority for lighting the district was to be found in Section 161 of the Public Health Act, 1875. The true effect of that section was that it gave the defendants authority to light their district, but it created no obligation to light it, and gave the authority a discretion whether they would light only some portions of the district and as to when the lamps were to be kept lighted in any portion of the district which they elected to light. There was a great distinction to be found between the powers given to local authorities under that section and the powers given under Section 130 of the Metropolis Management Act, 1855. He had come to the conclusion that there was no authority to support the proposition that Section 161 of the Public Health Act created any obligation upon the lighting authority to light any portion of the district. The only cases where the local authority had been found guilty of a breach of duty was where the authority had themselves created the danger or put the obstruction in the highway. That was not so in the present case. It was not possible to establish that the defendants were under any duty to the plaintiff to keep the lamp alight, and in those circumstances the appeal must be allowed and judgment entered for the defendants, with costs.

The other members of the Court delivered concurring judgment.

Unlicensed Wireman Charged at Melbourne.

The first prosecution under the rules for the "licensing of wiremen," as provided in the Electricity Commissioners Act, 1918, was held at the City Court, Melbourne, on February 17th, when F. P. Sawyer, senior clerk of the State Electricity Commission, charged G. E. Jobson, trading as Cooke and Jobson, electrical contractors, Ormond Road, Elwood, with having undertaken electric wiring in premises without having a licence to do so.

T. F. Whitelaw, inspector, Melbourne City Council electric supply department, gave evidence that he had inspected the work. He found a number of badly made joints, which were not covered, and were a source of danger.

In answer to the presiding magistrate, witness said that faulty work was a cause of fire. He was of opinion that defendant was not capable of carrying out the work.

For the defence it was stated that defendant was a minor, but had had a fair amount of experience. He was not a licensed man, but did not carry out any work unless accompanied by his partner, S. A. Baldwin, who held a permit as a vocational trainee under the Repatriation Department.

The presiding magistrate said that the evidence of the inspector showed that defendant was not only working without a licence, but that he was not capable of doing the work. These rules had been made for the protection of the public, but as this was the first case the bench would only impose a small penalty.

Defendant was fined £2, with costs.—*The Age* (Melbourne).

BUSINESS NOTES.

Bankruptcy Proceedings.—Charles Thomas Stanton, trading as The Southern Electric Engineering Co., 25, Beckenham Road, Penge, and 5, Laurel Grove, Penge, Kent, electrical engineer.—The first meeting of creditors was held last week, at the offices of the Official Receiver, 132, York Road, Westminster Bridge Road, S.E., under the presidency of Mr. Thomas Gourlay. According to the statement of affairs, the liabilities amounted to £1,166, of which £1,116 was expected to rank. The net assets are £123, or a deficiency of £993. It appeared that the debtor was for 17 years in the engineering branch of the Post Office Telephone Service, and started business for himself as an electrical engineer, in partnership, in March, 1919. He commenced without capital, and his partner brought in about £10 and £60 was borrowed and is still owing. The partnership was dissolved last July, and was duly gazetted. The debtor then continued the business, and last November an agreement was entered into for another man to enter the concern and to find £300 for a half share. The sum of £200 was actually brought in, but the person finding the money was dissatisfied and withdrew. He was given a receipt for £200, which the debtor undertook to repay by quarterly instalments of £30 each. Recently the debtor was continuously pressed by creditors, two executions were levied by the Bailiff of the Croydon County Court, and he filed his own petition. He attributed his present position to "want of capital, depression in trade, high cost of labour and material and pressure by creditors." The Official Receiver said the best course would be for someone to buy the business if they had any faith in it. There was no reserve of assets to allow a trustee to run the business. He was afraid the assets would not produce much more than £100 after providing for the preferential claims. No resolutions were passed, and the matter remains in the hands of the Official Receiver. The following are creditors:—

Pancho Cigar Co.	£324	Evans	£30
Allum, S. J.	200	Taylor, D.	23
Simplex, Ltd.	89	Express Electrical Co.	20
Ankers, T.	60	Corris	25
Williams, W. R.	89	London Electrical Co.	20
Taylor, C. W.	80	Metropolitan-Vickers Co.	25
Cocking, S.	82	Merrie, E.	13
Cocking, N.	80	Beckenham Electric Supply Co.	16

R. C. Jones (Electro-Magnetic Engineering Co.), of 10, Caledonia Street, King's Cross, N., and 59, Longridge Road, Earl's Court.—Receiving order made March 30th, on creditor's petition. First meeting was held on April 13th; public examination, June 3rd, at Carey Street.

J. C. Thomson, electrician, lately electrical engineer and contractor, Mansfield, Notts.—First and final dividend of 11s. in the £, payable April 20th at the Official Receiver's offices, 4, Castle Place, Nottingham.

W. H. Wood, electrical engineer, Birmingham.—Trustee (Mr. J. W. Blackham, 147, Corporation Street, Birmingham), released March 18th.

A. S. Palmer journeyman electrician, Margate.—Trustee (J. O. Osborne, 68a, Castle Street, Canterbury), released April 4th.

J. Jagger (J. Jagger & Co.), electrical engineer and contractor, Halifax.—Trustee (Mr. A. Gray, 9, Fountain Street, Halifax), released March 18th.

Albert Edward Dickinson, trading as Crown Electrical Co., 157, Hunslet Road, Leeds, electrical engineer and contractor.—The following are creditors :—

Casperson, George	£15
Calmont King & Co., Ltd.	61
Drake & Gorham, Ltd.	40
English Electric and Siemens Supplies, Ltd.	10
Forman & Sons	15
Jennings, Wm.	£183
Milne & Son, Ltd.	67
Manchester Lighting Co.	14
Smith, Burkby & Co.	17
Williamson, Jos.	57

W. Drysdale electrician, Barrow-in-Furness.—First dividend of 9s. in the £, payable April 23rd, at 4, Ramsden Square, Barrow-in-Furness.

Dissolution of Partnership.—The Primover Power Co., electrical and mechanical engineers, 364, Humberstone Road, Leicester.—Mr. G. E. Purdy and W. H. French have dissolved partnership. Mr. W. H. French will attend to debts.

Company Liquidations.—Orizaba Tramways Syndicate, Ltd.—Winding up voluntarily. Liquidator, Mr. A. F. Dickin, Sardinia House, Sardinia Street, Kingsway, W.C.

Anglo-Foreign Tramway Syndicate, Ltd.—Winding up voluntarily. Liquidator, Mr. A. F. Dickin, Sardinia House, Sardinia Street, Kingsway, W.C.

Electric Supply Company of Western Australia, Ltd.—A meeting is called for May 9th, at 225, Royal Liver Buildings, Liverpool, to hear an account of the winding up from the liquidator, Mr. G. Saies.

General Instrument and Engineering Co., Ltd.—Winding up voluntarily. Liquidator, Mr. W. J. Maxwell, 56, Moorgate Street, E.C. Meeting of creditors is called for April 21st.

Semaphore Engineering Co., Ltd.—Winding up voluntarily. Liquidator, Mr. H. W. MacLaren. Meeting of creditors held April 14th.

North British Electric Welding Co., Ltd.—Meeting called for May 19th, at 30, George Square, Glasgow, to hear an account of the winding up from the liquidator, Mr. W. Gilchrist.

Trade Announcements.—The Greengate and Irwell Rubber Co., Ltd., Greengate Works, Manchester, have appointed Messrs. Wakefield, Williams & Co., Richmond Road, Bradford, to be their agents for Yorkshire.

Mr. J. B. Rudkin, of 212a, Shaftesbury Avenue, London, W.C., has been appointed representative in Great Britain for Sprecher and Schuh Co., electrical apparatus manufacturers, of Aarau, Switzerland, for the sale of their apparatus.

Messrs. Ferguson, Pailin, Ltd., have appointed Mr. W. Wallwork, of Station House, West Boldon, Durham, as their representative in the North-East Coast district.

Messrs. Hogan & Wardrop have appointed Mr. Alexander Morrison, of 12, Waterloo Street, Glasgow, as agent for Scotland, and the Castle Engineering Co., Ltd., Church Street, Eccles, to represent them in Lancashire.

The Delta Electrical Co., of Temple Courts, Temple Row, Birmingham, has changed its name to The Y Switchgear Co. The change has been made by mutual arrangement with another company of similar name, in order to avoid confusion, but there will be no change whatever in the constitution and conduct of the business.

The telephone number of the Twiss Electric Transmission, Ltd., has been altered to "Victoria 7625."

New showroom premises at 11, Earl Street, Maidstone, have been opened by Mr. Wm. Coggar, electrical engineer.

Messrs. Nettlefold & Sons, Ltd., of High Holborn, inform us that Mr. D. M. Edwards, who has been appointed representative to Messrs. Baxter & Caunter, Ltd., was formerly their representative for electrical conduit tubes and fittings, and not manager, as stated in these "Notes" last week.

Catalogues and Lists.—Messrs. Drake & Gorham Wholesale, Ltd., 67, Long Acre, W.C. 2.—Leaflet No. 309, an illustrated price-list giving details of a new 30 volt bowl fire.

Messrs. Copus & Green, 22, Clapham Road, S.W. 9.—Two illustrated leaflets describing the "Aqua" electric water heater.

Engineering and Colliery Appliances, Ltd., Sheffield.—Two illustrated and priced leaflets describing patent tachometers and patent hand tachometers and cut meters.

The Photector Co., Ltd., Central Hall, Southall.—An illustrated pamphlet describing asbestos-woven resistance nets and grids and their application.

Metropolitan-Vickers Electrical Co., Ltd., 20, Brazennose Street, Manchester.—Leaflets Nos. 64 L/1—1 and 64 L/1—3, describing and illustrating type "F" high-pressure contactors for controlling live circuits; Leaflets No. 61/12—1 and 61/12—3, dealing with automatic contactor-type star-delta starters for three-phase non-reversing squirrel-cage motors.

Magic Appliances, Ltd., 151-159, Westminster Bridge Road, S.E. 1.—An illustrated price-list of the "Magic" suction cleaner, the pioneer British self-contained suction cleaner, which has been entirely re-designed.

The Y-Switchgear Co., Temple Courts, Temple Road, Birmingham.—Publication No. 100 B, an illustrated leaflet giving prices and descriptions of watertight tumbler switches in various styles.

Polish Commercial Activities.—Reuter's Agency learns from a Polish source that the Ministry of Trade and Commerce in Warsaw jointly with the Ministry for Foreign Affairs is pushing forward preparations for the conclusion of Commercial Treaties with Great Britain and Italy.

A Rumanian Trade Delegation is also expected to arrive in Warsaw shortly.—*Reuter.*

Correction.—An error occurred in the advertisement of the Z Electric Lamp and Supplies Co., Ltd., appearing in our issue of April 8th. For £17 10s., read £15, as in the advertisement of April 1st.

Book Notices.—Mr. W. H. Warren, Wh.Sch., has revised his "Engineering Construction—in Steel and Timber"—the third edition of which is now ready, price 30s. net, and will in future be known as Part I of his work. He has also written a new volume to be called "Engineering Construction Part II—in Masonry and Concrete," which will be ready shortly, price 36s. net. Both volumes are published by Messrs. Longmans, Green & Co.

"Education for Industry." (42 pp. illustrated.) Manchester: Metropolitan-Vickers Electrical Co., Ltd.—This is a very full description of the apprenticeship schemes which are in operation at the company's Trafford Park works, and the more advanced schemes for aiding post-graduate research students. Details are also given of the works training provided for students during their long summer vacation, special courses for women, and particulars of research scholarships, &c.

"*Transactions* of the South African Institution of Electrical Engineers." Vol. XII, Part 2. February, 1921. Price 2s.—In this issue are recorded the new President's inaugural address, and discussions on papers "Notes on Commutators," and "Notes on Small Suction Gas Plants," &c.

"The *Journal* of the South African Institution of Engineers." Vol. XIX. No 8. March, 1921.—The papers printed in this issue are: "A Contribution to the Study of the Influence of Mine Atmospheric Conditions on Fatigue," by A. J. Orenstein, C.M.G., M.D., and H. J. Ireland, M.B.E., and "Scheme for Working the City Deep Mine at a Depth of 7,000 ft.," by E. H. Clifford.

"Relativity and the Electron Theory." By E. Cunningham, M.A. (148 pp.) London: Longmans, Green & Co. Price 10s. 6d. net.

"Technology," the *Journal* of the Manchester Municipal College of Technology, Vol. X. (170 pp. and figs.) Manchester: The College.—Included among the papers presented in this volume of the *Journal* is "Dynamo-Electric Machinery, 1878-1916," by Prof. Miles Walker, M.A., M.I.E.E. This is a review of a branch of engineering which has undergone vast development, and in a relatively small space Prof. Miles Walker has contrived to deal with his subject in a very comprehensive manner. Other papers are "Part-time Secondary Education," by the Principal; "Cast-Iron: the Strength and Properties of Castings," by Mr. E. L. Rhead; "The Distribution of Frictional Losses in Internal Combustion Engines," by Mr. E. P. Taylor, and "Trisecting an Angle," by Prof. W. W. Haldane Gee, B.Sc., and Mr. Arthur Adamson.

"Electrical Engineering." By T. F. Wall, D.Sc., &c. (pp 491, figs. 463). London: Methuen & Co., Ltd. Price 21s. net.

Inquiry.—The name and address of the manufacturer of the "A.B.C." electric washing machine are required.

Australian Association of British Manufacturers and their Representatives.—After four years of strenuous work as chairman of the Australian Association of British Manufacturers and their Representatives, Mr. Walter A. Purdom, has now relinquished office through pressure of other work. Great strides have been made in the activities of the Association in the period of his chairmanship, although there remains ample scope for a continuation of his record of achievements in the coming years. The chief aim of the Association—the expansion of British trade with the Commonwealth—is being pursued indefatigably from year to year, but as Mr. Purdom recently pointed out in his speech on his retirement from office the exports of the United Kingdom to Australia are still far short of what they should be. While the Association fully recognises that Australian industries deserve whole-hearted support, there are still large quantities of goods from non-British countries coming into the Commonwealth, and it is for securing a greater share for British goods that the Association's efforts are directed. The Association has an office in London at 32, Victoria Street, S.W. 1, and United Kingdom manufacturers and merchants interested in Australian trade should maintain touch with it for purposes of guidance and information. Copies of the Association's "All-Red Directory" can also be obtained from the London office. This contains a complete list of members—manufacturers and agents—together with the goods they manufacture or handle.—*The Board of Trade Journal.*

Fuse Wire Table.—Messrs. P. Nutter & Son, 41, Side Newcastle-on-Tyne, have just issued a table giving the fusing currents of tin and copper wires ranging from 8 to 47 s.w.g.

A Liverpool Electrical Exhibition.—Messrs. James Scott, of the Knowsley Electricity Works, Bootle, are holding an interesting exhibition of electrical appliances in the Liverpool Exchange News Rooms this week. An interesting feature of the exhibition is Messrs. Scott's patent fire alarm, which is calculated to be of excellent service in giving prompt notification of an outbreak of fire in big buildings, such as hotels, &c., and in ships. An indicator is placed in a certain position in a ship or building, to which every bell is connected with its corresponding number shown on the indicator, so that when a fire occurs, its position is made apparent immediately.

Copper and Lead Prices.—Messrs. F. Smith & Co. report, April 12th:—Copper (electrolytic), bars, sheets, and wire rods and h.c. wire, no change.

Messrs. James & Shakespeare report, April 12th:—Copper bars (best selected), sheet and rod, no change. English pig lead, £22 5s., an increase of 15s. on last week's quotation.

For Sale.—York Corporation Electricity and Tramways Committee has for disposal two Willans-Dick, Kerr 500-kW. d.c. generating sets, with Allen surface condenser, pumps, control switchboard, &c.

Burnley Corporation Electricity Department invites offers for one 250-kW triple-expansion Belliss-Dick, Kerr generating set, with condensing plant, also one Lancashire boiler, with superheater and Bennis stoker.

Ashton-under-Lyne Corporation Electricity Department has for disposal generating plant, including one 75-kW and one 300-kW motor-generator, one 400-kW turbo-alternator, and one Lancashire boiler, &c. By direction of the disposal board, Messrs. Fuller, Horsey, Sons & Cassell will sell by auction, on April 28th, at the Thames Iron Works depôt, Greenwich, surplus electrical plant, &c.

For particulars, see our advertisement pages to-day.

Toronto Exhibition.—H.M. Trade Commissioner at Toronto has drawn attention to the Canadian National Exhibition —an annual event there—which is this year to be open from August 27th until September 10th. The Commissioner recommends the Exhibition as presenting a very good opportunity for United Kingdom firms to secure wide publicity for their products in Canada. It combines the features of a trade fair and a pleasure ground. Many of the more important Canadian and American firms are exhibitors, but the display by United Kingdom firms has hitherto been inconsiderable. At the 1920 Exhibition the number of United Kingdom firms represented was less than 30. Last year the attendance exceeded one million. As in former years, a Bureau of Information in connection with the Trade Commissioner Service in Canada will be maintained, and Mr. F. W. Field, H.M. Trade Commissioner at Toronto will be glad to receive any trade literature or catalogues for distribution, free of charge, from the Bureau in question. Small exhibits, typical of United Kingdom industries, and small attractive posters, will also be welcome. The catalogues, &c., should be sent direct to His Majesty's Trade Commissioner, 257-260, Confederation Life Buildings, East Queen Street, Toronto, not later than July 15th. Firms interested can obtain some further information from the Department of Overseas Trade in London, and applications for space should be sent at the earliest possible moment to the Secretary, Canadian National Exhibition, 38, King Street East, Toronto, Ontario, Canada.

German Electric Companies in Sweden. — With reference to the paragraph appearing under this heading in our issue of March 11th, we have received a communication from Osram G.m.b.H. Kommanditgesellschaft, of Berlin. It appears that the new company formed in Stockholm was founded by the Swedish Siemens-Schuckertwerke and the Stockholm A.E.G., and that it does not concern itself with the manufacture of glow lamps. The company is stated to be engaged exclusively in the sale of the manufactures of the Osram Co., of Berlin, referred to above, and it bears the name "Osram A.B."

Foreign Trade.—March Figures.—The following are the values of imports and exports of electrical goods and machinery in March :—

	March. 1921. £	*Inc. or dec.* £	3 months, 1921. *Inc. or dec.* £
Imports.			
Electrical goods, &c.	225,409	+ 146,581	+ 203,328
Machinery	1,295,649	+ 96,110	+3,882,506
Electrical machinery	71,853	+ 14,371	− 8,887
Exports.			
Electrical goods, &c.	1,155,718	+ 203,328	+1,302,386
Machinery	7,299,698	+3,882,506	+11,864,097
Electrical machinery	417,153	+ 266,762	+ 797,768
Re-exports.			
Electrical goods, &c.	30,324	+ 24,056	+ 65,118
Machinery	88,693	− 47,724	− 4,886
Electrical machinery	2,144	− 1,702	+ 6,243

Women's Wages Conference.—Unions represented at the conference at York, on April 8th, with the engineering employers on the subject of women's wages in the industry, declined to accept the new rates proposed by the employers, and adjourned to report on the position to their executives and members. The proposed rates provide for a basic rate, to which would be added an amount fixed for the cost of living and subject to quarterly fluctuations, according to the cost-of-living figures. They would give figures of 32s. per week for women of 18, with increases up to the age of 21 rising to 36s. Overtime and piecework would be calculated on the basic rate.—*Daily Dispatch.*

Cable Manufacturing in Holland.—The report for 1920 of the N.V. Nederlandsche Kabelfabriek, of The Hague, states that no difficulties were experienced in obtaining raw materials, and that after the reduction in the prices of the latter, the wages now formed a much higher percentage of the value of the finished product than formerly. The new machine shop was approaching completion; one of the lead presses had already been delivered and erected, and the second was ready, and was being dispatched by the makers. The rolling mill which was started in the summer had already contributed towards the possibility of completing orders within the stipulated period. As a proof of the confidence manifested in the company's manufactures, the report mentions the receipt from the Amsterdam Municipal Electricity Works of an order for 10 cables for 10,000 volts, of a total weight of 185 tons, which was finished, and the cables were laid in the Ij in August, 1920, so as to connect the Northern generating station with the Southern central station. The accounts show gross profits of 1,577,000 florins, of which 596,000 florins has been written off for depreciation of machinery, buildings, &c., and 30,000 florins allotted to the reserve fund for provident purposes. The balance then remaining, together with the amount brought forward, permits of the payment of a dividend at the rate of 23 per cent., as compared with 34 per cent. in 1919 on share capital of 1,250,000 florins. The share capital was increased to 2,500,000 florins, by means of a new issue made in July, 1920.

Careless Packing. — A correspondent writes :—"A leading trade association is considering the advisability of asking similar bodies to co-operate in a movement to secure the more efficient packing of goods of every description. The need is suggested by a statement made to the association by a carrying company that from December, 1919, to November, 1920, they received over one million claims for loss and damage. It is pointed out that in starting consignments aright it is important to determine, as regards many articles, what type of box to use and how it should be constructed. Dispatch clerks and shipping clerks should be instructed to see that all boxes are properly closed. Poorly assembled or improperly closed receptacles do not give their maximum service. A slight fall or jolt will break them open and expose the contents to damage and theft. Much damage also results from failure to prevent goods from moving about in the package. Movement means injury and breakage. Many firms have found it an advantage to have boxes made to proper size, and invite the box manufacturer to study the nature of the article and how it is disposed for shipment. The contents should, whenever necessary, be protected by bracing or by using "fillers" for open spaces. To reduce the pilferage evil, it has been suggested to the Manchester Association of Importers and Exporters that goods, such as textiles, hosiery, boots, &c., might be packed in wire netting and then made up into cases and bales as usual. The Council of the Association, however, considers that this plan would mean the payment of extra duty, as in some countries duties are charged on the gross weight, that there would be a possibility of valuable goods being torn by the wire netting or spoiled by rust, and that on the whole the suggestion is impracticable. Another plan recommended to the Association is to have bales cross-hooped with a view to checking the extraction of articles that do not go the entire length of the bale. This scheme is to be given a trial, and bales so hooped are to be watched, especially at East African ports, where numerous thefts occur."

Response to Emergency Call.—Nearly 400 men registered as electric train drivers in the Middle Classes Union attended an instructional class in London on April 8th. They attended in response to a call sent out a short time before. "Quite 4,000 of our members are registered as electric motor drivers," said an official of the Union. "Mr. Shortt, the Home Secretary, asked if we could supply any electric power station workers, and the authorities were very surprised when we found within a very short time 14 fully qualified power station controllers. We have every kind of engineer ready and waiting to take on voluntary duties."—*Daily Mail.*

Russo-German Trade Treaty.—The *Morning Post* of April 7th stated that it was reported that the signature of a Russo-German Consular treaty, corresponding to the commercial agreement between Great Britain and Russia, was imminent, the draft being under the consideration of the Soviet Government.

Germany recognises no loss or diminution of the rights of German citizens having industrial or other investments in Russia. Under the treaty German capitalists and others having property rights in Russia will be enabled to return to Russia or send their agents thither to take over their properties and where there are industrial establishments to restore normal working arrangements, and generally the treaty provides for the renewal of commercial relations between the two countries.

Burning Waste Fuel Dumps.—In view of the grave prospects of a prolonged strike on the part of the miners, and the possibility of difficulties of transport, the question of adopting means for burning substitutes for coal has again assumed importance. On the last occasion of a shortage of coal, large quantities of combustible refuse were successfully utilised by electricity works managers in place of coal, and doubtless there are many dumps of such material in industrial districts which are still available for use if necessary.

As explained in our description of the Wolverhampton electricity works (July 30th, 1920), during the war Mr. S. T. Allen, borough electrical engineer, succeeded in burning anything that was combustible by means of a combination of Underfeed stokers with forced and induced draught, and a special "Dutch-oven" furnace, without producing smoke. The "Turbine" furnace which we described in our issue of November 5th, 1920, has also been shown to be capable of burning waste fuel and rubbish which cannot be dealt with on the ordinary grate, and it can be fitted to existing boilers in a few hours.

Amalgamation of French Steel Companies.—The Paris edition of the *New York Herald* reports that three of the largest steel concerns in France are combining to form a new holding company. The Société Anonyme des Forges et Aciéries du Nord et de l'Est is to increase its capital from 46,000,000 to 86,000,000 fr., and will absorb the Société des Forges et Aciéries du Nord et de Lorraine and the Usines Metallurgiques de la Basse-Loire. The new combine will control an ore domain capable of producing 4,000,000 tons, six French coal companies and important coal deposits in England.—*Reuter's Trade Service* (Paris).

New French Companies.—The Société d'Electricité de la Région de Dunkerque is the name of a company formed, with 5,000,000 fr. capital, to carry out all kinds of operations relating to electricity, air, water, gas—their production, transformation, and installation. The offices are at 10, Rue Mogador, Paris.

Under the style of Société des Grandes Réseaux Electriques has been formed at Paris (8, Rue Lammenais) a company for the planning, construction, and installation of electric networks, and their accessories for the transmission, transformation, and distribution of electrical energy. Its capital is 1,000,000 fr. in 500-fr. shares.

Union to "Register" Contractors.—At a meeting of the Swansea Corporation Electricity Committee a letter was read from the local branch of the Electrical Trades Union stating that the time was now opportune for establishing a definite list of *bonâ fide* contractors, the reason being that serious complaints had been received of faulty installations by local employers and unskilled workmen, with the result that occupiers ran the risk of fires breaking out on their premises. The Union was, therefore, determined to set up a list of contractors, which would be duly advertised as and from July 1st next. Councillor Colwill pointed out that the Corporation already observed the Fair Wages Clause in all its contracts, and it could do no more. The Committee decided to take no action with regard to the Union's letter.

Board of Trade Committees.—The *Board of Trade Journal* gives a list of the Board of Trade Committees which are at present in being. The following are included :—

Committee.	Secretary.	Headquarters.
Electrical Communication with Lighthouses Committee.	R. H. Haylett.	Great George Street, S.W. 1.
Miners' Lamps Committee.	E. G. Fudge.	46, Victoria Street, S.W. 1.
Spontaneous Combustion of Coal in Mines Committee.	J. A. Kilpatrick.	46, Victoria Street, S.W. 1.
Water-Power Resources Committee.	T. Turner.	Great George Street, S.W. 1.
Water-Power Resources of Ireland Sub-Committee.	Prof. H. H Jeffcott.	Royal College of Science, Dublin, Ireland.

Reduction in South African Railway Rates.—The South African Railway and Harbour Administration announces that, as from Wednesday, April 6th, a reduction of 6s. 6d. per 2,000 lb. has been made on railway rates for bunker coal to Union Ports and Delagoa Bay. The reduction applies to all coal placed in the bunkers on or after April 6th. No alteration will be made in the existing net railway rates for export cargo coal and industrial coal. The foregoing gives a total reduction of 15s. 5d. per 2,000 lb. on the railway rates in force prior to February 7th, 1921.

German Price Reductions.—The Price Bureau of the Central Union of the German Electro-Technical Industry has made a further reduction in quotations, those for machines and transformers having been brought down on an average about 15 per cent. The selling prices of other products have also been slightly reduced. Prices for smaller and medium machines are now nearly 50 per cent. under those prevailing when the market was at its height.—*Reuter's Trade Service* (Berlin).

Italian Bill to Abolish Monopolies.—The *Tribune* understands that the Cabinet has approved a decree abolishing the monopolies in coffee and electric lamps, and suppressing the Bureau of Trade Monopolies. The revenue lost as a result of the changes will be replaced by Customs or excise duties. It is hoped that the revenue thus accruing to the State will surpass that at present received from the trade monopolies.—*Reuter's Trade Service* (Rome).

English Electric Factories for Canada.—It is reported that factories will be built in this city by the English Electric Co. which will compete on a large scale with the United States concerns, on whose Canadian branches Canada has so far relied for her supply of electrical machinery and equipment.—*Reuter's Trade Service* (Toronto).

According to the *Canadian Electrical News*, Mr. Gordon F. Perry, the President of the National Iron Corporation, Ltd., is chairman of the Canadian Board of the English Electric. Mr. Perry has been in England recently arranging the details, and manufacturing in Canada is expected to start at an early date.

LIGHTING AND POWER NOTES

Aberdeen.—Electric Lighting Scheme Abandoned.—The proposal to use electricity instead of gas for lighting King Street has been dropped owing to the excessive cost, which was stated to be £756

Extensions.—It is not now expected that a public inquiry will be required in connection with the Aberdeen Corporation Provisional Order, 1921, dealing with the proposed extension of the electricity works and the construction of a railway to connect the Caledonian goods yard with the electricity works, as there has been a withdrawal of the petitions objecting to the Order.

Ashford (Kent).—Proposed Electric Lighting Scheme.—At a meeting of the Urban District Council on April 7th, the Lighting Committee reported that as a result of the recent canvass to ascertain the probable number of consumers of electricity, only 83 residents had agreed to take electricity unconditionally. No further action was taken in the matter.

Barrow.—Proposed New Power House.—At the monthly meeting of the Town Council, on April 4th, the Electricity Committee reported that it had authorised the appointment of a small deputation to meet Messrs. Vickers, Ltd., with regard to obtaining a proposed new power house.

Blackburn.—Sub-Station Site.—The Parks Committee has decided not to allocate any portion of Brownhill Park for the purpose of the erection of an electricity sub-station.

Applications for Supply.—The Electricity Committee has received applications to extend the supply of electricity from the new station to Oswaldtwistle, Clitheroe rural district, Ramsgreave, Accrington, and Samlesbury. The Committee is already committed to supply Great Harwood, Rishton, and Darwen, and the new applications have been deferred.

Bradford.—Projected Expenditure.—The proposed expenditure of the Electricity Committee includes mains, stores, and offices and transformer test-room at Canal Road, £8,600 ; motor lorry shed, mess-room, blacksmith's shop, new offices and lavatories at Valley Road works, and roof over storage tank, £19,215 ; Blakehill quarry, £4,150 ; two 500-kW rotaries and switchgear ; caterpillar crane and grab, £2,970 ; accumulator battery, £11,000 ; motor generator, £505 ; and radial drilling machine, £1,460.

Bridlington.—Loan Sanctioned.—The Corporation has received from the Electricity Commission formal sanction to the borrowing of £4,500 for mains and services in connection with the electricity undertaking.

Cannock.—Electricity Guarantee.—The Rural Council has agreed to guarantee to the Wolverhampton Corporation £130 per annum for three years, for the supply of electricity to 40 houses at Bushbury.

Chile.—Water Power Statistics.—From a survey recently made by a department of the Ministry of Public Works in Chile, it appears that the available water power in the Republic amounts to more than 4,000,000 h.p. This is an underestimate, as data regarding many rivers and watercourses are absent, and the total may be safely increased by 1,000,000 h.p. Of this total, concessions have been granted for 1,383,000 h.p., of which only 63,780 h.p. is being utilised for industrial purposes. In view of the fact that the mining industry, ironworks, &c., employ coal to produce motive power equal to 301,000 h.p., and that the railways consume 300,000 tons of coal to produce 100,000 h.p., there is an obviously strong case made out for legislation to enforce the better utilisation of the country's water resources, and more especially because of the high cost of coal at the present time.—*Boletin de la Sociedad de Fomento Fabril.*

Darlington.—Electricity Undertaking and Rates.—Alderman W. E Pease, moving a rate of 13s., on April 7th, said the profits on what should be profit-earning departments were low, but he wished ratepayers to realise that though they were paying a high rate, they were getting water, gas and electricity at extraordinarily cheap rates. Alderman Wooler, who objected to the amount of the rate, said the costs of gas and electricity should be reduced to the lowest point, as it was unfair to derive profits by municipal trading.

Doncaster.—Opposition to Company.—The Electricity Committee, last week, received notice from the Adwick-le-Street Urban District Council of intention to oppose an application by the Electrical Distribution of Yorkshire, Ltd., for an order authorising it to supply electricity in the rural districts of Thorne and Doncaster and the urban district of Adwick. The Committee decided to recommend opposition to the company's application for power to supply in the area of the proposed North-East Midlands Electricity District.

Dover.—Supply to Lighthouse.—It was reported recently that Trinity House had declined to accept the terms offered by the Electricity Committee for a supply of electricity to the South Foreland lighthouse, and the engineer was instructed to submit alternative terms previously suggested, viz., Trinity House to find half of the estimated capital cost of the extension (£2,000), and pay for electricity at the rate of 10d. per unit for the first 5,000 units, and 5½d. per unit thereafter, with a guaranteed minimum of 15,000 units, which would produce £437, the Corporation to lay the necessary main and to supply a transformer, and to reserve the right to make additional connections at any point along the route.

Dublin.—Street Lighting.—Owing to the operation of the military "Curfew" order, it is proposed that only one street light in three shall be used.

Eastbourne.—Proposed Extensions.—At a meeting of the Town Council, the electrical engineer submitted details of a scheme for the extension of plant and mains, at an estimated cost of £65,443. Consideration of the report was postponed.

Electricity District.—Aire and Calder Inquiry.—The inquiry by the Electricity Commissioners into the three rival schemes in respect of the West Riding (Aire and Calder) Electricity District, which was to have been opened at Leeds on

Tuesday, has been postponed to a date to be fixed when industrial conditions are more settled. The Town Clerk of Bradford (Mr. N. L. Fleming), as solicitor to the Conference of West Riding local authorities who promoted the Bradford Conference scheme, received notice of the postponement on Friday, the Commissioners deeming it inexpedient to commence the inquiry under the present uncertainty of conditions.

Hereford.—Loan Sanctioned.—The Town Council has received sanction to a loan of £34,750 for mains, sub-station, transformers, &c., in connection with the supply of electricity in the Ross and Lydbrook areas.

Hove.—Converting Plant.—The Electricity Committee has approved the purchase of another 300 kW converting set, similar to two already installed. The purchase of a spare armature was also sanctioned. The new set will be employed as a stand by for use in the event of the other sets being overloaded.

Hoyland Nether.—Transfer of Order.—The Urban District Council has applied for powers authorising the Council to transfer its undertaking to the Electrical Distribution of Yorkshire, Ltd., and for an extension of time of the Council's Electric Lighting Order of 1912, for the laying of mains, &c.

Japan.—Growth of Electrical Industry.—The *Electrical World* states that official figures issued by the Department of Communications of Japan put the number of supply stations in the island at 715, the electric railways at 42, and the companies operating both central stations and railways at 53, making a total of 810 electrical enterprises, or an increase of 57 over last year. The total capital of central stations is put at 763,000,000 yen, of electric railways at 56,000,000 yen, and of central stations and railways which are combined at 453,000,000 yen—a total of 1,272,000,000 yen, indicating an increase over last year of 177,000,000 yen.

Liverpool.—Loan Sanctioned.—The Corporation has received the formal sanction of the Electricity Commissioners to the borrowing of £50,000 for prospective expenditure on electric mains.

London.—Camberwell.—The Borough Council, which asked its local members of Parliament to oppose the County of London Electric Supply Co.'s Bill, has had the following letter from Lieut.-Colonel Sir Frederick Hall:—

"I really fail to understand the opposition of your Borough Council to the proposed measure, as I should have thought that Camberwell had everthing to gain and nothing to lose by these proposals. Surely the cheaper a company is able to generate current, the better its position for supplying its consumers with electricity at a cheaper rate.

"You will recognise that it is not proposed to build a generating station in Camberwell, but that the borough is to be supplied with distribution mains. If there had been a suggestion to erect a generating station in Camberwell, I could, to a great extent, understand the opposition, as it might be justified, because your Council could argue that when the time comes for purchase they want to be in a position to buy a complete undertaking—that is to say, generation as well as distribution; but the County of London Electric Co. have no generating station in the district, and have no intention of building one, as I think I am right in saying they are supplied at the present time from Wandsworth.

"You will, of course, realise that under the circumstances I cannot support the resolution contained in yours under answer."

Hackney.—The *Poor Law Officers' Journal* says the Hackney Guardians propose to replace gas with electricity at their Homerton Institutions, and have decided to generate electricity themselves, instead of asking for a municipal supply. The schemes are estimated to effect an annual saving, based on the present prices of fuel, gas and electricity, of approximately £8,000—with the capital expenditure entirely written off. In addition to the installation of electric lighting plant—which has not yet been put into commission, and the anticipated saving on which has not been included in the calculations already made—the schemes comprise the utilisation of the exhaust steam in conjunction with the centralisation of the domestic hot-water supply; the burning of coke-breeze in lieu of steam coal; and the centralisation of the heating systems. Since they were first inaugurated the total expenditure has been £14,693, while the results have been so economical that the whole of this outlay has already been more than recouped, and, as stated, the Guardians are now promised a saving of £8,000 a year.

The Electricity Committee reports that it has secured an e.h.p. feeder and switchgear, from the National Projectile Factory at Hackney Marshes, at a cost of £2,379. The Committee has saved a great deal of expenditure in this manner; it previously secured an e.h.p. cable and switchgear from the factory for £2,516.

Fulham.—The Electricity Committee recommends the provision of two additional 200-kVA transformers, and the necessary switchgear at Messrs. Van den Bergh's sub-station. The estimated cost is £1,100.

The Council has secured the approval of the Electricity Commissioners to improvements at the electricity works. These include the replacement of economisers, alterations to the transformer house, fixing a new centrifugal pump and accessories at an estimated cost of £21,000.

Islington.—In order to meet an anticipated deficit on the electricity undertaking, the Finance Committee recommends that the charges for electricity be increased as from the March meter readings as follows:—For units sold at basic rates of 1¼d. and upwards from 70 to 100 per cent. on the basic rates; for units sold at 1d. and under, from 120 to 150 per cent. on the basic rates.

Manchester.—House Lighting.—At a recent meeting of the City Council, it was proposed that the houses on the Anson estate should be illuminated by gas, and those on other estates by electricity. An amendment was carried that electricity be adopted throughout.

Mohill (Co. Leitrim).—Power Station Destroyed.—The power house has been destroyed by fire. The occurrence is stated to have been due to an accident.

Musselburgh.—Supply Rights Question.—It was reported at a special meeting of the Town Council that a firm of manufacturers in Musselburgh had refused to take a supply of electricity from the Musselburgh Electric Light and Traction Co., and had asked for a supply from the Edinburgh Corporation. The latter authority was willing to give a supply if the consent of the local authority could be obtained. The Electric Light Co. objected to this arrangement, as it would infringe rights which it had obtained at great expense. The question was referred to the Law Committee to ascertain in what position the Town Council would place itself by withholding or giving consent.

Navan.—Electric Lighting Scheme Postponed.—The Munster and Leinster Bank intimated to the Urban Council that the directors could not see their way to grant a loan of £10,000, repayable in 20 years, for a public electric lighting scheme. It was therefore agreed to postpone the scheme for 12 months

Perth.—Company's Scheme Approved.—Subject to protective clauses being inserted, the County Council has consented to an electric lighting order being applied for by the promoters of the Dunblane electricity supply scheme.

Stockton-on-Tees.—Allocation of Profits.—In his review at the Corporation's annual finance meeting Ald. F. T. Nattrass stated that the electricity undertaking did not affect the rate levy on that occasion, but the Committee anticipated being able at the end of the new year to transfer a surplus of £1,204 to the reserve fund, from which the Committee contemplated providing for the cost of the reconstruction of switchboards and the extensive renewal of feeder cables.

South Shields.—House Lighting.—At a meeting of the Electricity Committee, the electrical engineer stated that he had reported to the Housing Committee the negotiations that had been proceeding between himself and the County of Durham Electrical Power Distribution Co. with regard to the terms on which the company was prepared to supply electricity in bulk within the area covered by the proposed extension of the borough. The Housing Committee had instructed him to endeavour to secure further concessions from the company, and the matter was having attention.

Extensions.—The engineer also introduced the question of extending the boiler house at the generating station with a view to making provision to accommodate at an early date, two new water-tube boilers, complete with economisers, induced draught fans, chimney stack, and all necessary auxiliaries. The demand for electricity is constantly increasing for lighting, heating and power, and this, together with the further demands of the tramway department for the proposed light railway, requires that preparations be made for extra steam-raising plant at an early date so as to provide for the department's requirements in this direction for the winter of 1922. The borough engineer was instructed to prepare plans, specifications, quantities, and estimates for the building.

Swansea.—Oil Fuel Proposed.—The Electricity Committee received a report from the electrical engineer stating that, in consequence of the shortage of storage accommodation for coal, the Committee should take into consideration the question of providing an alternative method of firing the boilers by means of liquid fuel. With a few modifications the change could be made, and at the shortest notice coal-firing could be resumed. He did not say that oil was cheaper than coal, but in times like the present coal crisis, it was necessary to have liquid fuel as a stand-by. The Committee referred the matter to the Standing Sub-Committee for consideration.

Teignmouth.—Electricity Supply.—The Urban District Council has resolved that Messrs. J. & W. Purves be informed that it would welcome the introduction of an electricity supply to Teignmouth, but that it has no wish to take over the Teignmouth Electric Light Order held by the firm.

Wallasey.—Report on Breakdowns.—The Special Joint Committee of the Corporation appointed to inquire into the causes of the breakdowns at the power station has issued its report, which makes the following recommendations:—(1) Immediate steps should be taken to reorganise the staff of the generating station; (2) the engineer's office should be removed to, and adjoin, the Poulton power station, and that office accommodation should be provided for the station superintendent; (3) that the electrical engineer should reside in the borough as near to the station as possible; (4) that an expert should be called in to investigate the primary cause of the corrosion of the pumps, and that periodical chemical tests should be made of the boiler contents; (5) that the turbines should be so controlled as to ensure steam being cut off when sets are standing; (6) that the boiler feed pumps should be periodically tested and opened out for inspection; (7) that the pumps should be so fixed that they can be easily examined, dismantled, and in a position that is reasonably clean, and that an additional feed pump be installed.

West Hartlepool. — Station Closed Down. — The electrical engineer reported, last week, that in consequence of the industrial situation the Seaton Carew Iron Co. was closing down its blast furnaces, so that no waste heat would be available for the Corporation's generating station. It was decided to close down the generating station for the present, and take a bulk supply from the Cleveland and Durham County Electric Power Co.—*Yorkshire Post.*

Worcester.—Future Extensions. — The Electricity Committee has issued a report in which it points to the probable increase in the demand for electricity during the next three years. It will be necessary to carry out considerable extensions, and the cost of these is estimated at £62 200. The Committee desires authority to ask for loans to carry out the work, and in the event of its failing to secure sanction to borrow the amount it proposes to ask the Electricity Commissioners for an order making a sub-district of South Worcestershire to be administered by a committee on which Worcester should be represented.

TRAMWAY AND RAILWAY NOTES.

Accrington.—No Restoration of Penny Fares.—An effort to refer back a recommendation in opposition to the restoration of penny fares was defeated at a meeting of the Council. Ald. Higham, chairman of the Tramways Committee, said such a policy, however much stages were shortened, would bring the tramway undertaking on the rates. Nothing had been put to reserve for the renewal of the track during the past six years.

Australia.—Brisbane.—Up to a month or two ago, negotiations had been proceeding for the acquisition by the Queensland Government of the Brisbane tramways at the expiration of the holder company's "franchise." The company stated a price in the neighbourhood of £3,000,000, but having regard to the great expenditure which would have to be incurred after purchase, the Government is not inclined to take any further steps in the matter at present.

Melbourne.—From March 7th the fares on the Metropolitan Tramway systems were increased. The 1d. fare was raised to 1½d. on weekdays and 2d. on Sundays and holidays. The new rates are expected to give an increase in revenue of £160,000 up to the end of the year, or £195,000 for the complete financial year.

Barrow. — Cancellation of Deficit. — The Finance Committee has decided to grant the Tramways Committee the sum of £14,000 to enable an accumulated deficit of £15,680 on the undertaking to be wiped out. The balance of the deficit is to be carried forward to the next period, when it is hoped that decreased expenditure will make it possible to cover the amount.

Bradford.—Deficit.—For the first time for many years, and in spite of record receipts, the tramway undertaking incurred a loss of about £80,000 during the year just ended. The chairman of the Tramways Committee attributed this deficit chiefly to the high expenditure upon renewals, which represented 3d. per car-mile.

One-man Cars, &c. — Having recently received from the Ministry of Transport a statement that no objection is raised to the use of a new single-deck type of railless car, with only one man in charge, the Bradford Tramways Committee has instructed the general manager to prepare an estimate of the cost of these cars, and to obtain information as to the working expenses of petrol-motor omnibuses operated in other towns.

The Committee, at its April meeting, resolved to recommend to the Parliamentary Sub-Committee of the Corporation that in the next Bill promoted in Parliament by the Corporation, power be sought for the construction and operation of double-deck, top-covered railless trolley vehicles of a four-wheeled typed, weighing not less than 7½ tons, and of a six-wheeled type weighing not less than 9½ tons, unladen weight in both cases.

Darlington.—Effect of Fare Increase.—It was stated at a recent meeting of the Council, that since increased fares had been put into force, the revenue had increased by 4 per cent., while the number of passengers carried was reduced by 7½ per cent.

Dewsbury.—Extensions Deferred. — At a Town Council meeting, last week, it was reported that the Electricity Committee had considered a proposed extension of the town tramway termini in the Market Place, so as to avoid congestion, but found this would cost over £4,000, and under the present conditions it had decided against the expenditure. It had also, for the same reason, dropped a proposed scheme of running cars by Longcauseway, which would cost between £7,000 and £8,000. A proposition that the matter should be referred to the General Purposes Committee was defeated, and the minutes were adopted.

Edinburgh.—Car Conversion.—Under the supervision of the tramway manager (Mr. Pilcher), one of the old cable cars has been converted at the Shrubhill works for use as an electrically-driven vehicle at a cost of about £300. This is a great saving to the Corporation, as a new car is estimated to cost £2,000 at the present time.

Essex.—Light Railway Loans.—The Ministry of Transport recently informed the Parliamentary Committee of the Essex County Council that, owing to a decision of the Cabinet, the Ministry was unable to sanction any grants or loans for the construction of light railways for a period of 12 months.

Liverpool.—Effect of Fare Increase.—Liverpool Corporation tramway traffic returns show that during the first three weeks of the increased fares, there was a decrease of no less than 2,374,304 passengers, yet there is a daily increase in revenue of between £500 and £600. The present increase in the receipts, however, is only about one half of what is required to meet the year's expenditure.

Newcastle-on-Tyne. — Prospective Expenditure.— The estimated expenditure by the Tramways Committee during the current year includes the following items:—Alterations and new pumps and pipes in pumping station, £4,000; renewals to cars, £12,500; purchase and equipment of motor-buses, £2,000; reconstruction of overhead work, £4,000; new plant in power station, £35,000; renewals to permanent-way, junctions, &c., £46,360; total, £103 860.

New Routes Opened.—On April 8th the new tramway routes to West Moor and Forest Hall were formally opened. This completes a programme of construction commenced by the Corporation in 1914. The system now extends from one side of Gosforth Park by a wide circular route to the other side, and it is hoped that the circuit will be completed through the Park under a foreshadowed scheme of construction.

Uruguay.—Tramways *v.* 'Buses.—The High Court of Justice has recently given an important decision affecting tramway companies' rights. The tramway companies of Monte Video brought an action some time ago against the Government for infringement of their rights by instituting a motor-'bus service over routes served by them. The Court of First Instance decided in favour of the Government. The companies appealed, and the Court of Second Instance decided in their favour. The High Court has now reversed this decision, giving judgment in favour of the Government.—*Review of the River Plate.*

United States.—New York Improvements.—In the recently-published report of the New York-New Jersey Port and Harbour Development Commission, a number of proposals are made for the re-organisation of services at the two ports.

At the present time there are 12 railways with termini at the port of New York, each of which has its own clearing arrangements; there is practically no means by which trains from one system can be transferred readily to another system. It is proposed, therefore, to construct "belt lines" in the vicinity of the Port; over these lines freight cars, connected with all the existing lines, will run. A series of multiple-story clearing houses or "freight terminals" will be erected, and beneath these will be tunnels in which will operate small electric trailer trucks. These trucks will take over goods from trains at a transfer yard. At the freight terminals lifts will be provided capable of taking one of the trailer trucks at a time, and raising it to the correct floor of the building.

Wednesbury.—Track Renewals.—The South Staffordshire Tramways Co., Ltd., has intimated to the Wednesbury Town Council that it intends to relay the track along the Darlaston Road to the Bull Stake.

TELEGRAPH AND TELEPHONE NOTES.

Cable and Wireless Rates.—"Deferred Rate" Services Re-opened.—Marconi's Wireless Telegraph Co., Ltd., has re-started its deferred (L.C.O.) service to Canada, Newfoundland, and the West Indies, which has been suspended since 1917. The cost of transmission by this route is less than that for a corresponding service by the cable companies. On April 9th the Western Union Telegraph Co. re-introduced its deferred service between the United Kingdom and the United States of America and Canada, which has been suspended since September, 1918.

Cable Delays.—It will be remembered that during the sittings at Washington of the International Conference on Communications, last autumn, statements were made to the effect that commercial telegrams passing between the U.S.A. and the Continent had been intercepted by the British authorities, and the impression was created that they were purposely delayed, or improper use had been made of the information they contained. The correspondence which passed between the British Ambassador at Washington and the U.S. Secretary of State, together with a note by Lord Curzon on the subject, has been published as a White Paper (Cmd. 1,230).

Cuba.—New Cable.—Mr. C. H. Mackay, president of the Commercial Cables Postal Telegraph System, announced recently the inauguration of a new cable between Miami (Florida) and Havana (Cuba), and also of several new telegraph offices, which are calculated to provide increased reliability and improved service with Cuba, and a competitive telegraph service on the east coast of Florida.

Long-distance Telephony. — *The Times* correspondent at Washington states that on April 11th he took part in a long-distance telephone conversation from the Pan-American Union building to Havana, and with a wireless operator in Catalina, an island in the Pacific off Los Angeles. He proceeds : "As plainly as though we were all seated in the same room, I heard Havana speaking to Catalina and Catalina answering. It was by far the longest conversation in point of distance ever held by telephone. The message to which I listened passed through 115 miles of cable, connecting Havana and Key West, in Florida, thence over the land wires connecting the chief towns of the Atlantic seaboard with New York, Chicago, Omaha, Salt Lake City, Sacramento, San Francisco, Fresno, and Los Angeles, and from Los Angeles by wireless to Catalina, 29 miles from the mainland, a total distance of 5 056 miles. In quick succession the transcontinental roll call was taken, and we heard voices responding from 26 towns situated in 19 different States. Col. John J. Carty, the vice-president and chief engineer of the American Telephone and Telegraph Co., to whose organising ability the demonstration owes its success, afterwards observed : Had to-day's conversation been held over land wires only, it could have been heard exactly with the same clearness over 10,000 miles of land wires, weighing 435 lb. per mile, and equipped with telephone repeaters and other apparatus of various kinds used in America."

Stock Exchange and Wireless.—The Stock Exchange demands upon the London-Paris wireless service are such that special relays of Marconi messengers have been made available, from April 11th onwards, at 75, Old Broad Street, Shorters Court (American door), and New Court door. By the attendance of these messengers between the hours of 10.30 a m. and 3 p.m. it is hoped to save members the necessity for telephoning the Fenchurch Street office.

Empire Wireless Chain.—It will be remembered that the Imperial Wireless Telegraph Committee, 1919-20, of which Sir Henry Norman, M.P., was chairman, and which reported last June, recommended, among other things, that a scheme of Imperial wireless communications should be established connecting the communities of the Empire by geographical steps of about 2,000 miles each ; and that these stations should be planned by a Wireless Commission of about four members. A Commission was accordingly appointed. It consisted of Lord Milner (chairman), Dr. Eccles (vice-chairman), Mr. L. B. Turner, Mr. Shaughnessy, and Lieut.-Col. Crawley (secretary), who was assistant secretary to Sir H. Norman's Committee, of which Dr. Eccles and Mr. Turner were members With the exception of Lord Milner, the members of this Commission are now engaged, says *The Times*, in investigating the latest developments of wireless telegraphy. They will report this summer, but no decision with regard to Empire wireless will be taken until after the Imperial Conference which is to be held in London in June.

France.—Wireless Communication.—An objection has been raised by M. Poulle, a member of the Senate, against the Convention of October 29th, 1920, handing over the French wireless plant and communication systems with Great Britain, Spain, and the United States to a private company. It is declared that such a convention is null and void by law, as the Posts and Telegraphs are a State monopoly. M. Poulle has tabled a resolution inviting the Government to submit the Convention to Parliament for its approval, and M. Laffont, Under-Secretary for Posts and Telegraphs, has agreed to this course.

M. Laffont, on April 9th, explained that the contract did not confer a monopoly on the company. Furthermore, the employés and the members of the Board of Administration must be Frenchmen, and the working, as well as the tariffs, must be under the control of the Administration ; the work of construction must be carried out at the company's expense, and all working expenses be borne by the company. Consequently, continued the Minister, there was no risk to the State which had benefited from the company's receipts. The Minister's explanations satisfied the Senate and the resolution of M. Poulle was referred to the Senate Financial Committee.—*Reuter's Trade Service* (Paris).

Greenland.—Wireless Station. — According to the Copenhagen *Sociald Demokraten*, the building of a wireless telegraph station is again under consideration, and the British authorities are said to have approached the Danish Government in connection with the matter.—*The Times.*

Telephone Service.—Cancelled Contracts.—Mr. Pike Pease, replying to a question in the House of Commons, said that about 10.000 subscribers had cancelled their telephone contracts during February and March. As, however, that number was about the average, it was impossible to say how many cancellations were due to the increased rates.

Parliamentary Committee's Inquiry. — The recently appointed Parliamentary Committee charged with inquiring into and reporting upon the working of the telephone service, met for the first time for the taking of evidence on April 6th at the House of Commons. The first witness was Sir Evelyn Murray, Assistant Secretary to the Post Office. There was a full attendance of the 15 members of the Committee, over which Mr. E. Cecil presided, and Mr. William W. Cook (a consulting engineer who was connected with the old National Telephone Co.) was appointed the Committee's scientific assessor.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—April 27th. Victorian Railway Commissioners, Spencer Street. Caustic soda primary cells, complete (Contract No. 33,914).*

Postmaster-General's Department (Melbourne). May 31st. Telephone switchboards (Schedule No 1,670).*

Postmaster-General's Department, May 31st. Supply and delivery to several States manual telegraph transmitting devices (Schedule No. 1.680). (April 8th.)

May 2nd. With reference to the recent invitations to tender by the Victorian Government Railways for 12 miles of two-core, lead-sheathed, wire-armoured 2 200-volt cable, the Department of Overseas Trade learns from H.M. Senior Trade Commissioner in Australia that the Railway Department is prepared to give consideration to alternative offers for cable with the section of each core ·0145 sq. in., in lieu of ·015 as originally specified.

May 31st. Victorian Electricity Commissioners. Morwell power scheme : Street poles (Specification No. 47) ; copper cable (Specification No. 66). (See this issue.)

Victorian Railway Commissioners. June 22nd. One electric lifting magnet (capacity ½ ton), one 440-V motor generator.

June 29th. Supply of 1-ton platform type industrial storage battery trucks, also battery charging equipment.—*Reuter's Trade Service* (Melbourne).

Ballinrobe. — April 23rd. Electricity Supply Co. Wiring of consumers' premises. (April 8th.)

Belgium. — May 27th. The Service d'Etudes et de Controle des Applications de l'Electricité, 52, Boulevard du Regent, Brussels. For the supply and installation of ten electrically operated capstans in connection with the locks on the Upper Scheldt.

Buenos Aires.—June 3rd. The Commercial Secretary to H.M. Legation at Buenos Aires (Mr. H. O. Chalkley) reports that the Board of Sanitary Works of the Nation at Buenos Aires is again inviting tenders, to be presented by 3rd June, for the supply and erection of the plant and accessories for a new generating station, previous tenders having been called for in 1919 and 1920. The plant comprises three four-cycle Diesel engines of 375-h.p., and adapted to run on crude petroleum from Comodoro Rivadavia, and three three-phase alternators, each of 250-kW, 2,200 volts between phases, 50 cycles and power factor of ·8. A copy (in Spanish) of the general conditions of tender and specification, also a blue print showing the general layout of the plant, can be seen at the Department of Overseas Trade in London, on application to Mr. Holloway (Victoria 9040 : Extension 4) until April 23rd.

Dewsbury.—April 23rd. Electric-light installation at Eastborough Working Men's Club, Battye Street. Specifications, &c., the Secretary.

Fiji Islands.—The municipality of Suva invites tenders, closing June 30th, for the supply and erection of a 200-kW, 480/520-V, three-wire, d.c. generator, directly coupled to a 300-h.p. vertical Diesel oil engine, together with accessories for generator and panel.—*Reuter's Trade Service* (Melbourne).

Ipswich.—Electricity Supply Department. One 500-kW rotary converter or motor converter. (See this issue.)

Jugo-Slavia.—May 1st. The Serb, Croat, and Slovene Ministry of Public Works. Erection of a power-station, main conductors and transforming stations in connection with an electrical scheme at Kostolac for the supply of energy to Belgrade, Semlin, &c.*

Keighley.—April 23rd. Tramways Department. One 2 to 3-ton petrol chassis, one 2 to 3-ton petrol end-tip wagon. (See this issue.)

London.—L.C.C. April 18th. 5,500 tons of standard steel girder tramway track rails, lipless track rails and renewable guard rails with fastenings. Chief Engineer, County Hall, Spring Gardens, S.W. 1.

Lowestoft.—April 18th. Electricity Department. L.p. cable feeder pillars, joint boxes, &c. (April 8th.)

Manchester.—May 2nd. Electricity Committee. Three steam turbine-driven boiler feed pumps. (See this issue.)

New Zealand.—April 19th. Public Works Department. H M. Trade Commissioner has forwarded particulars of a call for tenders for 6 000 pin insulators, suitable for a line operating at 66,000 volts between phases. Tenders (accompanied by deposit of £100) to the Secretary, Public Works Tenders Board, Government Buildings, Wellington. Specifications may be seen at the Department of Overseas Trade, 35, Old Queen Street (Room 59), Westminster, S.W.1.

South Africa.—Pretoria.—May 10th. Municipality. Switchgear. Tenders, marked "Electric Light and Power Department, 1920 Extensions, Contract No. 5," to Deputy Town Clerk, Municipal Offices, Pretoria. Deposit, five guineas. Further particulars may be obtained from the general manager of the Electric Light and Power Department or from the consulting engineer, Mr. G. M. Clark, 40-42, Meischke's Buildings, Johannesburg.

Johannesburg. — June 22nd. South African Railways and Harbours. Electrification of Capetown-Simonstown and Durban-Maritzburg lines: Overhead equipment of permanent way and overhead transmission line, switchgear and accessories, and trackbonds. (April 1st.)

Spain.—Madrid.—April 30th. La Sociedad de Ferrocarriles Electricos, Plaza de Canovas 4, Madrid. 2,750 metric tons of rails, fish plates, nuts, bolts, points, &c., for the Calahorra-Arnedillo Electric Railway.

St. Anne's - on - Sea. — Electricity Department. One natural draught cooling tower. (See this issue.)

St. Helens.—May 1st. Electricity Department. One d.c., 3-wire, distributing switchboard, complete with supporting steelwork. (April 8th.)

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Belgium.—Five tenders were received by the Société Nationale des Chemins de Fer Vicinaux, of Brussels, last week, for the supply and laying of the underground armoured cables required in connection with the distribution of the current for the lines in the Louvain district, the lowest offer (175,665 francs) being that of the Société Omnium Electrique, of Dison, Belgium.

The Belgian Post and Telegraph authorities in Brussels last week placed some large contracts for miscellaneous telephone material, the principal orders being divided between the New Antwerp Telephone and Electrical works, of Berchem, Antwerp, and the Bell Telephone Manufacturing Co., of Antwerp.

Bolton.—Tramways Committee. Accepted :—

400 tons of tram rails and 10 tons of fish plates.—W. Scott, Ltd.

Bradford.—Electricity Committee :—

Ash-handling plant for No. 4 boiler-house at Valley Road Works, £7,923.—Underfeed Stoker Co., Ltd. (London).

Steelwork for foundations of new cooling towers at Valley Road, £530.—H. Barrett & Sons Ltd.

Steel casing cover for vertical turbo-generators at Valley Road, £725.—British Thomson-Houston Co., Ltd.

Canterbury.—Town Council :—

Steam pipe work, Electricity Works, £917.—John Spencer, Ltd.

Standard steel cubicles, for switchgear, £100.—Ferguson, Pailin, Ltd.

Steel framework supports for oil tank, £69.—Superheater Units, Ltd.

Cork.—Electric motors for lighting, refrigerating plant, &c., for the Irish Creameries and Exporters' Association, Ltd., Cork.—The Electric Tramways & Lighting Co., Ltd.

Doncaster.—Electricity Committee :—

Construction of foundations for installation of new plant at Electricity Works, £4,139.—C. Sprakes & Sons.

Folkestone.—Town Council :—

E.l. installation, Enteric block, Sanatorium. £38, plus £30 for extension of main cable.—Marchant & Co, Folkestone.

Electric lighting, zigzag path (lights for three standands, lamp tops, five other lights, wires and cables, £163.—Folkestone Electricity Supply Co., Ltd.

Nigeria.—The civil engineering and contracting department of Sir. W. G. Armstrong, Whitworth & Co., has obtained, in competition, the contract, from the Crown Agents for the Colonies, for the Ebute Metta workshops, which are to be erected near Lagos for the Nigerian Government Railways. The contract consists of the supply, erection and equipment of new locomotive shops, carriage and wagon shops, an electrical power-station, saw-mills, &c. The contract time for completion (says the *Financial Times*) is two years.

South Africa.—Mossel Bay, Cape Province.—The tender of Messrs. Higham & Co., of Mossel Bay, has been accepted by the municipality for the house-wiring of all buildings to be connected to the new municipal supply, at £2 7s. 6d per point for enamelled close-joint conduit laid on the surface, with additional prices for concealed work, &c.

Beaufort West, Cape Province.—The tender of Messrs. R. G. Jack & Son, of Cape Town, has been accepted for the municipal house wiring.

Swansea.—The Corporation Electricity Committee last week accepted the tender of the Switchgear Construction Co. for switchgear for the station, price £959. The engineer (Mr. Burr) reported that two tenders had been received for meters, one from a British firm that had bought German meters, which were offered at £2 2s. each, and the other from a British firm offering British meters at £2 18s. The quality was about the same, and he wanted the instructions of the Committee, as the German meters meant a considerable saving, seeing that he required 600 meters. During discussion it was stated that probably these meters were bought before the reparation proposals were made, under which the Government intends to hold 50 per cent. of the cost of German exports by way of payment of the German indemnity; but the chairman, Mr. Alex. Sinclair, said that doubtless in any future exports the Germans would put the 50 per cent. on the price. Councillor Daniel Jones moved that the Committee accept the British meters. Was it worth while considering, seeing that so many British works were at a standstill? "Be hanged to the Germans and their goods," he added. Eventually, however, the matter was deferred pending further inquiries as to the effect of the reparation proposals.

Wakefield.—Electricity Committee. Accepted :—

Constructional work, foundations, pipe lines, &c., the basis of payment to be 10 per cent. on materials used and 20 per cent. on wages paid.—Parker & Sharp.

Wolverhampton. — Corporation Electricity Committee. Accepted :—

British Insulated and Helsby Cables, Ltd, £42,237, for the supply, laying and jointing of a 33,000-volt trunk main and pilot cable between Wolverhampton and Cannock.

British Electric Transformer Co., Ltd.—Four 2,000-kVA, 33,000 and 6,000-V single-phase transformers, £9,921.

Metropolitan-Vickers Electrical Co., Ltd.—Switchgear units, including protective gear for Hilton sub-station, £2,448, plus 10 per cent. for contingencies; battery and motor generator, £250.

General Electric Co., Ltd.—Switch and metering gear for Cannock sub-station, £1,850, plus 10 per cent. for contingencies; battery and motor generator, £250.

Reyrolle & Co., Ltd —3,000-V, three-phase oil switch and panel as an extension to the existing switchboard, including special relay, for Commercial Road generating station, £1,272, plus 10 per cent. for contingencies.

Ferguson, Pailin, Ltd.—Eight sets of e.h.p. switch cubicles, £104 each set. £250 is to be paid to the Metropolitan-Vickers Electrical Co, Ltd., as an extra to their contract for the supply of one 250-kW rotary convertor.

Worthing.—Electricity Committee. Accepted :—

Feeder cables, £2,234.—Callender's Cable and Construction Co., Ltd.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, April 15th. At Caxton Hall, Westminster, S.W. At 8 p.m. Paper on "The Metering of Steam," by Mr. C. R. Sams.

Electrical Power Engineers' Association.—Lectures on "The Work, Aims and Scope of the Electrical Power Engineers' Association," will be given on Saturday, April 16th, at the Y.M.C.A., Leeds, at 6.30 p.m.; Wednesday, April 20th at the Connaught Hall, Newcastle-on-Tyne, at 7 p.m.; and on Saturday, April 23rd, at the Royal Victoria Hotel, Sheffield, at 7 p.m.

North of England Institute of Mining and Mechanical Engineers.—Saturday, April 16th. At the Wood Memorial Hall, Newcastle-on-Tyne. At 2 p.m. General meeting.

Royal Society of Arts.—Monday, April 18th. At John Street, Adelphi, W.C. At 8 p.m. Cantor lecture, "Recent Applications of the Spectroscope and the Spectro-photometer to Science and Industry," by Mr. S. J. Lewis.

Institution of Electrical Engineers.—

North-Western Centre.—Tuesday, April 19th. At the Albion Hotel, Piccadilly, Manchester. At 7.30 p.m. Smoking concert.

South-Midland Centre (Students' Section)—Tuesday, April 19th. At the University, Birmingham. At 7.30 p.m. Address by Mr. F. Forrest. Annual general meeting.

Institution of Civil Engineers (Students' Section).—Wednesday, April 20th. Visit to the electric generating station (L. & N.W. Rly.), Stonebridge Park.

Chemical Society.—Thursday, April 21st. At Burlington House, Piccadilly. W. At 8 p.m. Ordinary scientific meeting.

Manchester Wireless Society.—Thursday, April 21st. At the Albion Hotel. At 7.30 p.m. Ordinary meeting.

Roentgen Society.—Thursday, April 21st. At the University College, Gower Street, W.C. At 8.15 p.m. General meeting.

Edinburgh Electrical Society.—Friday, April 22nd. At the Philosophical Institute. At 8 p.m. Open night.

Physical Society of London.—Friday, April 22nd At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary meeting.

Royal Institution of Great Britain.—Friday, April 22nd. At Albemarle Street, W. At 9 p.m. Lecture on "Electro-Synthesis in Organic Chemistry," by Sir James Walker, F.R.S.

Technical Inspection Association.—Friday, April 22nd. At the Royal Society of Arts, John Street, Adelphi, W.C. At 7.30 p.m. Lecture on "The Physical Properties of Clay," by Mr. A. S. E. Ackerman.

NOTES.

The late Mr. T. E. Gatehouse.—We regret that in our last issue the birthplace of Mr. Gatehouse was incorrectly given as Eye, in Suffolk; his early boyhood was spent at Eye, but he was born at Norwich, in Norfolkshire.

The Prince of Wales's Calendar.—The Prince of Wales has given permission for the National Portrait Fund to publish "The Prince of Wales Calendar for 1922," in aid of all those men of the three Fighting Services, irrespective of rank, who defended their Empire with self sacrificing loyalty and devotion, and now find themselves in want. The Calendar is of beautiful design, and mounted upon it is a specially-selected unpublished portrait of the Prince reproduced in English photogravure. In commending this Calendar and its object to our readers we strongly suggest that before ordering their usual supplies for 1922, all firms should make a point of communicating with the Hon Secretary, The National Portrait Fund, 13, Duke Street, St. James's London, S.W. 1 who will willingly send samples and full particulars. It is hoped that every commercial house will follow the Prince's lead in this great cause by giving its practical support.

Street Accidents.—An official return of street accidents in the United Kingdom during 1920 records a serious increase over the 1919 figures. Fatal accidents numbered 2,837, as against 2 628 in the previous year, while non-fatal accidents rose from 48,698 to 54,910; these figures show a percentage increase of 12·5. An analysis of causes attributes 2,527 accidents to tramway cars, horse-drawn vehicles were responsible for 2,836, omnibuses for 1,756, and "other mechanical vehicles" for 10,636 accidents. To this last class 443 deaths are attributed, tramway cars caused 41 deaths, omnibuses 82, and horse-drawn vehicles 73. The greatest number of accidents in any one town occurred in Liverpool (2,145). In Glossop only one (non-fatal) accident occurred.

A Wirelessly-Controlled Clock.—Mr. T. S. Casner, a mechanical engineer, has perfected a clock that is entirely automatic in its operations, and is corrected daily by the wireless impulse sent from Washington for that purpose. It is self-winding, and besides indicating time itself, the clock will operate and control any number of secondary clocks. The apparatus is so designed that it selects the one signal flashed at the exact hour of 12 noon, and makes possible, it is believed, for the first time the synchronising of time-pieces all over the country by wireless.—*Reuter's Trade Service* (New York).

Freemasonry.—At the regular meeting of the Kelvin Lodge which was held at the Connaught Rooms on Thursday, 31st ult., the reigning Master, Mr. H. Porter-Cox, presided over an assembly of 87 members and visitors, including many men well known in the electrical profession, and during the speeches at the Banquet following the Masonic Ceremonies, he referred to the fact that he would shortly be installed in the Chair of the Kelvin Chapter, and would then be occupying simultaneously the Chairs in both the Lodge and Chapter. He expressed his keen appreciation of the way in which he had been supported by the members in connection with the Great Masonic Charities, and referred to the rapid growth of the Lodge during the last few years, which showed the interest taken in the Craft by the electrical engineering profession, and the desire of so many of those who were associated therewith to become members of the Lodge.

Service Notes.—The following revision of the substantive scales of pay of certain grades of the electrical generating, &c., staffs employed at H.M. Dockyards and Naval Establishments at home, is approved. Weekly rate for hired men:—Mains and distribution supervisor, 51s. to 60s. (for a working week of 47 hours); "A" class station supervisor, 59s. 6d. to 73s. 6d., for a working week of 55 hours, working in shifts. These rates are subject to the regulation deduction in the case of established men. For "B" class station supervisors and drivers, and dynamo attendants, the revised rate is 47s. 10d. Warrant Electrician W. A. Nimmy has been appointed to the battleship *Ramillies* from the 9th inst., and Warrant Electrician Ford to the battleship *Agamemnon* from the same date.

Withdrawal of Electric Coal-Cutters Recommended.—The Committee appointed to inquire into the question of the safe working or otherwise of the electrically-driven coal-cutting machines at Mount Kembla Colliery, recommends the withdrawal of these machines until such time as safe conditions can effectively be established, as in the Committee's opinion it is not safe to work them in the Mount Kembla Colliery at present. A copy of the Committee's report may be consulted by United Kingdom firms interested on application at the Inquiry Room, Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W. 1.

Appointments Vacant.—Assistant Professor of Electrical Engineering, having special knowledge of telegraphy and telephony, for the City and Guilds (Engineering) College (£600 to £800); works manager. for the Stockton-on-Tees Corporation Electricity Department: ledger clerk, in the Hackney Borough Treasurer and Accountant's Department (Electricity Section), £310; shift engineer, for the Redditch Urban District Council Electricity Department; general manager. for the Wigan Corporation Tramways (£700); assistant electrical engineer (632 Rs. 8 annas per month), for the Great Indian Peninsular Railway. See our advertisement pages to-day.

No Summer Time in Canada.—In the Dominion House of Commons on April 11th, it was stated that the Government would not introduce legislation to establish "daylight saving" time. In the absence of a Federal enactment last year some municipalities adopted daylight saving, but others did not, with the result that much public inconvenience was caused.—*Birmingham Post.*

Charging for Idle Current.—An error occurred in the article by Mr. C. G. Carrothers in our issue of April 1st, in the value of p; on p. 405, lines 13 and 16, and in the key to the figure, for 1·5 read 1·25.

The Defence Force.—Men with special technical knowledge are urgently needed, such as field or P.O. linesmen, motor-cyclists, instrument repairers, operators (line, visual and wireless), and telephone switchboard operators. Depôts are at 3, Henry Street, Gray's Inn Road, for 1st London Division (D.F.) Signal Company; 46. Regency Street, S.W. 1, for London Electrical Engineers (D.F.); and Elverton Street, S.W. 1, for 3rd (London) Corps Signal Companies (D.F.). Electrical and mechanical engineers are needed to complete the requirements of the Force.

Deterioration in Slack.—A letter has been received by the F.B.I. from a member firm drawing attention to the deterioration in the quality of slack during recent years, and was read before a meeting of the Coal Committee at the head office on March 17th. As the subject is one of great importance to fuel-consuming interests throughout the country, it was felt that the subject should be brought up for full consideration at the next meeting of the Committee. The member firm suggests that the deterioration in slack is due to three main factors:—(*a*) The use of shaking screens with a fine mesh instead of the older fashioned fixed bar screen; (*b*) The use of high explosives in the pits; and (*c*) The practice of loading by shovel instead of by rake and basket. The F.B.I. will be pleased to learn the experience of those members who are slack users in dealing with this difficulty, and to receive their suggestions concerning possible remedies.

The Electricity Supply Bill.—On Tuesday, Sir E. Geddes, Minister of Transport, presented a Bill in the House of Commons to amend the Electricity (Supply) Act, 1919.

The Threatened Strike.—On Tuesday, the Executive of the Electrical Trades Union, at a meeting in London, decided to support the railwaymen and transport workers if they struck in sympathy with the miners. Apparently there was considerable opposition to declaring a strike.

Faraday House Old Students' Dinner.—Owing to the threatened strike of the transport workers, the dinner, which would have been held on Friday, the 15th inst., has been postponed.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Scottish Centre.—The seventh ordinary meeting will be held at 7·30 p.m., at Dundee, on April 29th, when the paper by Messrs. E. Griffiths, D.Sc., and F. H. Schofield, B.A., B.Sc., entitled "Some Thermal Characteristics of Electric Ovens and Hot-plates," will be read.

North-Western Centre.—The annual general meeting was held on April 12th, at the Engineers' Club, Manchester, Mr. J. Frith presiding. The Committee's report for the year stated that 11 general meetings had been held, including the popular lecture given at the Manchester College of Technology on April 6th by Prof. Marchant, at which the attendance was about 600. At the other meetings the attendance averaged 110, and the number of speakers who took part in the discussions averaged seven.

The membership had considerably increased, the figures on April 1st being: Members, 143; Associate Members, 516; Associates, 20; Graduates, 94; Students, 375; total, 1,178, as against a total of 984 last year and 833 in the year 1918-19. In the Liverpool Sub-Centre the membership had reached 367. The Committee of the Preston Sub-Centre had decided to discontinue as a Sub-Centre on account of their meetings overlapping with those of the English Electric Engineering Society, which already covered practically the whole of the membership in Preston. Eight meetings of the Students' Section had been held.

The report was adopted on the motion of the chairman, who described it as highly satisfactory. He was especially pleased that the increase of membership was mainly among the students, whose number had increased during the year from 222 to 375. A request signed by 56 members had been received by the Committee that informal meetings should be held during the session at which the younger members would be encouraged to speak, no reports being published. That request would be given careful consideration.

Votes of thanks were passed to the retiring chairman, the hon. secretary, Mr. Ellis, and the other officers. The election of officers for the next year resulted as follows:—

Chairman: Alderman W. Walker.
Vice Chairmen: Mr. A. S. Barnard and Mr. G. A. Juhlin.
Hon Secretary and Treasurer: Mr. A. G. Ellis.
New Members of Committee: Messrs. A. G. Livesay, C. D. Taite, R. Townend.

North-Western Students' Section.—The annual meeting of this Section was held at Manchester, on April 5th; Mr. S. Chadwick was in the chair, and was re-elected chairman. A satisfactory account was given of the Section, which embraces Lancashire and Cheshire (excluding Liverpool), and numbers about 250 members. Mr. W. T. Anderson gave a lantern lecture entitled "From factory to face, or the history of a colliery cable."—*Manchester Guardian.*

Liverpool Sub-Centre of the North-Western Centre.—In the absence of Sir William Noble, Mr. T. E. Herbert read the paper on "The Long Distance Telephone System of the United Kingdom," before the Liverpool Sub-Centre on April 11th. The meeting was the largest of the session, with an attendance of 140. Mr. A. J. Eames opened the discussion, and dealt in a general way with the telephone system. Mr. Harrison briefly discussed the paper, and related one or two telephonic experiences of his recent American tour. Mr. Holttum criticised some of the figures in the appendices, and suggested modifications which, in his opinion, would make the tables more complete. Dr. Marchant discussed the paper, and said how pleased he was to observe such a large audience, which more or less confirmed the opinion expressed in his chairman's address, when he indicated that he thought the Sub-Centre should develop and encourage discussions on telephonic subjects. Mr. Mercer discussed the paper from the cable manufacturers' point of view. Mr. Pratt outlined some developments, and made sympathetic reference to the work of the late Mr. C. E. Hay. Mr. Bolton asked some questions relating to Continental practice. Mr. Herbert replied to the discussion in detail in a manner which was very much appreciated by the audience.

North-Eastern Centre.—A meeting of the members of the Centre was held at Armstrong College, Newcastle-on-Tyne, on April 11th. It had been expected that Mr. E. A. Watson would be present to read his paper upon "Magnetos for Ignition Purposes in Internal Combustion Engines," but, unfortunately, the disorganisation of the train service consequent upon the miners' strike prevented his getting to Newcastle, he having lost a connection at Birmingham. Under these circumstances, Mr. Thomas Carter kindly contributed a "Few Notes on Power-Factor Correction," which were listened to with interest.

Conjoint Board of Scientific Societies.—The Board has decided to discontinue the publication of the annual calendar and fortnightly *Bulletin* of scientific meetings ("Diary of Scientific and Technical Societies"), owing to the heavy printing liabilities incurred.

S.A. Institute of Electrical Engineers.—In the course of his inaugural address, delivered on February 17th last Mr. L. B. Woodworth (President) commented upon the Institute's progress. In 1910 the total membership was 205, and the bank balance £189. At the end of 1920 the Institute had 489 members and £1,095 in funds, having given, in addition, £500 in aid of the Associated Scientific and Technical Societies of South Africa, of which body Dr. A. J. Orenstein was recently elected President.

Association of Mining Electrical Engineers.—In a paper read before the Ayrshire Branch of the Association, Mr. G. Mullen, colliery manager, Irvine, said one of the great causes of reduced output in mines was the fact that so few of the men in charge of mechanical coal-cutters were competent for the work. Through neglect, machines frequently broke down, with the result that men were thrown idle. The machines depreciated in value, and output was greatly reduced. The men were not to blame, because they had never had an opportunity of learning and understanding the mechanism of the machines under their charge. Men should be taught the function of each part of the machine and its proper care, but mine owners and miners' leaders seemed quite indifferent to the practical education of the workmen.

Royal Institution.—On Thursday, April 21st, Mr. H. S. Foxwell begins a course of two lectures on "Nationalisation and Bureaucracy." The Friday evening discourse on April 22nd will be delivered by Sir James Walker, on "Electro-Synthesis in Organic Chemistry."

Institute of Physics.—The meeting to inaugurate the Institute of Physics will take place on April 27th, at 6 p.m., in the Hall of the Institution of Civil Engineers, Great George Street, Westminster. Sir Richard Glazebrook, K.C.B., President, will preside, and Sir J. J. Thomson, O.M., will deliver an address. Mr. A. J. Balfour is expected to be present and to extend a welcome to the Institute. Non-members of the Institute or of the Societies associated with it may obtain tickets of admission on application to the Secretary, 10, Essex Street, Strand W.C. 2.

Paisley Association of Electrical Engineers.—The annual general meeting of the Association was held on April 6th. The secretary's and the treasurer's reports were read and approved. The following office-bearers and committee were appointed for next session:—President, Mr. W. R. Scott; vice-presidents, Messrs. Joseph Savage, R. W. Dobson, and W. R. Bruce; hon. secretary, Mr. E. D. Anderson, B.L.; hon. treasurer, Mr. J. M. Barbour; and committee, Messrs. D. E. Craven, D. M'Kay, James Orr, W. Blair Smith, and George Wright.

Birmingham and District Electric Club.—At a meeting held on April 9th, Mr. Frank Forrest, M.I.E.E., gave an address upon the Birmingham municipal electricity supply undertaking. He traced its growth, and also referred to the delimitation of areas under the Electricity (Supply) Act, 1919.

Institution of Production Engineers.—The second meeting in connection with the formation of the above Institution was held on April 2nd, when Mr. Cecil F. Hammond, of Coventry, presided over a large attendance.

In an opening speech, the Chairman referred to the way in which the Provisional Council came into being, and added that they, the Provisional Council, had found it necessary to constitute themselves under a memorandum of association into an incorporated Institution, and under the proposed articles it would be seen that the Council had power to add further members up to 26.

After a thoroughly interesting discussion, a resolution was put to the meeting and unanimously carried: "That the memorandum of association be accepted."

Subsequently the meeting discussed in detail the proposed articles of association and by-laws as provisionally drafted by the Council.

The proprietors of *Engineering Production* are to be approached with a view to making that journal the official organ.

Midland Institute of Mining, Civil and Mechanical Engineers.—At a meeting of the Institute, held in Doncaster, on April 2nd, Mr. S. Diggle read a paper on "Electrical Haulage and the Elimination of Pit Ponies." In his paper, the author gave particulars of the improvements effected in this direction at the pit, of which he has charge. The substitution of electrical for horse haulage gave vastly improved service at a lower cost.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

According to the daily Press, Prof. Einstein has accepted an invitation of the Council of the University of Manchester to give a lecture at the University during his visit to England in the near future.

Mr. S. F. Cox has been appointed managing director of Electrical Devices, Ltd., of 18-20, Collingwood Street, Newcastle-on-Tyne.

Bradford Corporation Advisory and Co-ordination Committee, last week, postponed for six months the question of salary increases for Corporation officials; the proposals involve an addition of £6,330 to the expenditure on wages and salaries.

Bury Town Council, despite opposition, has decided to increase the salary of its tramway manager from £500 to £600 per year, in addition to bonus.

Mr. Horace I. Palmer, chief traffic assistant, has been appointed traffic superintendent of the Liverpool Corporation Tramways at £650 per year. Mr. J. Wood, chief traffic clerk, has been promoted to the position of chief traffic assistant at £500 per year.

Last week, at the Halifax Tramways Club, the employés of the department gathered to present a silver tray and case of cutlery to Mr. J. C. Caird, late tramway manager, whose place has had to be filled, owing to his continued ill-health. For the same reason Mr. Caird was not able to be present, but Mr. W. M. Rogerson, electrical engineer, undertook to convey the gifts to him, and on Mr. Caird's behalf, thanked the gathering.

Nelson Town Council is asking all Corporation servants to forgo any increases of salary to which they may be entitled. Wallasey Town Council has decided that all war bonuses shall cease at the end of July. In other districts there is determined opposition to any further increases of salary or wages.

The friends of Mr. A. J. Davis, electrical engineer, Pigeon House power station, Dublin, have presented him with a wallet of Treasury notes and other gifts on his leaving for Canada.

Mr. C. Sylvester, who was until recently situated at Jamaica, is now holding the position of Lecturer in Electrical Engineering at the Municipal Technical School at St. Helens.

Mr. C. J. Elliott, chief electrical engineer to the Calico Printers' Association, Ltd., was married on 8th inst. to Miss Winifred Pegler, of Cheltenham.

Mr. E. J. H. Bluett, A.M.I.E.E., electrical engineer to the Ascot District Gas and Electricity Co. since the inauguration of the electricity supply in 1907, has resigned from that position and entered into partnership with Messrs. John Drake & Co., electrical engineers, Sunningdale, with branch establishments at Egham and Englefield Green.

Obituary.—Mr. G. Braulik.—We regret to record the death, on April 5th, after a few weeks' illness, of Mr. George Braulik, of 8, Lambeth Hill, E.C.

Mr. Bertram Blount, F.I.C.—We regret to read in the *Times'* "Deaths" column that Mr. Bertram Blount, F.I.C., passed away on April 9th, at 48, Bedford Gardens, Campden Hill, London, at the age of 54 years. Mr. Blount was the author of a work on "Practical Electro-Chemistry," a subject on which he was a well-known authority.

Wills.—Mr. James Keith, managing director of James Keith and Blackman & Co., Ltd., left £115,160 gross, and £107,630 net personalty.

The Earl of Galloway, a director of W. T. Henley's Telegraph Works Co., Ltd., left £28,446.

NEW COMPANY REGISTERED.

Electrical Devices, Ltd. (174,038).—Private company. Registered April 4th. Capital, £1,000 in £1 shares. To carry on the business of dealers in electrical supplies, accumulators, engines, chassis, cables, wires, lamps, dynamos, carbons, &c. The subscribers (each with one share) are: J. R. Cox, 17, Douglas Road, N. 1, manufacturer; W. Dunscombe, 11, Melfort Road, Thornton Heath, electrical engineer; A. T. Dowles, 79, First Avenue, Manor Park, E. 12, accountant. The first directors are not named. Solicitor: E. L. D. Zeffertt, 17, Coleman Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Berry's Electric, Ltd.—Mortgage dated March 21st, 1921, to secure all moneys due or to become due from company to London Joint City & Midland Bank, Ltd., charged on certain freehold land, buildings, machinery, &c., in Spring Road, Yardley, Birmingham.

Jackson Electric Stove Co., Ltd.—Satisfaction in full on June 17th, 1920, of debentures dated July 23rd, 1913, securing £500.

Gratze, Ltd.—Debenture dated April 1st, 1921, to secure £2,000, charged on company's undertaking and property, including uncalled capital. Holder: R. W. Nuttall, Briarfield, Walton-on-the-Hill.

Switchgear & Cowans, Ltd.—Issue on March 31st, 1921, of £1,000 debentures, part of a series already registered.

Alliance Electrical Co., Ltd. (166,835).—Capital, £10,000 in £1 shares. Return dated February 26th, 1921. 3,854 shares taken up, 10s. per share paid up in cash and 10s. per share credited as paid. Mortgages and charges: Nil.

CITY NOTES.

Urban Electric Supply Co., Ltd.

For the year 1920 the gross profits amounted to £90,979, as compared with £59,824 for the previous year. £86,685 is carried to the net profit and loss account. Interest, debenture stock redemption, and income tax absorb £60,845. £1,322 is brought forward, £25,000 is placed to reserve for depreciation, and £2,163 is carried forward. The report states that the directors feel that despite the substantially improved results shown, they are not yet in a position to recommend the resumption of a dividend on the cumulative preference shares, the whole of the company's cash resources being still required to meet its current needs. The enlarged powers which the Electricity Commissioners and the Ministry of Transport are seeking to enable them to revise maximum prices irrespective of the limitations imposed by the Statutory Undertakings (Temporary Increase of Charges) Act, 1918, have not yet been obtained, and consequently those undertakings which have been able to obtain only the inadequate relief afforded under the terms of that Act are still restricted thereto.

The following table shows the connected load in kW and profits for the years 1919 and 1920:—

	Load in kW.		Profits.	
	1919.	1920.	1919.	1920.
Hawick	3,816	4,145	£5,608	£10,758
Stamford	1,824	1,931	2,008	1,958
Weybridge and Walton	4,170	4,470	4,990	5,601
Godalming	2,032	2,193	1,715	3,314
Twickenham and District ..	11,416	12,677	11,919	22,319
Dartmouth	1,121	1,189	1,859	1,587
Camborne, Redruth & Cornwall..	9,272	9,662	7,084	4,735
Newton Abbot	1,895	2,097	3,226	2,840
Grantham	2,255	2,439	6,995	7,069
Glossop	1,546	1,709	4,939	6,425
Berwick	1,250	1,386	loss, 750	2,449
Caterham	1,243	1,389	1.607	1.950
Newbury	1,459	1,593	716	5,410
Cornwall Co.	—	—	7,200	7,200
Penzance Co.		—	669	621
Totals	43,299	46,882	£59,784	£83,707

Llanelly & District Electric Lighting & Traction Co., Ltd.—At the annual meeting held last week Mr. A. R. Holland, who presided, said that the year had been one of great difficulty, but they were enabled to recommend the maintenance of the dividend as in 1919. Their power business continued to develop very satisfactorily, and many new and important consumers had been connected. The business was sufficient to fully and profitably employ the new plant, and given normal conditions the prospects were good. The directors had under consideration the terms of a proposed new issue of capital.

W. Canning and Co., Ltd.

The report for 1920, submitted at the first annual meeting, held yesterday, at Birmingham, shows that the balance of profit, after charging all expenses, including directors' and management remuneration, maintenance and depreciation of properties, plant and fixtures, and also after providing reserves for estimated income tax, corporation tax, and excess profits duty, is £24,353, from which has to be deducted the proportion of profit to June 1st, payable to the vendor under the agreement for sale and purchase, £9,956, leaving a balance of £14,397. A dividend on the ordinary shares at the rate of 7½ per cent. per annum as from the date of allotment of shares, June 22nd, 1920, up to December 31st, 1920, less income tax, requires £8,285; it is proposed to write off half the preliminary expenses, £4,660, and to carry forward £1,452. The sales for 1920 were the largest in the history of the business, but the serious trade depression, with its accompanying heavy fall in values, adversely affected the profits during the latter part of the year. The new London premises have now been adapted to the company's special requirements, and have been occupied since November last. The old London leasehold property has been sold satisfactorily. The company has acquired extensions to its freehold properties in Birmingham, but no building development has been put in hand.

Folkestone Electricity Supply Co., Ltd.

During 1920 there was an increase of 16,981 8 c.p. lamps, making 198,808; this was the largest increase the company has experienced. Including the receipts from hired installations, the profit on revenue accounts from the three undertakings was £14,918, an increase of £611. Adding £939 brought forward, and interest on investments, &c., and allowing for interest on debenture stock and bank overdraft and dividend on preference shares, the balance is £10,226. Out of this £7,019 has been carried to depreciation fund, making it £64,324. Dividend at the rate of 4¾ per cent., less income tax, on the ordinary shares for the year; carried forward £832. The payment of the dividend recommended is subject to the consent of the Electricity Commissioners which has yet to be obtained. The directors have under consideration the question of carrying out in the immediate future a substantial capital outlay in connection with plant extensions, to cope with the extra demands made on the company's station. Negotiations have been entered into with the Air Ministry for the supply of electricity to the Hawkinge Aerodrome, a contract has been prepared in connection with the public lighting of Cheriton, and other contracts are being negotiated, in addition to substantial increases made from time to time in connection with ordinary private supplies. To cope with these demands it is necessary to lay down further plant, which will entail a considerable expenditure. Under these circumstances the shareholders will be asked at the meeting to-day at Folkestone to pass a resolution authorising the directors to raise or borrow an additional sum of £50,000 over and above the present issue sanctioned of £100,000. It is not intended to raise the whole of this sum at once, and for present purposes a temporary advance of not exceeding £20,000 will meet the company's requirements.

France.

The report of the Tramways de Rouen Co. states that the receipts for the year were 9,230,430 fr., and the expenses 9,700,656 fr., leaving a gross deficit on the working of 417,260 fr., which, adding thereto the balance of interest and other accounts, and the service of the loan, brought the deficit up to 819,877 fr., less the carry over of the foregoing year of 178,694 fr., leaving the net debit balance 646,183 fr. To remedy this shortage on the working, the company had obtained from the superior authority, with the agreement of the City of Rouen, the approval of various modifications in the system of lines and an increase on the fares. These modifications were, however, only of a provisional and inadequate character, and to further ease the situation the City of Rouen had made various advances to the company, the total of which up to December 31st, 1920, had risen to 1,085,925 fr. Further steps had likewise been taken with the city authorities to establish a tariff régime more in accordance with existing economic conditions. As an outcome of the rise in the price of coal and the resulting increased cost of electrical energy, the working of certain of the tramway lines on steep slopes had become so burdensome that it had been decided, with the assent of the city, to suspend these services until the cost of electricity had sunk to a level allowing of their working without loss to the company.

Prospectus.—*Central Electric Supply Co.*—This company has this week been offering £500,000 8 per cent. secured and guaranteed notes, which are unconditionally guaranteed as to principal and interest by the St. James's & Pall Mall Electric Lighting Co. and the Westminster Electric Supply Corporation. The price of issue is 97, and the notes are repayable in April, 1926, or earlier on specified terms. As our readers are already aware, the proceeds are required for the purpose of new plant and machinery and for extensions at Grove Road bulk supply station. The list was to close yesterday, Thursday.

City of London Electric Lighting Co., Ltd.—This company's new issue of £300,000 second cumulative preference shares and £94,050 ordinary (all £1 shares) was to have been published on Monday, but was postponed until Wednesday on account of the strike.

Sweden.—The directors of the Elektriska A.B. Eek of Partille report a loss of 291,000 kr. in 1920, which is covered by a transfer from the reserve fund. Notwithstanding the labour dispute for two months at the beginning of the year, the working results were favourable, but they were dislocated by the unprecedented fall in prices of all kinds of materials and manufactures towards the close of the year. In 1919 a loss of 905,000 kr. was incurred, as it was found necessary considerably to write down the stocks of goods and installation materials. This was met partly by the absorption of the balance forward and partly by transfer from the reserve fund.

The Austrian Felten & Guilleaume Co.—The accounts of Felten & Guilleaume, Fabrik Elektrischer Kabel, Stahl, und Kupferwerke A.G., of Vienna, indicate net profits of 28,520,000 crowns for 1920, or 24,480,000 crowns more than in the previous year, and the dividend is at the rate of 30 per cent., as against 17 per cent. It has been decided to increase the share capital from 20,000,000 to 50,000,000 crowns.

Monte Video Telephone Co., Ltd.—Interim dividend on the ordinary shares for the half-year at the rate of 6 per cent. per annum, free of tax.

Lancashire Dynamo & Motor Co., Ltd.—The financial Press records a final dividend of 6¼ per cent. on the ordinary shares, making 10 per cent. for the year.

Castner-Kellner Alkali Co., Ltd.—The directors announce a dividend at the rate of 16 per cent. per annum for the past half-year.

Belgium.—La Société des Cableries et Trefileries Leigeoises, of Renory-Angleur, is paying a dividend of 6 per cent. for the last financial year.

Stock Exchange Notices.—The undermentioned have been order to be officially quoted:—

Henley's (W. T.) Telegraph Works Co., Ltd.—250,000 ordinary shares of £1 each, fully paid. Nos. 400,001 to 650,000.

English Electric Co., Ltd.—A dividend of 8 per cent., less tax, on the ordinary shares is announced.

Reyrolle & Co., Ltd.—A dividend of 12½ per cent. on the ordinary shares is announced.

Direct United States Cable Co., Ltd.—Final dividend of 4s. per share, less tax, making a total of 4 per cent. for the year.

STOCKS AND SHARES.

TUESDAY EVENING.

PRICES of Stock Exchange securities have been blown about by every breath of idle rumour concerning the coal crisis and the various conferences that have arisen therefrom. On this (Tuesday) evening the markets left off in a somewhat nervous condition, with gossip taking an unfavourable view of the outlook. Investment stocks, however, are well maintained, and Government issues improved, on the assumption that cheaper money is close at hand. This had a strengthening effect upon the War Loan and, through its agency, upon the other purely investment securities. But the general tendency was inclined to heaviness, and business dwindled to a mere shade of what it was, say, twelve months ago.

In the railway market, Underground Electric Income Bonds have risen another 2 points to 69½, making 6 within a fortnight. The £10 shares, however, slipped back to 1⅛. What the Underground group would do in the event of a strike is naturally a topic of eager debate. It is recalled that during the strike of October, 1919, the District and some of the other tube lines managed to maintain a volunteer service, but unless report spoke wrongly, a good deal of damage was caused by the operation of complicated machinery in unskilled hands. The Tube group, however, has always stood more or less apart from the others, and while steam stocks weakened in price, the Underground Income Bonds, as already mentioned, have further advanced. Metropolitans are 2 better at 24½, while Districts added the fraction at 14½. Central London deferred stock at 22½ is up 5; the Assented deferred remains at 43½.

Declaration by the English Electric Co. of 8 per cent. dividend on its ordinary shares has come as a pleasant piece of news for this particular department. Some had feared that the dividend would be cut to 5 per cent. The report is awaited with no little interest. There is, however, no particular change in prices of manufacturing shares. General Electrics are easier at 22s. Both classes of the company's preference—the 6½ per cent. and the 7½ per cent.—are 6d. lower at 18s. Babcock & Wilcox receded to 26s. 3d.

It may be useful to point out that English Electric 8 per cent. 6-year Notes, which were issued at 98, can be bought at 95½ with a full half-year's interest in July next. They are redeemable in 1927 at 103, or can be paid off after 1923 at the same price. The company's 5½ per cent. sinking fund first mortgage debentures are obtainable at 83½, with interest in January and July, affording a yield of £6 12s. per cent. These are repayable in 1940 at 103, by a cumulative sinking fund of 2½ per cent. per annum. The Central Electric Co. has published its prospectus of £500,000 8 per cent. secured and guaranteed Notes offered at 97 per cent. They fall due in 1928 unless redeemed earlier at a premium. The St. James's & Pall Mall Electric Light Co. and the Westminster Electric Supply Corporation guarantee the notes, and the security is admirable. The only objection which can possibly be raised is the fact of redemption occurring five years hence, when, of course, money may possess a value very different from what it commands to-day. In other words, the investment is a short-dated one, although this in the eyes of a good many people will be an advantage and no drawback, inasmuch as the brief tenure of the Notes will have the effect of keeping up the price during the interval. The City of London prospectus of 600,000 8 per cent. second preference and 94,050 ordinary shares to be offered at 20s. and 22s. 6d. respectively has not made its appearance up to the time that these paragraphs are written. The underwriting was finished, however, some days ago, and the preference underwriters received 3 per cent. commission with ½ per cent. over-riding. Sub-underwriters receive, of course, a little less.

	Gross revenue.		Gross expenses.	
	1913.	1920.	1913.	1920.
Brompton	£56,482	£103,372	£24,984	£59,469
Charing Cross, W.E. ...	151,240	311,045	66,866	208 214
Do. City ...	149,819	418,746	80,639	355,061
Chelsea	72,602	115,404	35,052	73,530
City of London ...	311,822	649,391	139,724	438,132
County of London ...	255,670	698 625	120,531	454,372
Kensington and K. ...	81,859	127,141	47,679	97,107
London	162 854	372,230	91,101	272,743
Metropolitan	217,605	516,594	111,317	318,638
St. James'	146,161	227,959	94,010	187,012
South Metropolitan ...	65,635	199,037	24,065	116,216
Westminster	256,800	401,040	154,254	315,726

Prices of the various cable stocks are a trifle less steady than usual, owing to the fact that a few shares have come in at a time when investors, even in these shares, are not particularly anxious to increase their engagements. However, as soon as the strike clouds are rolled away, there is every reason to suppose that the strength of the market will be resumed. The firm spot in this group is Marconi ordinary. Humorists attribute the month's rise to the fact that the Italian Ambassador, Senor de Martino, paid a visit to the Stock Exchange last Monday. A more practical reason for the improvement is, of course, that mentioned on several occasions here, namely, that the optimists expect a payment of 20 per cent. dividend to be declared shortly. If this is done, it would make 25 per cent. for the year, the same as that which was paid in the preceding twelve months. With the price of the parent shares, that of the preference has also strengthened to 2⅛. Canadian Marconis are also better at 6s. 9d., while Radio Common keep about 9s. and the preferred at 11s. 6d.

The accounts of the various electricity supply companies are now all published, and it is possible to compare the figures with those of the preceding years. We think it may interest a good many readers to notice how gross revenue and expenses have both gone up since the outbreak of war. Therefore, taking the figures for 1913, we add those just published in respect of 1920, and they compare as shown in the accompanying table.

Business in this section is so quiet that the only alteration on the week is a fall of sixpence in City of London ordinary shares.

In the foreign traction department, Brazil Tractions dropped 2 to 35. What little French support had been forthcoming for these shares is now withdrawn, and the market is dull. Mexicans, on the other hand, are somewhat better, despite absence of news from Mexico. Mexican Light & Power First Bonds are 2 up at 62. There are also improvements in Pachuca and several other bonds in Mexican utility companies. Anglo-Argentine Tramways second preference receded to 3.

Metropolitan-Vickers ordinary are lower at 18s. 6d., the preference remaining about 35s. Vickers and other armament shares have strengthened to a modest extent. The rubber share market remains moribund. In the annual report of the Stock Exchange, just issued, it is shown that the Managers spent £5,891 upon "electric power, working expenses and maintenance." This is nearly £4,000 more than the same item absorbed in the previous year. It has been found necessary to renew the electric installation throughout the Stock Exchange, and the carrying out of the work is responsible for much of the increase in the charge under this head.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend		Price April 12,		Yield.
	1919.	1920.	1921.	Rise or fall.	p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary.. . ..	12	12	6	—	£10 0 0
Charing Cross Ordinary ..	7	8	3⅞	—	10 6 6
do. do. do. 4½ Pref...	4½	4½	2¾	—	8 8 8
Chelsea..	4	6	3	—	10 0 0
City of London	13	14	23/3	6d.	12 0 10
do. do. 6 per cent. Pref...	6	6	18/-	—	6 13 4
County of London .. - ..	8	8	7⅝	—	10 9 10
do. do. 6 per cent. Pref...	6	6	8	—	7 10 0
Kensington Ordinary	7	9	4⅛	—	10 18 2
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref. ..	6	6	2¾	—	10 18 2
Metropolitan	6	7	8¼	—	10 15 4
do. 4½ per cent. Pref. .	4½	4½	2 15/16	—	7 13 2
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	6	—	2½	—	9 2 10
South Metropolitan Pref. . ..	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	5⅛	—	9 15 2
TELEGRAPHS AND TELEPHONES.					
	1918	1919			
Anglo-Am. Tel. Pref.	6	6	7½	– 1	7 11 0
do. Def...	33/6	1½	15⅞	—	9 8 6
Chile Telephone	8	6	5½	—	6 6 8
Cuba Sub. Ord.	7	7	6½	—	10 15 4
Eastern Extension	10	10	16	—	6 6 0
Eastern Tel. Ord. .. - ..	8	10	160	—	6 5 0
Globe Tel. and T. Ord.	8	10	15⅞	—	6 6 0
do. do. Pref.	6	6	9		6 13 4
Great Northern Tel.	22	23	22		10 0 0
Indo-European	13	10	30	—	8 6 8
Marconi	25	25	2 3/16	+ ⅛	—
Oriental Telephone Ord.	10	12	2 3/16	—	*5 9 7
United R. Plate Tel. . .	8	8	6⅛	—	6 10 8
West India and Panama	1/3	Nil	9/16	—	Nil.
Western Telegraph.. .. .	8	10	16	-	*6 5 0
HOME RAILS.					
	1919	1920			
Central London Ord. Assented .	4	4	44⅛	—	9 0 0
Metropolitan . .	1½	1½	2 ½	+2	6 2 4
do. District	Nil	Nil	14½	+ ½	Nil
Underground Electric Ordinary ..	Nil	Nil	1⅛	— ⅛	Nil
do. do. "A" .	Nil	Nil	6/-	—	Nil
do. do. Income ..	4	2	69½	+2	2 17
FOREIGN TRAMS, &C.					
	1918	1919			
Anglo-Arg. Trams, First Pref. ..	Nil	6½	2⅝	—	10 9
do. do. 2nd Pref. ..	Nil	Nil	3	—	Nil
do. do. 5 % Deb. .	5	5	59½	-	8 8 0
Brazil Tractions	Nil	Nil	35	—2	Nil
British Columbia Elec. Rly. Pfce.	5	5	55	—	9 1 10
do. do. Preferred	2½	5	54½		*8 14 0
do. do. Deferred	Nil	8	51½		*11 17 6
do. do. Deb. ..	4½	4½	56½	—	7 10 8
Mexico Trams 5 per cent. Bonds..	Nil	Nil	85		Nil
do. 6 per cent. Bonds .	Nil	Nil	21½	—	Nil
Mexican Light Common .. .	Nil	Nil	12½	—	Nil
do. Pref. . .	Nil	Nil	18	—	Nil
do. 1st Bonds . ..	Nil	Nil	62	+2	Nil
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	2 5/16	— 1/16	6 10 0
British Aluminium Ord.	10	10	17/6	—	11 8 6
British Insulated Ord. ..	12½	15	1 9/16	—	9 12 0
Callenders	25	15	1⅜	—	10 18 2
„ 6½ Pref. ..	6½	6½	17/6	—	7 8 7
Crompton Ord. ..	10	10	18/9	—	14 11 0
Edison-Swan	10	10	10/-	—	—
do. do. 5 per cent Deb.	5	5	70	—	7 2 10
Electric Construction ..	10	10	15/9	—	12 14 0
English Electric	—	8	11/-	—	14 11 0
Do. Pref. ..	—	6	13/-	—	9 4 8
Gen. Elec. Pref. . .	6½	6½	18/-	—6d.	7 4 5
do. Ord.	10	10	22/-	—6d.	*9 1 10
Henley	25	15	1 5/16	-	11 8 6
do. 4½ Pref.	4½	4½	8¼	-	6 18 6
India Rubber	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	1¾	—	9 2 10
Siemens Ord.	10	10	1	—	*9 15 2
Telegraph Con.	20	20	20½	—	*5 16 6

* Dividends paid free of Income Tax.

THE MEASUREMENT OF FREQUENCY AND SPEED.

Some Everett-Edgcumbe Instruments.

In almost every branch of engineering the measurement of the speed of rotating machinery is a matter of importance, but in none is accuracy so essential as in electrical engineering. This being so, it is curious how limited is the number of instruments available for the purpose, more especially when it is desirable, as is so often the case, for the speed to be observed at a distance from the machine in question. This condition at once rules out the revolution counter and the mechanical tachometer, which, however useful in themselves, are necessarily limited in their applications.

One of the most useful of tachometers is the resonance pattern, in which a "comb" of tuned steel reeds is rigidly attached to the machine whose speed is to be determined. Since the vibration of a running machine is due solely to a want of balance, it follows that the frequency of vibration is equal to the speed of revolution, and if it can be transmitted to a set of tuned reeds (see fig. 2), the one whose free period is equal to that of the vibrations will be set swinging in resonance, and forms a ready means of determining the speed. In practice it is only necessary to mount the instrument on the machine itself, no form of transmission being required. These instruments, one of which is shown in fig. 1, are particularly useful in connection with turbo-generators, the speed of which it is difficult to determine by any other means.

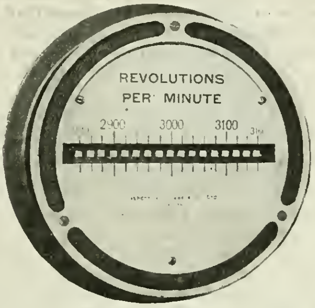

Fig. 1.—Resonance Pattern Tachometer.

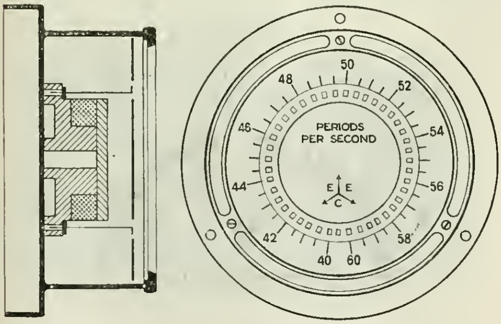

Fig. 2.—Elevation and Section of Frequency Meter.

Below, say, 1,000 revolutions per minute, the reeds become somewhat "unwieldy," and it is preferable to increase the number of vibrations for each revolution of the machine. This is readily done in the case of a rotating shaft by fitting it with a cam having two, four, or any other number of projections, against which presses a small roller connected in any convenient way to the indicator, as, for example, by a stretched wire or cord. By this means speeds from the lowest to the highest can be measured with the utmost ease and precision.

Since in electrical work the speed of revolution and the frequency are so intimately connected, it may be convenient to deal at the same time with instruments for the measurement of both these quantities. The best known frequency meter is probably the resonance or vibrating reed pattern, which is unsurpassed for accuracy and permanence. It is shown in section in fig. 2. The flexible reeds, each tuned to a definite frequency, surround a central electromagnet which is excited from the source, the frequency of which is to be measured. All the reeds are attracted once during each half cycle, that is to say, twice per cycle. The motion, however, is too small to be visible except in the case of the particular reed whose free period of vibration corresponds to the frequency of the current, and which is, therefore, set in resonant vibration. This is at once noticeable, owing to the fact that the reed swings from side to side so as to bridge over the circular slot in the dial at that point.

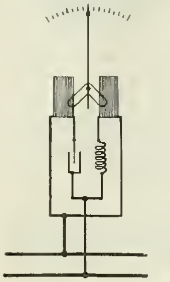

Fig. 3.

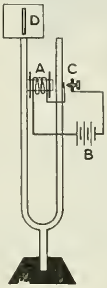

Fig. 4.

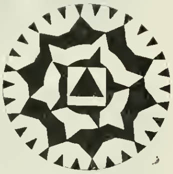

Fig. 5.

Such an instrument is extremely accurate and permanent in its indications, but is necessarily somewhat less easy to read than one provided with a pointer moving over a graduated scale. For this reason a considerable demand has arisen for a deflectional frequency meter. The connections of the Everett-Edgcumbe instrument of this pattern are shown in fig. 3. The moving element consists of a pair of soft iron needles fixed to a staff centred in jewels and carrying a pointer. The two coils, acting upon the needles, are connected—the one through a choking coil and the other through a condenser—across the source of supply. The constants of the circuits are so chosen that, at normal frequency, the action of each coil upon its respective soft iron needle is the same. Under these conditions, therefore, the pointer stands in the centre of the scale, whilst a rise of frequency is accompanied by an increase of current through the one coil and a decrease through the other, thus deflecting the pointer to the right, and *vice versa*. The result is a long and open scale having wide divisions at the centre, or normal point, but closed up somewhat towards the two ends, which is the ideal form of scale for an instrument of this class. Fig. 6 shows, half size, the scale of one of these instruments

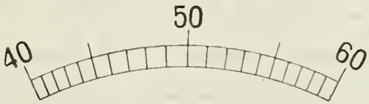

Fig. 6.

with a range of 40-60 cycles, and from this the clearness and openness of the divisions will be apparent.

It is evident, from the principle of action just described, that by careful design any change of voltage can be made to give a corresponding change of current through each coil, thus leaving the reading unaffected. How well this condition is fulfilled in practice will be clear from the following extract from a report by the National Physical Laboratory on a 100-volt instrument:—

"The instrument was tested at 70, 110, and 150 volts on a circuit the wave shape of which approximated closely to a sine curve. The accuracy of the instrument at these voltages was found to be identical."

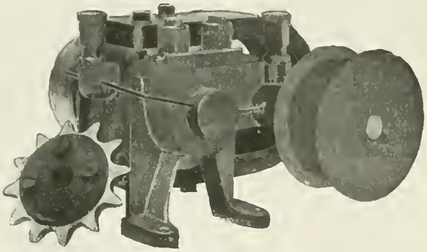

Fig. 7.—Transmitter (Open Pattern).

The report continues:—

"Further observations on the instrument were taken on a circuit the wave shape of which was of the form of an isosceles triangle, with small ripples superposed."

The results obtained with 100 volts on the instrument were as follows:—

Instrument reading.	True frequency sine wave.	True frequency triangular wave.
60	60.0	59.6
55	54.7	54.3
50	50.2	49.9
45	44.8	44.5
40	40.1	Not tested.

These deflectional frequency meters have been largely used for the high frequencies (up to 1,000 cycles per second) met with in wireless work, and are particularly valuable for such a purpose, since the vibrating reed pattern is less suitable, the necessarily short and stubby reeds being difficult to distinguish when in vibration.

Frequency meters can be graduated in revolutions per minute, and then afford an extremely accurate means of determining the speed of revolution of an alternator. Moreover, in order to obtain a permanent record of frequency or speed, the same principle can readily be applied to a graphic instrument.

Although not always directly applicable to industrial work, the stroboscopic method of measuring frequency and speed is of great importance, and it may be of interest to describe the use made of this method by Messrs. Everett, Edgcumbe & Co. in adjusting their frequency meters, &c. Fig. 4 shows, diagrammatically, an electrically-operated tuning fork, adjusted to give a definite frequency of 50 cycles per second. The electromagnet A, when excited by means of the battery B, draws the two limbs of the fork together and, in so doing, breaks the circuit at the contact C; the fork then springs back again, and is kept in vibration at a definite frequency, thus moving the attached slotted plate D from side to side with a definite frequency—in the case considered, 50 complete vibrations per second. By this means, an eye looking through the slot has its field of view uncovered 100 times per second, that is, once as the limbs of the fork approach one another and again as they recede.

Attached to the end of the shaft of the generator, the speed of which is to be controlled, is fixed a disk having drawn upon it a number of regular figures surrounded by a circle of 30 radial teeth, as shown in fig. 5. If this disk is rotated at a constant speed of 200 revolutions per minute, the number of teeth passing a given point each second will be $(200 \times 30)/60 = 100$, that is to say, each time the slot passes through the central position a fresh tooth is exposed to view at exactly the same spot, so that the ring appears stationary. If the speed of rotation is slightly less than 200 r.p.m., the teeth will appear to rotate backwards, and *vice versa*. If the speed is increased to 400 r.p.m. every alternate tooth will be exposed synchronously, and the disk will again appear stationary. This will recur at 600, 800, 1,000 r.p.m.—for all speeds, in fact, which are multiples of 200 r.p.m.

Similar reasoning holds for the other figures, and by noting which of them is stationary at the same time as the toothed ring, it is easy to distinguish between the various speeds which cause the latter to stand still. The stroboscopic method is employed, in this way, to give a number of definite points on the scale of a standard magneto speed indicator (described below), the transmitter of which is attached to the shaft of the alternator, and thus forms a sub-standard by means of which frequency and speed meters are adjusted and scaled.

Instead of the operator looking through the slot D (fig. 4), it is sometimes more convenient to illuminate the disk (fig. 5) by intermittent flashes of light of definite frequency. This is readily done by causing the rays from a powerful source of light to fall upon the disk through the vibrating slot D. By this means, the disk is illuminated 100 times per second, and the various figures appear to rotate or to remain stationary in exactly the same way as has already been described.

Innumerable cases arise in which it is required to measure the speed of rotating machinery at a distance, and for this purpose a magneto-electric transmitter connected to a moving-coil indicator has been developed. Fig. 7 shows the open pattern; it consists of a small magneto generator running in ball bearings and having a permanent magnet, and carbon brushes. The armature resistance is very small, and armature reaction has been reduced to a negligible quantity, so that the terminal voltage is sensibly proportional to the speed of revolution. Two wires run from the transmitter to a moving-coil indicator, which may be of either the round, sector, or edgewise pattern, and can be installed at any required distance from the transmitter, for example, in the engineer's or manager's office.

The open pattern is effectively protected from dust, but for situations liable to excessive damp or dirt the enclosed transmitter is preferable. The latter form of transmitter is perfectly watertight, glands and stuffing boxes being provided for the connecting leads and for the spindle.

Fig. 8.—Testing Equipment for Electric Trains.

Various methods are available for driving the transmitter. The armature speed is increased, by means of suitable gearing, to about 1,500 r.p.m., at normal speed, but in many cases it is possible to drive the magneto spindle direct from the machine under test. A short spiral coupling forms a very convenient means of so doing. If, however, this is not possible, owing either to the speed being unsuitable or to the end of the shaft being inaccessible, a belt and pulley or a sprocket and chain are employed. The latter has numerous advantages, in particular, freedom from all slip, but for many purposes a flat belt and pulley are all that is required. Both the sprocket and the pulley are shown in fig. 7.

Needless to say, such transmitters can be employed to actuate a number of indicators situated in any convenient positions, and are also particularly well adapted for use in connection with graphers to give a continuous graphic record of the speed.

A very successful tramcar speed indicator was developed by Messrs. Everett, Edgcumbe & Co. on this principle. It consists of a transmitter belted to the axle of the car or motor and connected to a watertight indicator at each end of the vehicle. Or, if preferred, a single removable indicator can be employed, to be carried by the driver from end to end. Such speed indicators have proved of great value, both in preventing accidents and for training the drivers to estimate speed correctly.

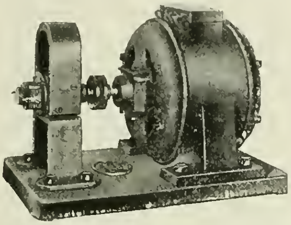

Fig. 9.—Synchronous Motor-driven Transmitter.

In connection with electric trains, these speed indicators have been extensively used for testing purposes, either permanently installed in a test coach or as portable instruments which can be placed in the driver's cabin of any train. Fig. 8 shows an equipment supplied to the London & South-Western Railway Co. It consists of a graphic ammeter, voltmeter, and speed indicator. In order to ensure synchronism between the records each grapher is fitted with an electromagnet marking device, such that at intervals of 5 seconds a current is sent through an electromagnet on each grapher fitted with a pen, thus making simultaneous marks on all the charts. The graphers are fixed in traction suspension frames, which prevent the motion of the coach from affecting the records.

Fig. 9 shows a further application of the electromagnetic transmitter, namely, to the construction of an indicating or graphic frequency meter transmitting to a distance. The small a.c. motor is so designed that it runs at practically synchronous speed, thus driving the magneto-generator so that its voltage is directly proportional to the frequency. An advantage possessed by this arrangement is that the scale of the indicator or the chart of the grapher is evenly divided throughout. Moreover, if desired, the scale can be "set up" so as to give a particularly open reading at and about the normal point.

Such speed indicator equipments have been extensively used in connection with motor-driven rolling mills. The speed indicator is conveniently fixed on an instrument pillar placed near the driver's controller, which also carries the ammeter, voltmeter, wattmeter, &c., for the motor.

In the case of rolling mills operated on the Ward-Leonard system, two indicators are usually installed, the one showing the speed of the motor-generator set and the other that of the rolling-mill motor.

Amongst other uses to which these speed indicators and graphers have been applied may be mentioned the following:—

Measuring the propeller speed of ships (ranging from ocean liners to submarines), controlling the loom speed in cotton weaving, determining the lifting speed of cranes (a special differential arrangement has been developed which enables two cranes to maintain precisely the same speed when lifting the two ends of a single load), measuring the speed of steel rolling mills, checking the revolutions of aircraft engines, measuring the speed of rotation of testing drums for determining the flight velocity of 15-in. shells, and, at the other end of the scale, indicating the speed in "miles per hour" of roundabouts at a fair.

FIRE PREVENTION AND THE INSURANCE COMPANIES.

(Communicated.)

The appointment of a Royal Commission to "inquire into the existing provisions for the avoidance of loss from fire" is not unlikely to bring to a head the resentment which has long been simmering as regards the rates charged by the tariff insurance companies for what are known as "protected risks."

It is not easy to understand the attitude of the tariff companies towards measures having for their end the prevention of fire. From time to time various fire preventive devices have been brought upon the market, some good, some indifferent, and some bad. It is reasonable enough that the tariff companies, before according recognition to any such inventions, should require them to be tested by a committee appointed by their representative association, the Fire Offices Committee, and, if approved, as a condition of a rebate from the premium charged for the unprotected risk, should insist upon the strict observance of regulations for the maintenance of the appliances in good working order. Nor is it surprising that the Fire Offices Committee should fix this rebate with a full appreciation of the difference between theoretical and empiric values. The charge, however, which is brought against the Fire Offices Committee is that, after long years of use and experience, it persists in ignoring all evidence of protective value, and continues to demand from the owners of protected premises premiums which bear no sort of relation to the diminished loss ratio of their risks.

It would have been helpful, in considering the genuineness of this grievance, to have been able to turn to official statistics showing the exact protective value of the various appliances to which the Fire Offices Committee has, from time to time, granted its imprimatur. Had the Committee been keenly desirous of promoting the development of the science of fire prevention, one suspects that it would have found a way to keep records of this nature. Rather regrettably, however, the Fire Offices Committee has always taken up the position that the compilation of statistics of this kind forms no part of its duty to the public. It is fortunate, therefore, that as regards automatic fire alarms, probably the most scientific of all preventive devices, such records exist.

It is now a quarter of a century since the first automatic fire alarm came upon the market. It is a reasonable estimate that, at the present time, property to the value of over £100,000,000 is under protection by some form of automatic fire alarm in the United Kingdom alone. Of this amount, £46,000,000 is protected by alarms which are periodically tested and examined under contract. It is only in respect of the latter class that statistics are available. These records show that the gross premiums received from 1911 to the end of 1920 amount approximately to £1,420,000, and that out of the above premiums the fire insurance companies have only been called upon to pay as fire losses an approximate sum of £40,000, equivalent to a loss ratio of 2.83 per cent. of the fire premiums.

In the earlier years of automatic fire alarms it was customary for the tariff companies to explain their refusal to reduce their rates by declaring that sufficient time had not elapsed to enable the law of average to operate, but the passing of years has made this contention less plausible, and to-day it can no longer be regarded as valid. Of course, it may be asked why an insurance company should not be permitted to charge what rates it pleases. Has not a disgruntled trader the option to take his business elsewhere if he is not satisfied? The reply the trader makes is that the tariff companies have to-day obtained a practical monopoly in insurance matters—at any rate, so far as the placing of the larger risks is concerned. This position has been reached partly by the action of the Legislature, which by the Assurance Companies Act, 1909, imposed restricted conditions on the formation of new insurance companies, partly by the elimination of non-tariff competition by the calculated policy of purchase and absorption of the smaller companies, and partly as a result of the natural growth of the tariff ring. Certainly it has to be conceded that competition is no longer the factor it once was in the regulation of insurance rates.

It must be borne in mind that the installation of an automatic fire alarm costs a good deal of money. It involves the whole of the premises being wired and fitted with sensitive instruments which notify any sudden accession of heat. There has to be a line running through the streets and connecting the building with the fire station. This installation has to be inspected and tested periodically to prove that it is in perfect working order. The trader who is anxious, at all costs, to avoid fire has not only to bear the expense of installing the alarm, but has in addition to pay the Postmaster-General's charges and the cost of inspection and maintenance. It must be admitted that he has a legitimate ground for complaint if he has to pay a premium fixed without reference to the material improvement he effects, at his own cost, in the fire hazard of his property.

The State has always accepted the principle that the public has the right to be safeguarded against arbitrary demands of monopolies or practical monopolies. This principle is in operation to-day as regards the rates charged for carriage by the railway companies. The Royal Commission which will shortly sit will have to consider whether the time has not come to provide the public with similar protection as regards insurance rates. In the case of the railways, the maximum rates are fixed in the first place in consultation with the Board of Trade. No railway company can increase a rate without giving notice to the Board of Trade of the desired variation. If a trader complains, it rests with the railway company to prove that the increase is reasonable. The Commissioners appointed under the Railway and Canal Traffic Acts have jurisdiction to hear and determine any such complaint, but only after the complaint has been made in the first instance to and considered by the Board of Trade. In inquiring into the complaint the Commissioners are entitled to consider all circumstances which can fairly be said to show reasonableness or the reverse.

Why should not similar protection be afforded the public as regards insurance rates? It is asking too much of human nature to expect a purely commercial undertaking such as an insurance company to hold the balance level when its interests and the interests of the public are in direct conflict. It is difficult to see what answer the insurance companies have to the demand that the grievances of traders and others should be made the subject of a reference to the Board of Trade, and, failing an amicable adjustment, should be submitted in the last resort to an independent tribunal for determination.

The Royal Commission has ample powers under the terms of its reference to report in favour of the Legislature's providing safeguards of this nature. One of the objects of the inquiry is to consider how the annual loss to the community from fire, amounting to about £10,000,000 per year, can be reduced. If the evidence submitted to the Commissioners justifies them in finding that the cure lies in the adoption of scientific methods of fire prevention, and that this remedy is held back by the refusal of the tariff companies to bring their rates into sympathetic relation with the loss ratio of the protected risks, one may reasonably expect that the Legislature will take steps to impose some measure of statutory control on insurance companies. The form of that control will, it may be hoped, follow the precedent already established in the case of railway companies.

THE BRITISH ELECTRICAL AND ALLIED MANUFACTURERS' ASSOCIATION (INC.).

Operations during 1920.

Mr. W. O. Smith's Review of the Situation.

THE annual meeting of the B.E.A.M.A. was held at the Connaught Rooms on March 17th. Mr. W. O. Smith (Elliott Bros. (London), Ltd.), chairman of the Association, presided over a good attendance of members. From the report officially provided, we learn that the chairman proposed, and Mr. Nalder seconded, the adoption of the statement of accounts, which, after the chairman had examined and explained the items in detail, was unanimously carried.

In proposing the adoption of the annual report, Mr. Smith said that when they met at last year's annual meeting they were hopeful as to the future, for after the prolonged strike of the moulders, which adversely affected every manufacturer, a settlement had lately been arrived at, and they were again busy clearing off arrears of work which had accumulated during the strike, and making plans for the future. They had already begun to think that their troubles were really over, and saw before them a vista of renewed manufacturing activities which were to compensate them for all the hardships endured during the war period. He thought that nobody could deny that the electrical industry, as a whole, was to-day faced with a more difficult position than, perhaps, at any previous epoch of its existence, and there did not appear to be much definite sign of improvement at present. Export business, especially, was at a low ebb, for how could they compete with their late enemies, the Germans, when the German could afford, largely owing to the exchange, to sell their wares in other countries at something like one-half of the prices of British manufacturers? He dared say most of their members had experienced this difficulty in some shape or form, and, therefore, he did not propose to enlarge on it in any way. The tone of the Stock Exchange was one of the best indications of the state of trade of this country. It had been depressing for some time past to look at the daily quotations, and to see that the values of nearly all securities had been dwindling and sliding in the downward direction. It was perfectly true that for the last week there had been an improvement, but they were told by experts that this was only temporary, and that bottom had not even yet been reached. Let them hope they might be wrong. The fall in values had been especially heavy in all industrials dealing with engineering, and it was to be feared that until there was some stability in exchange established by international agreement, and protection against the stream of cheap foreign imports, the British manufacturers would be at a great disadvantage, and our late enemies would win back in commerce that which they lost in war.

He wondered if members present read carefully the speeches of the chairmen of the leading British banks at the recent general meetings. He cited the banks because they had connections with all the manufacturing concerns in this country, and, therefore, had a knowledge of all branches of trade. The speeches were quite interesting reading, although there was a strong vein of pessimism in evidence in all of them. The chairmen did not all agree as to the cause of the present position. One appeared to attribute it to E.P.D., another to instability of exchange, another to restriction of output by workpeople, another to the large increase in wages, and yet another to extravagance and unfair treatment on the part of the Government. It seemed to him, however, that no one of these causes alone could be the reason of the trouble, but rather the cumulative effect of these and other causes, such, for instance, as the unsettled condition of the coal mining industry, on which the prosperity of this country depended to so large an extent, and further, to the fact that after the strain of the war, and the anxieties of that period, there followed a period of exhaustion and inaction, from which we had not, even up to the present, quite recovered. In his view, before the country generally and the electrical industry in particular, could be brought up to a state of efficiency again, harmonious working between employer and employed was an absolute essential. The employer must pay a fair and reasonable wage, and the employed must be prepared to give a full day's work for a full day's pay, and must also realise that the excessive wages which the employed extracted, directly or indirectly, from the Government in time of emergency, could not be continued now that the industries had reverted to private enterprise, and severe competition had to be met. It was up to the workpeople to decide whether they wished to be employed or unemployed; if they insisted on extracting the last penny from the employer, only unemployment could result. There was no doubt that unemployment was still on the increase at the present time. From the newspapers it appeared that the workpeople in some industries were beginning to see the effect of excessive wages, and were themselves approaching the employers with offers of reduction, rather than find themselves out of work. That, if true, was an encouraging sign.

No doubt the members of this Association would have learned with pleasure that the life of E.P.D. was ebbing fast—and there was not likely to be any mourning over its departure. Mr. Smith then asked what they, as an association, could do to meet the present situation. "It seems to me," he said, "that never before has there been such a need in the electrical and allied industry for co-operation. Although we may compete in friendly rivalry in our own country, let us present a solid front to the enemy, even if we have to make sacrifices for the moment; let us not think and act as individuals only, but rather as an association whose common aim is that of the good of the industry and its members in bringing back trade to this country."

Referring to the matter of transport, the report showed that it had largely occupied the attention of their Traffic Committee during the year, and now the Ministry of Transport was to be abolished. That did not, however, mean that any of the problems dealt with would disappear, or that the labours of the committee had been so much time wasted. The problems still remained to be solved and fought out, and it mattered little whether the party dealing with the matter in future were Sir Eric Geddes or the Railway Department of the Board of Trade. Their efforts must not be relaxed, and the committee would still continue its labours in the interests of the Association.

The chairman said that during the year a very large number of sectional committee meetings had been held, and he thanked the members of them for their work; he also, in conclusion, referred to the efficient service rendered by the large staff employed under the able guidance of the director, Mr. Dunlop.

The report was passed unanimously, after which the chairman announced the election of the following members to fill the five vacancies in the Council for 1921:—

Belliss & Morcom, Ltd.
Cole, Marchent & Morley, Ltd.
Elliott Bros. (London), Ltd.
Ferranti, Ltd.
Mather & Platt, Ltd.

Messrs. Price, Waterhouse & Co. were re-elected auditors for the year.

The Report of the Council.

The following are extracts from the report for the year 1920, adopted by the meeting:—

The Association is still steadily pursuing its objects and enjoying the full confidence and loyal support of its members.

"The business year of 1920 affords little occasion for favourable comment; for it was not very old before the numerous inquiries for engineering machinery from all overseas markets with which it opened began to change to complaints, and members to encounter difficulties.

"The taking of an order implies the giving of a date, more or less fixed, for its delivery, and that was by no means an easy matter with shops full of unexecuted home work accumulated from a five months' moulders' strike, general labour unsettlement, and shortages of all raw materials. The taking of an order also involves the giving of a price, more or less fixed. Your Association was one of the worst involuntary sufferers under a device invented elsewhere for avoiding strict definition in this matter, namely, the price-adjustment clause, which was rendered necessary by the extreme buoyancy of costs of labour and raw materials. As soon as the clause proved to be an added discouragement to buyers, who began to seek elsewhere for firm deliveries and prices, your Council, after conferences with other trade associations, discountenanced its use after January 1st, 1921.

"Probably the most discouraging of all the features which 1920 presented was the alarming discovery that Europe was in the position of the "poor man," and that the British manufacturer, burdened with the heaviest taxation per head of population in the world, was unable to help him to help himself. The Brussels Conference having accomplished little of practical value, the Government is, at the time of going to press, with the advice of experts in banking and insurance, endeavouring to apply palliatives in the form of credit schemes to enable the "poor man" to do business and to deflate his currencies; and, in the form of Parliamentary Bills for the regulation of imports, to prevent his becoming a further danger to our own industries. How these things will work out the present Parliamentary session alone will show. Meantime, the world generally and labour in particular are being again schooled in the commonplace lesson that one cannot get something out of nothing, and that more strenuous work and higher effective production for lower rewards are the inevitable results of war."

During the year the Export Committee have had the advantage of visits from Trade Commissioners and others from overseas, all of whom gave valuable and interesting accounts of the trade position and possibilities in their respective territories.

As the outcome of the application of the Overseas Committees for extended powers, a new Draft Constitution was drawn up and has been adopted with variations in different parts of the world.

Members of the Association were thereupon invited to make nominations to the Overseas Committees under the new constitutions, and it is believed that they have thus been materially strengthened for work in their respective territories, and that good results will be forthcoming.

The preparation of the proposed BEAMA Code has made good progress during the year, and the signing of contracts for its production now awaits only the settlement of certain questions of copyright and patent right.

During the year the Education Committee settled the terms of the studentships and scholarships offered by the turbine and turbo-generator sections of the Association for the study of problems of research relating to turbines and turbine-driven generators, and these were duly published. The object of these scholarships is to encourage technically trained students to fit themselves for posts on the higher staffs of engineering concerns and research institutions. Procedure has also been settled for receiving into British works properly qualified student apprentices offered by overseas Governments and educational institutions. During the latter part of the year, twelve students nominated by the Egyptian Government were so placed.

The Electrical Research Committee obtained its incorporation during the year under the title of the British Electrical and Allied Industries Research Association.* The last report of progress (September 30th, 1920) shows that there were 87 technical reports in preparation. Amongst other researches taken over are those on the corrosion of condenser tubes (carried out jointly with the Institute of Metals), the special BEAMA research into the most suitable materials for turbine blades, and the research (conducted jointly with the Institution of Mechanical Engineers) into the proper proportions of turbine nozzles.

With regard to standardisation, the old system under which the first steps towards the making of a specification were taken by the B.E.S.A., has been reversed; the preliminary work of preparing drafts on electrical subjects is now usually done by the BEAMA. For dealing more effectively with the work of standardisation, several sections have set up permanent technical committees which draft specifications to form bases on which the B.E.S.A. will build the final texts.

In addition to public business of this kind, the sections, by their technical committees, have done much useful work on the domestic side. Thus, the switchgear section has prepared a revised edition of its purchasing specification, *Slate Panels and Slabs*, and, in collaboration with the insulations section, has standardised a complete line of moulded insulating bushes for use in switchgear and allied work. The industrial instrument section has also, in collaboration with the switchgear and meter sections, drafted standard drilling centres for the ends of instrument and meter shunts. These standards will be embodied in future editions of the Association's rules. The stationary and portable accumulator sections have standardised the relative capacities of batteries at all rates of discharge, together with final voltages. Standard curves have been plotted, and these have been accepted by Government departments and other large buyers, and the curve for portable accumulators has been adopted as standard British practice by the Society of Motor Manufacturers and Traders.

The Standardisation Committee has made recommendations to the turbo-generator section on methods of declaring the efficiency and standard overloads of turbo-alternators; to the rotary converter section on the permissible ripples in the d.c. voltage of rotary converters, having special reference to the possible disturbance produced in telephone circuits; and to the gas and oil engine section on cyclic speed irregularity in its relation to parallel running of synchronous machines. The Committee has now under review a revision of the B.E.S.A. publication, No. 72/1917, *Electrical Machinery*, and it is anticipated that the observations of members of the Committee during their recent visits to America will have an important bearing on that work.

The Traffic Committee have had a very busy year in the preparation of evidence and recommendations for and in appearances before the Rates Advisory Committee, either through their own witnesses or by counsel engaged by the Federation of British Industries on behalf of their constituent associations. We quote the report at length on this subject:—

"It will be recalled that the Minister of Transport, shortly after assuming office, set up this committee (Sec. 21 of the Act) to advise him as to how he should meet the annually recurring deficit of several millions on British railway working; and that, as a consequence, goods rates were raised 112 per cent. above pre-war figures and passenger rates 75 per cent. No long time passed before the Minister found himself obliged to call for further advice as to (1) the principles which should govern the fixing of rates and charges; (2) the classification of merchandise, and the particular rates and charges to be imposed; and other matters.

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* Elec. Rev., December 17th, 1920, p. 797.

"The Rates Advisory Committee have now issued their report (Cmd. 1,098) on the first portion of their reference, viz., The principles which should govern the fixing of rates, &c.; and your Council note with satisfaction that they adopt certain principles which form part of your committee's recommendations, *e.g.*, (*a*) That a trader should pay only for services rendered by the railway companies for either station-to-station or private-siding traffic. (*b*) That rates should be computed on the basis of continuous mileage when the transit is over the lines of more than one railway company, and should be based on the 'cumulative' principle, and that the quantity constituting a consignment should be taken into consideration. (*c*) That all rates should be disintegrated, showing what is included for conveyance, service terminals, station terminals, and any other services rendered. (*d*) That the general railway classification should be revised and brought into harmony with present-day practice.

"At the time of going to press, the Rates Advisory Committee were taking evidence on the second part of their reference, *viz.*, the classification of merchandise traffic and the particular rates, charges, &c., thereon, and the railway companies have proposed revisions which, if adopted, would place many electrical articles in a higher class than hitherto. Moreover, the mileage scale of charges, hitherto enjoyed by steam and gas engines and certain other machinery, would be abolished, which means that such articles would be penalised with the heavy-weight surcharge for pieces exceeding ten tons.

"It will be necessary strenuously to oppose these amendments to the classification, and your Traffic Committee have prepared rebutting evidence and will argue for a lower classification than hitherto on certain items. They will also press for the abolition or reduction of the heavy-weight surcharges' on the grounds, *inter alia*, that, with the exception of the actual conveyance, the trader usually performs all the other services, such as loading, unloading, &c., in this connection.

"Your council issued on April 27th a memorandum prepared by your Committee for the guidance of members in dealing with the increased rates and charges put into operation on the interim recommendations of the Rates Advisory Committee; and it was evident from the replies received from members that this served a very useful purpose and enabled members to check the accounts of the railway companies, which at that time were not prepared upon any uniform plan.

"Your Committee have also advised members from time to time on charges for special trucks, the proper classification of various items, loss or damage in transit, demurrage, consignment notes, &c."

Legal business on conditions arising during the year was practically normal, the money value of such contracts as called for expert advice being about three-quarters of a million sterling, most of them being settled without friction of any kind and to the satisfaction of purchasers.

The I.E.E. Joint Committee of Revision referred to in the last report began work on the amendments proposed by the Association to the text of the model conditions, and accepted most of them. The just counterpoise of the buying and selling interests on the committee, however, resulted in the production of several amendments by the former, which has delayed the issue of the report. Negotiations are proceeding with Government departments as to their adoption of standard forms of conditions, the main point of difficulty being the arbitration clause.

The British Electrical Development Association reports a steadily increasing membership. This now includes 102 municipalities and 25 supply and power companies. Members are strongly recommended to acquaint the secretary of the E.D.A. with any new devices and developments in their branch of industry, so that the public may be kept alive to the best and latest practice in electrical science. Direct advertising on behalf of individual members does not form any part of the functions of the E.D.A.

The report contains particulars of additions made to the BEAMA list of publications during the year.

The standing rule of the Association which barred members from incurring the expense of exhibiting at shows not sanctioned by the Council, came under consideration during 1920 in response to representations by certain northern members that they suffered hardship under its operation. The rule was, after due consideration, modified so as to apply to electrical exhibitions only, and the modified suspension dates so as to terminate on December 31st, 1921. It follows that all members are free to accept an invitation to exhibit at any exhibition which is not wholly or mainly electrical until that date without the sanction of the Council. Owing to difficulties in obtaining the required space, a date has not yet been settled for the holding of the next BEAMA exhibition.

The Council regard the holding of an annual dinner by the Association as a matter of expediency to which no element of indispensability necessarily attaches; and, after consideration of the general situation, have decided that it may very well be dispensed with this year.

"Thanks to the liberality of members, your Association's subscription list is in a very satisfactory state. The increase of the maximum subscription (from £250 to £500) decided upon in 1919, was found inadequate to meet the increased expenditure, and your Council last year again raised the maximum subscription (from £500 to £1,000), and altered the rate of assessed subscriptions from 2s. 6d. per cent. of wages paid to 5s. per cent., the minimum (£10) remaining as before. The new rates came into force on October 1st, 1920, and the manner in which members have met the call, and the fact that several members liable in the minimum subscription only have voluntarily doubled it, are excellent testimony to their appreciation of the work accomplished by your Association."

The Council announce the creation of a fund (*a*) to meet applications for financial support from other organisations in the electrical and allied industries engaged in a mutual effort to develop them in all branches in the United Kingdom; (*b*) to assist, in particular, the Electrical Development Association in its work; and (*c*) to support financially the Electrical Research Association and the British Engineering Standards Association. This electrical and allied industries development fund is under the control of a financial board representing the contributing sections who act in co-operation with the Council.

An instrument transformer section was constituted during the year, and has made a promising start.

The Association maintains close working relations with the Institution of Electrical Engineers and other bodies.

The system of tendering embodied in the cross-tendering agreements continues to find favour among members, but has not been extended.

The number of members on the register of your Association at the end of the year was 224. Fourteen members were admitted to membership during that period and 15 resigned, due in many cases to amalgamation, reconstruction, or dissolution.

EXCITATION AND FIELD TEMPERATURE INDICATORS.

Two New Electrical Instruments.

The development of electric ship propulsion has emphasised the need for some new electrical instruments, two of which have been developed and are in use on the U.S.S. *New Mexico*, S.S. *Eclipse*, and the S.S. *Cuba*; they are known as excitation and field-temperature indicators, and are described in the February, 1921, issue of the *General Electric Review*, from which we abstract the following details and illustrations.

The *excitation indicator* shows the operator when the correct value of the alternator-field excitation is being maintained and whether it must be raised or lowered. It also indicates whether the motor and alternator are operating on the stable or unstable side of their combined characteristics, *i.e.*, whether the motor is "in or out of step" with the alternator, and the instrument can be used regardless of whether the motor is an induction or synchronous machine; in the latter case, however, the motor-field excitation should be varied together with the alternator field so as not to change the line power factor.

Fig. 1 shows the connections of the indicator to the lines between the alternator and the motor. There are current and potential elements, the vanes of the two elements being connected to a common movable shaft in such a way that when the stationary coils are excited, the torques produced in the vanes are opposite. Since there is no spring acting on the moving parts, the position taken by the shaft to which the pointer is attached depends only on the ratio of currents in the stationary coils of the two elements. The current element is connected directly to a current transformer in the line between alternator and motor. The potential element is connected in series with a high reactance X and then to a potential transformer as shown in fig. 1. Thus the current in the potential coil is directly proportional to line voltage, and on account of the reactance X it is inversely proportional to the frequency of the line voltage. Therefore, the position of the pointer depends on line voltage divided by line amperes and line frequency.

As a rule there is little saturation in an alternator when it is loaded up to maximum output with any value of field excitation that can be maintained continuously, since due to the regulation the line voltage will be below normal. If the line current, power-factor, and excitation are kept constant, then the line voltage and kilowatts output will vary directly as the frequency, from which it follows that the above-mentioned ratio is constant when the alternator is loaded up to maximum kilowatts output at a given power-factor regardless of what the speed of the alternator or its field excitation may be, it being understood that the field excitation is not higher than can be maintained continuously.

Therefore, since the position of the pointer of the excitation indicator depends on the same fraction, this position is always the same when the alternator is operating at its maximum kilowatts output regardless of excitation or speed. If at a constant load the alternator is operating at its maximum output and if the field excitation is then increased, the line voltage will increase and the line amperes will decrease causing the excitation indicator pointer to move; while if the field excitation is decreased, the indicator pointer will move in the opposite direction. Thus the position of the pointer indicates whether the alternator is operating on the maximum of its output curve, whether it is on the stable side, or whether it is on the unstable side, that is, on the side where an increase in line current gives a decrease in kilowatts. This decrease in kilowatts output is due to the fact that the voltage decreases at a greater rate than the current increases.

In the case of electric ship propulsion equipment, the alternator cannot hold the driving motor in step when operating on the unstable side of its output curve regardless of whether the motor is an induction or a synchronous motor, and if the motor is out of step it will pull the alternator over on the unstable side. Therefore, when the pointer of the excitation indicator shows that the alternator is operated on the unstable part of its characteristic, the motor is out of step and should be brought into step.

To run at the highest economy and with least heating of the alternator field, the alternator-field excitation should be kept as low as will hold the motor in step; in other words, the alternator should operate as near the maximum of its output characteristic as the variations in propeller load will allow.

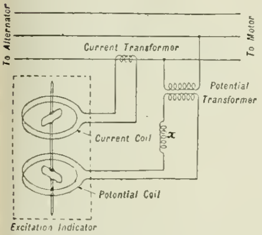


Fig. 1.—Excitation Indicator.

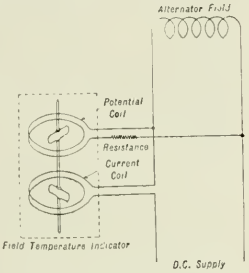


Fig. 2.—A.c. Generator Field Temperature Indicator.

The instrument cannot be taken from one equipment and be connected to another equipment of different design without changes and recalibration.

The *field-temperature indicator* depends for its operation on the change in resistance of a conductor with change in its temperature. It really indicates electrical resistance, but instead of a scale of resistance a scale of temperature in degrees Fahrenheit is used, and is employed on the alternator field only, no such instrument being necessary on the field of the synchronous motor.

The connections to the alternator-field circuit are shown in fig. 2, from which it will be seen that it is similar to the excitation indicator. When the two stationary coils are excited, the torques produced in the vanes are in opposite directions, and the resultant position taken by the shaft, to which a pointer is attached, depends only on the ratio of the currents in the two stationary coils; or since one coil is connected across and the other in series with the field, it depends on the ratio of the voltage applied to the field to the current in the field. Since there is a definite relation between the resistance of a copper conductor and its temperature, the instrument is calibrated directly for temperature, and has to be calibrated for the field to which it is to be connected and cannot be used on another alternator without recalibration.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Water-tube Boilers.

With reference to the article on Water-tube Boilers, by Mr. J. Cauthery, in the Electrical Review dated April 1st, this certainly contains very valuable advice with regard to the care of this type of boiler, and it evidently gives the results of many years' practical experience.

One correction, however, is necessary under the heading "Causes," section (*d*), which reads: "Excessive density where the water in boiler contains material proportion of salts or other matter in *suspension*."

This should read "in *solution*," and not suspension. Matter in suspension has, of course, no effect whatever on the density of water.

As regards Mr. Cauthery's limit of boiler water density, which he gives as 2/32nds, we do not think many engineers who have the control of water-tube boilers would go anywhere near this figure. Boiler insurance companies usually recommend a maximum of one-half of 1/32nd with this type of boiler, and we consider that this should be the limit; otherwise priming, overheating, and other troubles soon develop. Our experience is that for modern high-pressure water-tube boilers, the density is seldom allowed to exceed one-quarter of a 1/32nd, and when it does rise above this, it usually indicates a leaky condenser. It would be interesting to have the experience of engineers in charge of water-tube boilers at electricity stations in this respect.

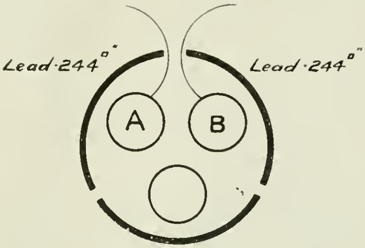
per pro **Porter Water Softening & Eng. Co.**
W. H. Porter.

Flixton, Manchester.
April 4th, 1921.

Heating of Buried Cables Report.

I have read with interest Major Taylor's letter in your issue of the 1st inst., and can only say that the results appear to me extraordinary. So far as I know they are entirely at variance with all previous experiments on the same subject and with the Buried Cables Preliminary Report, which distinctly states that tests were made both with alternating current at 50 cycles and with direct current, and there was no appreciable difference in heating.

Suppose we consider a 0.15 sq. in. 20,000-V cable carrying 230 amps. in each core; a 120 deg. sector of lead on this cable would be about 0.244 sq. in., so that the current required in this sector to equal 62½ per cent. of the corresponding core loss would be 29 per cent. of the core current = 67 amps., which does not seem reasonable.



Again, suppose we make a perfect transformer between two cores and two lead sectors as per sketch, then all the flux generated by cores A and B will interlink the sectors so that mutual inductance will be equal to the self-inductance of the cores. This works out to roughly 1 millihenry per mile, and at 230 amps. the voltage induced in the secondary will be $2\pi 25 \times 230/1{,}000 = 36.1$.

The resistance of the secondary is about 4 ohms per mile, so that, neglecting reactance, the induced current would be about 9 amps. under ideal conditions instead of 67.

The above figures are only rough, and are based on the temperature rises given in Major Taylor's remarks published in the Review of December 31st.

With regard to eddy-current losses in the lead sheaths of single-conductor unarmoured cables, Messrs. Clark and Shanklin, in their paper on "High-tension Single-conductor Cable of Polyphase Systems" summarised their results, one of which is given as follows:—

"By testing lengths of lead-sheathed cable and then repeating the measurement after the sheath was removed, it was clearly proved that the additional loss due to eddy currents in the open-circuited sheath was too small to be detected."

It is to be hoped that Major Taylor will publish details of the cable used for his tests and his methods of making these experiments.

J. A. Morton.

Prescot.
April 4th, 1921.

Mr. J. A. Morton has very kindly allowed me to see his letter to you of the 4th inst., before publication, and though I cannot at the moment reply fully, yet perhaps misinterpretation of my letter by your readers may be avoided if I state very briefly the points which have, I believe, been demonstrated by the experiments referred to.

First, let me say with reference to Mr. Morton's quotation from Messrs. Clark and Shanklin's paper that I agree that in the case of unarmoured single-phase cables the increased loss over that of direct current is inconsiderable. I regret, also, that in my letter published in your issue of the 1st inst., I inadvertently quoted Monsieur Capelville's results as supporting my own figures. These results, at the time of writing, I took to be made with cables having wire armouring, which greatly affects the results. Moreover, they refer only to single-phase currents.

The point I wish to make is that, assuming there is nothing demonstratively wrong in the tests which I have been permitted to put forward, the loss in a 3-core armoured cable, due to the *rotating* field produced by the polyphase current as distinct from the loss due to the *pulsating* field in each individual conductor, is some 50 per cent. above the rise due to a uniformly distributed continuous current, when tested at 25 periods, and is considerably less when tested at 50 periods. If, however, the cable is stripped of its armour, the losses are greater in each case (25 and 50 periods), but are still considerably less with 50 periods than with 25 periods.

It is, no doubt, very difficult to separate the loss due to the rotating field from that due to the pulsation of the current, but the fact that with 3-phase currents the losses in unarmoured cables are in each case considerably greater than those in armoured cables, coupled with the fact that with single-phase currents in the same cables the losses in armoured cables—particularly at 50 periods—are enormously greater than in unarmoured cables, proves to my mind conclusively that the first-mentioned (*i.e.*, the loss with 3-phase currents) is a loss caused by the *rotating* field, while the second mentioned (*i.e.*, the loss due to single-phase currents) is a loss due to the *pulsating* field.

The above assumption of the loss due to the rotating field is, I think, further borne out by the fact of the losses due to this cause being considerably less at 50 periods than at 25 periods. If we think of the lead sheathing as being a closed secondary circuit, and consider, for example, that in the case of 25 periods a magnet having a given strength is rotated inside that closed circuit, there will be a certain reduction of the field due to that magnet by the reaction of the 25-period eddy currents induced in the lead sheathing. If, now, we rotate a magnet of exactly equal strength at double the speed, the eddy currents would tend—for unreduced field—to cancel the flux due to the magnet with double the force that they did in the first case, and the resultant of the action and reaction would be a considerably reduced field with consequently reduced loss. If the speed of rotation were infinite there would be no field at all, and no loss.

The fact that, with an armoured cable and with three-phase currents, the loss is *less than with an unarmoured cable* can, I think, be explained on the assumption that when there is no armouring the rotating field is more or less concentrated on a diameter of the cable, and that the lines of flux pass through the lead sheathing normal to the surface of the same, whereas, when there is a steel wire armouring, two parallel magnetic return paths are formed, closely contiguous to the copper cores, and the lines of flux no longer enter the lead sheathing normal to the surface, but they branch away from the diametral line in both directions, and pass through the lead sheathing at quite an easy slope, corresponding more nearly to that which obtains when a single-phase pulsation takes place from a centrally situated core.

I regret that at this time I cannot give details of any of the tests, as to do so would be to take up too much of your valuable space, and would interfere with other work which I am engaged upon, but I hope later to be in a position to contribute these tests to the Institution files.

The whole of the argument in Mr. Mortou's letter is on the basis of proving that the losses due to single-phase currents with unarmoured cables at 25 periods are negligible, and as I am virtually in agreement with him on this point, I will not attempt to controvert his arguments. I may say that when the "Buried Cables Report" came out I compared one or two observations with the figures which I possessed, and that where the buried cables were not tested in ducts, but in the open, the results seemed to agree pretty closely. I have not, however, looked again at these lately, but will do so at an early date.

A. M. Taylor,
Hon. Major, S.O.2., W.B.A.M.

Birmingham.
April 6th, 1921.

Power Installations.

With reference to the inquiry by "Interested," on page 379, in the Electrical Review dated March 25th, 1921, I would recommend "Machinery's Handbook," price 28s., obtainable from the Machinery Publishing Co., Ltd., 52, Chancery Lane, W.C. 2.

This gives the h.p. required for most kinds of machine tools, &c., and the types of motors used, from data collected by the Westinghouse Electric & Manufacturing Co., as well as a number of formulæ which are used in general practice.

Alec. Kur.

South Tankerton.
April 6th, 1921.

[We may add that similar data are given in "Electricity for Everybody," by R. Borlase Matthews, Electrical Press, Ltd., price 5s. net, and "Electricity in Factories and Workshops," by A. P. Haslam, Crosby Lockwood, price 7s. 6d. net. —Eds. Elec. Rev.]

Payment According to Ability.

Referring to "Broad Minded's" letter in your current issue, one is tempted to wonder whether the word "experience" counts at all. In the first place, do all people agree that 50 per cent. of new ideas, &c., emanate from the technical colleges? I do not wish to run down colleges, having a high opinion of the training I have received through them, but in my brief experience I have found that practice makes perfect. It is impossible for a man to be as experienced at 21 years of age as a man at 40, given equal intelligence. Indeed, according to the view of "Broad Minded," a man is better without any practical experience gained during ordinary work, than a man who has devoted years of study, &c., in negotiating difficulties met with in the course of his work, which argument will not hold water. Why do all chiefs of firms advertise for men of experience if younger men without any would do? Regarding the statement "If there was a little less cant amongst British workmen," I fail to see its application. I have had charge of plenty of "British workmen," and consider them very good material to help build up our "old country."

In conclusion, I quite agree that everyone requires a living, but would also add that everyone must start at the bottom of the ladder.

Experience.

April 9th, 1921.

Your correspondent "A Regular Reader" seems to have missed the point in my question: "Who was the better man?" He admits that I was; yet my first employer evidently thought differently, and under such a scheme as "A Regular Reader" suggests would have paid me less than the other man. He further states that he does not care whether a man is married and has children or not. Just so; he would treat him as a mere machine for producing profits. This attitude on the part of a section of employers, backed by such men as "A Regular Reader," is responsible to a great extent for the prevailing industrial discontent and the spread of such pernicious doctrines as Bolshevism and Communism. He further states that I failed to pass my test through want of experience. Yes, I grant that, though not through lack of ability, as I think I proved. He, however, says: "Payment according to ability." Ability and experience are not synonymous terms.

To put "fear of unemployment" down as utter nonsense is a very convenient way of disposing of the argument, but it is a very real cause of low production, as any electrical contractor knows to his cost when trade is slack. A man can do his work quickly and well, but there is a limit beyond which he can only increase quantity at the expense of quality. A foreman or manager may, though not invariably, know who is his best man, but may not recognise the fact. His best man may be an even better man than himself, in which case jealousy, mutual or otherwise, would probably take a part. The best workman as regards skill and output per hour may be the most unreliable timekeeper. The best man is more likely to resent criticism, thereby putting himself out of favour. Then there is a grievance in many a shop over the foreman's relatives. Lots of influences are at work besides a man's efficiency. One has to deal with things as they are, not as they should be. Your correspondent seems to think he has to deal with machines instead of men. He should have stated "Payment by results" instead of "Payment according to ability." Payment by results would undoubtedly increase production, but the majority of workmen object to it. Why? Simply because experience has taught them that when earnings have reached a high level employers have attempted, sometimes successfully, to cut rates, even though the proportion of standing charges to unit of output has gone in their favour. The result is that the men have lost confidence in their employers. Restore that confidence and we shall be well on the way to higher production, whether payment be by results or by time.

Another Regular Reader.

April 11th, 1921.

A Peculiar Phenomenon.

I am very interested in a letter entitled "A Peculiar Phenomenon" in your current issue, which deals with the luminous blue-grey glow caused when fingering a small dry metal-filament bulb. I have recently noticed this in connection with a 4-volt m.f. lamp, and shall be glad if some other reader can give some elucidation.

F. Ainsley Cook.

Newcastle-on-Tyne.
April 9th, 1921.

Wiring Ferro-concrete Factories.

One would have thought that the object that "Phase" and myself had in view when writing our letters had been sufficiently explained and endorsed by the Editors' note on the "Freedom of the Press" in the issue of the 1st inst.

Cannot "Two Phase" understand that if Mr. Brooking had written courteously explaining to what extent C.T.S. *was* suitable for use in ferro-concrete factories, we should all have been obliged to him, and still more so if this were supported by the recommendations of unbiased users, of whom I presume "Two Phase" to be one?

The difference between the *possibility* of using a certain system in a particular case and the fact of its being the most *suitable* does not seem to be properly appreciated by Mr. Brooking or "Two Phase."

The choice of a system of wiring for particular circumstances must be a matter for the judgment of those concerned, and it is exceedingly improbable that any one system will be the most suitable for every case.

In the particular industry in which I am engaged, one in which there is considerable fire risk, I am so far convinced that V.I.R. wire in heavy gauge weldless screwed conduit is the safest system, and in certain districts the use of this system is laid down as a condition for passing buildings (electrically lighted) for this purpose.

The exponents of C.T.S. should remember that they virtually relegate all other systems to the scrap heap, and consequently should be prepared for a little criticism themselves.

Now, I think our good Editors will agree that it is time we got back to the original subject of this correspondence—viz., the best form of wiring for ferro-concrete factories, and gave our original "Inquirer" the fair play which "Two Phase" quite rightly holds so dear.

A. C. Purday.

Croydon.
April 11th, 1921.

As the contractor for the 250 houses mentioned in this correspondence, I would like to say something about my experience with regard to C.T.S.

At first, I admit, I did not jump at it, as I never like risking my reputation on a comparatively new and at that time unproved system. I was, however, forced into using it for a fairly big job, because C.T.S. was specified, and I then found out some of its advantages, namely, ease of erection and fewness of tools required.

One of your correspondents asks what C.T.S. is unsuitable for. At one time I should have put a fairly long list forward with regard to this, but now I find it difficult to think of anything, in view of the large number of varied conditions under which I have used it.

I do not think it would be commercially suitable for underground mains.

I, however, look forward to learning of any defects, as my experience of C.T.S. may be limited compared with the experience of others.

per pro **Harry Rogers.**
J. B. Robertson.

Warrington.
April 11th, 1921.

Your correspondents all seem to strike the wrong note, and Mr. Brooking, although quite right in his threat *re* legal proceedings, would have made his point much better if instead he had emphasised the fact that the correspondent did not know the subject he was writing about. We hold no brief for C.T.S. cable, with the exception that we have used a great deal of this cable on all sorts and conditions of installations and have never yet found it fail to do all that is claimed for it. We are sorry and can quite feel for Mr. Brooking, for *we* have had to put up with a lot of semi-libellous statements *re* C.T.S. cable from people who should know better. Most of it is prejudice—for we are a very conservative nation as regards new applications—and a manufacturer has no guarantee that in open column discussions a "stick-in-the-mud," ignorant of the matter at issue, will not rush into print and undo a lot of good work. It is really a dangerous precedent, Mr. Editor, to allow your columns to be used at all for or against any particular manufacturer's commodity. If in favour, it looks like a cheap "puff"; if against, it may be libellous, or at any rate, unfair. We, like "Two Phase," would like to know what job it is not suitable for. We have installed it in laundries with their excesses of water and steam, boiler houses with tremendous heat, and refrigerators with the opposite of temperature, and yet no complaints. Has our friend—who has so much against C.T.S.—tried it under all these circumstances? If so, will he let us know where it fails? If not, will he stop rushing into print *re* something he knows nothing about, for "a little knowledge is a dangerous thing."

Hurlingham Electric Co.
Fred. C. Ferrier.

London.
April 4th, 1921.

[The correspondence on this subject has proved very interesting, and has amply demonstrated the accuracy of our statement of April 1st (p. 402): "If the subject under discussion is meritorious, the fact is sure to be brought out." Mr. Brooking could not have wished for a finer series of tributes to the merits of his system than it has received. Incidentally, we may point out, as some of our correspondents do not seem to have read "Inquirer's" letter, that he did not make any attack upon C.T.S. wire, which he regarded as "ideal for some classes of work." The question under discussion is specifically the best method of wiring *ferro-concrete factories*, and it is a question of considerable importance.—Eds. Elec. Rev.]

Third Harmonics.

Referring to Mr. J. B. Stansfield's letter of the 24th ult., I quite agree that the e.m.f. wave corresponding to a smooth flux wave will not possess ripples provided it is shown as embodying *all* the harmonics involved.

The e.m.f. waves shown in figs. 5 and 6 were obtained by analysis and differentiation of the flux wave, and when actually completing the e.m.f. wave, harmonics above the fifth were ignored. This accounts for the rippling of the e.m.f. wave at the zero axis.

If Mr. Stansfield's letter is an indication of interest in the article I shall be pleased to send him a reprint copy on receipt of his address.

S. Austen Stigant.

Lewisham.
April 5th, 1921.

Conditions of Living and Prospects in Brazil.

Having noticed from time to time in your valued columns inquiries relative to conditions abroad, and also noting that many of your readers with foreign experience were obliging enough to give help in this way, I wonder if, through the medium of your paper, I could obtain information as to the climate from a Britisher's point of view, and the outlook of the electrical industry in Brazil; particularly in the State of Sao Paulo. Any little knowledge gleaned will be gratefully accepted.

Inquirer.

April 5th, 1921.

[A series of articles on Brazilian conditions appeared in the Electrical Review commencing November 10th, 1911, which dealt very fully with the position at that time. The climate is quite suitable for British immigrants (but what climate is not?). We shall be pleased to receive communications on the subject.—Eds. Elec. Rev.]

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR MARCH, 1921.

The trade figures for March followed very closely those of the previous month. Export and import figures showed increases of about 3·7 per cent., and 5·7 per cent. respectively, while re-exports were reduced by approximately 2·3 per cent. In the exports section there were increases in the shipping of electrical goods and apparatus (unenumerated), insulated wire, glow lamps, meters, electrical machinery (unenumerated), switchboards, and telegraph and telephone instruments and apparatus; other export items showed reductions, especially arc lamps, which fell from £2,421 to £467. Increases occurred in the value of imports of unenumerated electrical goods, insulated wire, batteries, unenumerated electrical machinery, and telegraph and telephone instruments and apparatus. The re-export of meters experienced a considerable decline, but the value of re-exported telegraph and telephone instruments was doubled.

Values of Electrical Exports and Imports for March, 1921.

	Exports.	Imports.	Re-exports
Electrical goods and apparatus (unenumerated)	£234,722	£94,969	£15,447
Insulated wire	382,804	20,754	525
Glow lamps	49,503	21,302	11,552
Arc lamps and parts	467	1,452	27
Batteries	57,518	20,215	—
Meters	36,119	26,114	593
Carbons	9,532	4,645	86
Electrical machinery:—			
Railway and tramway motors ...	8,949	—	—
Other motors and generators ...	229,243	—	—
Electrical machinery (unenumerated)	178,961	71,853	2,144
Switchboards (not telegraph or telephone)	14,146	—	20
Telegraph and telephone cable and material:—			
Telegraph and telephone wire and cable (not submarine)	131,140	2,219	184
Submarine telegraph and telephone cable	86,682	—	—
Telegraph and telephone instruments and apparatus	153,085	33,739	1,890
Totals... ...	£1,572,871	£297,262	£32,468

Preventing Insulator Breakage.—Writing in the *Electrical World*, Mr. R. H. W. Lockyer, of Trail, B.C., says:—A sliding base to allow for the expansion of heavy 'buses has put an end to a considerable breakage of post-type insulators that had been customary in a Canadian power company's station. A heavy bus-bar of some length and supported rigidly on post-type insulators was giving trouble because of the tendency of the insulators to break off. Upon investigation it was found this was due to the expansion of the 'bus when operating heavily loaded. Many remedial schemes were thought of—such as expansion joints in the 'bus—but no other was so effective as a post-type insulator on a sliding base. The base consists of two separate parts, one the brass slipper which is attached to the insulator and the other the guide in which the slipper moves. The guide is of machined grey cast-iron. When the 'bus changes its length no strain is put on the insulator, as it is free to slide with the 'bus.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

9,216. "Electric light extension switch." R. Amy and E. F. Greenshields. March 29th.

9,242. "Electrical distribution fuse-boards, fuse-boxes, &c." W. G. H. Cox, Midland Electric Manufacturing Co., Ltd., and H. E. Sutherland. March 29th.

9,270. "Movable point for overhead run-ways." H. Morley and W. Tout. March 29th.

9,294. "Electric switches." J. Morray. March 29th.

9,318. "Automatic electric heating device for glass furnaces." L. N. Bruner and W. G. Clark. March 29th. (United States, March 29th, 1920.)

9,322. "Electric dry battery cells." A. Aron. March 29th. (Germany, March 29th, 1920.)

9,352. "Dipping tanks for electrical apparatus, &c." H. D. Symons. March 29th.

9,366. "Control of electric motors." R. Brooks, S. Gowan and Metropolitan-Vickers Electrical Co., Ltd. March 29th.

9,368. "Fusible electric cut-outs." L. Bartmann. March 29th.

9,385. "Devices for transforming electrical energy into mechanical energy and inversely." J. E. A. Michel. March 29th.

9,388. "Electric switches, &c." Firm of A. Cohn, Sur. March 29th. (Germany, April 23rd, 1919.)

9,406. "Telephoto lenses." O. E. Wheeler. March 30th.

9,411. "Speed regulating devices for electric motors." L. T. Bates. March 30th.

9,465. "Electrically illuminated signs." J. Moiseiwitsch. March 30th.

9,470. "Wireless telegraph transmitters." Ges. fur Drahtlose Telegraphie. March 30th. (Germany, March 31st, 1920.)

9,471. "Telephone systems." Ges. fur Drahtlose Telegraphie. March 30th. (Germany, April 1st, 1920.)

9,473. "Speed regulating systems." British Thomson-Houston Co., Ltd. (General Electric Co.). March 30th.

9,475. "Repair of metallic lamp filaments." J. von Rottenburg. March 30th. (Germany, August 24th, 1920.)

9,490. "Automatic circuit breaker, &c." E. C. R. Marks (Elektriska Aktiebolaget Volta). March 30th.

9,491. "Electric drive." E. C. R. Marks (Soc. Anon. Construction Electriques de Belgique). March 30th.

9,494. "Storage batteries." H. E. Smith. March 30th. (United States, March 31st, 1920.)

9,498. "Apparatus to be connected to telephones to deliver a message." C. J. Maglekilde-Petersen. March 30th. (Denmark, March 31st, 1920.)

9,501. "Means for detecting breaks, &c., in submarine electric cables." B. S. Smith and F. B. Young. March 30th.

9,507. "Apparatus for examining X-ray tubes, &c." G. Hubers. March 30th.

9,518. "Automatic, &c., telephone systems." W. D. Edwards and Relay Automatic Telephone Co., Ltd. March 30th.

9,522. "Electric controllers." L. Satchwell. March 30th.

9,524 "Electric switches." L. Dobson and Foster Engineering Co., Ltd. March 30th.

9,529. "Switch wall plug." A. N. Gosling. March 31st.

9,532. "Control systems for electric furnaces." O. G. Sharples. March 31st.

9,536. "Continuous current electrical systems." J. A. M. V. de P. Givelet. March 31st.

9,552. "Wireless telephony" R. Whiddington. March 31st.

9.553. "Reciprocating electric motors." A. Bettica, A. Macchioni, and G. Mazza. March 31st.

9,558. "Copper contact plates for controllers for electrically-propelled vehicles." W. Scott. March 31st.

9,590. "Electrical resistance grids." R. F. Baerlocher. March 31st.

9,591. "Commutators for dynamo electric machines." R. F. Baerlocher. March 31st.

9,593. "Combined dynamo and motor." W. H. Robinson. March 31st.

9,595. "Electrical switchgear." W. A. Coates, D. R. Davies, and Metropolitan-Vickers Electrical Co., Ltd. March 31st.

9,596. "Electrical switchgear." W. A. Coates, D. R. Davies, and Metropolitan-Vickers Electrical Co., Ltd. March 31st.

9,598. "Accumulators for motor cars, &c." W. T. Coulson. March 31st.

9,599. "Automatic circuit interrupting apparatus." G. A. Cheetham and Metropolitan-Vickers Electrical Co., Ltd. March 31st.

9,604. "Sockets or bases of trolley poles for electrically propelled vehicles." E. M. Munro. March 31st.

9,607. "Dry cell for electric pocket lamps." J. Skorpik. March 31st. (Germany, March 25th, 1919.)

9,618. "Magnetic separators." S. Percival (Central Mining and Investment Corporation, Ltd., Transvaal, Consolidated Land & Exploration Co., Ltd., S. T. Tregaskis, and L. B. Woodworth). March 31st.

9,628. "Processing higher harmonic currents in secondary circuit of polyphase metal-vapour rectifiers." Akt.-Ges. Brown, Boveri et Cie. March 31st. (Switzerland, April 1st, 1920.)

9,654. "Means for recording and gauging duration of telephone calls." J. Dunlop. March 31st.

9,657. "Circuit making and breaking device." E. Schattner. March 31st.

9,664. "Call recording device for telephone instruments." R. B. Dunlop. April 1st.

9,683. "Self-cleaning sparking plug." D. D. Esson. April 1st.

9,707. "Spring contacts of electric lamps." J. H. Brown. April 1st.

9,721. "Electric heaters." Cutler-Hammer Manufacturing Co. April 1st. (United States, June 22nd, 1920.)

9,724. "Dynamo electric machines." W. E. M. Ayres. April 1st.

9,741. "Automatic electric switches." H. W. F. Ireland, H. Lucas, and O. Lucas. April 1st.

9,742. "Electro-magnetic horns" H. W. F. Ireland, H. Lucas, and O. Lucas. April 1st.

9,752. "Thermionic valves, &c." Mullard Radio Valve Co., Ltd., and S. R. Mullard. April 1st.

9,754. "Fittings for electrical conduits." A. F. Smith. April 1st.

9,763. "Switches of the quick make and break type." J. B. Tucker. April 2nd.

9,771. "Method of fixing in place stator cores of induction motors, &c." Electric Construction Co., Ltd., and H. Jones. April 2nd.

9,774 "Electrical indicator and controller for bearings" G. Marshman. April 2nd.

9,779. "Sealing ends of cable-carrying pipes." H. R. Billing. April 2nd.

9,792. "Automatically indicating location of fault or overload in electric power system." J. S. Blackhall. April 2nd.

9,805. "Electric, &c., lighting apparatus" W. L. Chance and F. E. Lamplough. April 2nd.

9,807. "Search lights, &c." F. Simoni. April 2nd.

9,814. "Electric fuse boxes." H. A. Erdbrink, F. C. Mellmann, and F. W. Randt. April 2nd.

9,823 "Means for controlling power factor of motor, &c., circuits." H. A. Carney. April 2nd.

9,825. "Electrically-operated bells, &c." J. H. Henderson, F. V. Russell, W. K. Sykes, Interlocking Signal Co., Ltd., and E. S. Tiddeman. April 2nd.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

2,158. "Continuous current measuring apparatus with iron in the field of current." Allgemeine Elektricitats Gesellschaft. February 13th, 1917. (Germany, June 24th, 1914.) (10,480.)

1918.

5,398. "Process of electrolytically producing iron and alloys thereof." A. T. C. Estelle. March 27th, 1918. (159,906.)

1919.

11,303. "Electrically heated soldering irons." Soc. Anon. Dite "Calor." May 6th, 1918. (126,635.)

15,317. "Electric irons." G. A. Hughes. June 18th, 1919. (159,909.)

18,148. "Electric ovens." F. J. Hewson. January 20th, 1920. (160,191.)

21,446. "Electric fuses, heating elements, and the like." A. F. Berry. September 1st, 1919. (160,195.)

21,891. "Electric wave form indicators or oscillographs." P. Trichard. September 5th, 1919. (160,196.)

22,287. "Electric supply systems." F. Mooron. September 10th, 1919. (Switzerland, September 10th, 1918.) (132,516.)

24,683. "Electrical testing apparatus." R. H. Lane and Indicators, Ltd. October 9th, 1919. (160,201.)

25,440. "Electric clocks." I. H. Parsons and A. E. J. Ball. October 17th, 1919. (160,204.)

26,415. "Electrical cut-out." W. H. Illingworth. October 28th, 1919. (Cognate application 14,414/20.) (159,917.)

26,984. "Means for supporting electric fittings from conduit outlet boxes and the like." E. C. R. Marks (Toledo Metal Products Co.). November 3rd, 1919. (159,918.)

27,314. "Construction of vacuum tubes and the like, especially of the type used in wireless communication." J. Scott-Taggart. November 6th, 1919. (159,920.)

27,324. "Electric driving and controlling gear for planing machines." Electromotors, Ltd., B. Longbottom, and E. Greenhalgh. November 6th, 1919. (160,209.)

27,636. "Ammeters, voltmeters, and other recording and indicating instruments." W. F. Smith and T. G. P. Healey. November 8th, 1919. (160,211.)

27,706. "Suspension chains for the support of electric lamps, lamp fittings, and electric cables and wires, and other purposes." J. I. Hall. November 10th, 1919. (159,932.)

27,938. "Dynamo-electric machines." A. E. White (United States Light and Heat Corporation). November 11th, 1919. (159,939.)

28,307. "Electric connections" British Electric Transformer Co., Ltd., and W. J. Sims. November 14th, 1919. (160,218.)

28,499. "Electric gas lamp with glow discharge." Pintsch Akt.-Ges. October 27th, 1917. (135,485.)

30,355. "Manufacture of thermionic valves and the like." H. L. Crowther and W. Makower. December 4th, 1919. (159,955.)

30,485. "Conducting leads for electrical apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). December 5th, 1919. (159,958.)

30,487. "Electro-magnetic wave signalling apparatus." J. Robinson and H. L. Crowther. December 5th, 1919. (159,959.)

30,792. "Magneto electric machines." F. J. Lord and R. A. Taylor December 9th, 1919. (159,975.)

30,800. "Signalling transmitting mechanisms." Western Electric Co., Ltd. (Western Electric Co., Inc.). December 9th, 1919. (Addition to 24,506/14.) (159,976.)

30,816. "Electric furnaces for calcining magnesia and for similar purposes." F. S. Newall. December 9th, 1919. (160,231.)

30,843. "Thermionic amplifiers and detectors." H. J. Round. December 9th, 1919. (159,984.)

31,088. "Electrical coils and the manufacture thereof." H. Wade (Coto-Coil Co.). December 11th, 1919. (159,997.)

31,268. "Telephones." R. L. Murray and Telephone Manufacturing Co., Ltd. December 13th, 1919. (160,243.)

31,304. "Electrical signalling apparatus for use in mines and other places." F. F. Imeson and C. Hunter. December 13th, 1919. (160,245.)

31,329. "Sparking plugs." F. J. Nicholls December 15th, 1919. (160,001.)

31,345. "Radio-navigational apparatus and the like." J. Erskine-Murray, J. Robinson, and H. L. Crowther. December 15th, 1919. (160,250.)

31,346. "Radio-navigational apparatus and the like." J. Erskine-Murray, J. Robinson, and H. L. Crowther. December 15th, 1919. (160,251.)

31,384. "Electrically-driven sewing machines." F. W. Le Tall (Westinghouse Electric & Manufacturing Co.). December 15th, 1919. (160,255.)

31,390. "Electric lighting systems for automobiles and other vehicles." J. S. Withers (L. Renault). December 15th, 1919. (160,257.)

31,472. "Mounting of rotary shafts for electric motors, dynamos, and rotary converters." I. King. December 16th, 1919. (160,264.)

31,501. "Electric signalling apparatus." M. J. Railing and J. L. V. Connaughton." December 16th, 1919. (Addition to 139,994.) (160,261.)

31,891. "Contact breakers for ignition magnetos and the like" Villiers Engineering Co., Ltd., F. H. Farrer, and F. Bountney. December 19th, 1919. (160,283.)

31,966. "Sparking plugs for internal combustion engines." G. Wilson. December 20th, 1919. (160,011.)

32,090. "Protective devices for electric circuits." British Thomson-Houston Co., Ltd. (General Electric Co.). December 22nd, 1919. (160,017.)

32,194. "X-ray apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). December 23rd, 1919. (160,019.)

32,195. "X-ray apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.) December 23rd, 1919. (160,020.)

32,732. "Alternating current electric control mechanism for cranes or other hoisting gear." H. Morris, Ltd., and W. N. Weston. December 31st, 1919. (160,302.)

32,828 "Masts for boats, ships, aeroplanes, seaplanes, portable wireless installations, and other purposes." J. Harrison (legal personal representative of C. Harrison, deceased). December 31st, 1919. (160,027.)

32,881. "Apparatus for waving or curling the hair." Quain Electric Co., Ltd., and J. R. Spink. December 31st, 1919. (160,304.)

1920.

152. "Dynamo-electric machines." British Thomson-Houston Co., Ltd., H. W. Taylor, J. Hutt, and F. H. Clough. January 2nd, 1920. (160,307.)

243. "Electric insulators for electric switches and like connections." British Thomson-Houston Co., Ltd., and H. Trencham. January 3rd, 1920. (160,031.)

2,031. "Apparatus for grinding electric commutators or distributors." F. Bolton. January 22nd, 1920. (160,330.)

4,058. "Electrical heating apparatus." G. F. Joseph. February 10th, 1920. (160,348.)

5,024. "Electrical fuses, switches, and the like." Midland Electric Manufacturing Co., Ltd., and H. E. Sutherland. February 19th, 1920. (160,354.)

5,097. "Dynamos for use with lighting and starting devices upon motor vehicles." J. R. P. E. F. M. Grimaud. June 13th, 1919. (144,997.)

5,190. "Electric heaters for liquids." C. G. Nobbs and W. W. Nobbs. February 20th, 1920. (160,074.)

7,664 "Electric furnaces." E. C. R. Marks (Scovill Manufacturing Co.). March 15th, 1920. (160,082.)

8,878 "Electric signalling systems." Western Electric Co., Ltd. November 14th, 1914 (140,807.)

1921.

608. "Means for cleaning cooling apparatus." K. Baumann and Metropolitan-Vickers Electrical Co., Ltd. October 27th, 1919. (Divided application on 158,080.) (160,134.)

THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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DIVIDED COUNSELS.

WITH the sudden decision of the railwaymen and transport workers to withdraw their active support from their allies and to abandon their intention to bring about a "general strike" on Friday last, the crisis of the situation was passed. Various reasons have been assigned for their action, none of which, in all probability, was the only factor involved. The excuse officially put forward was that the miners ought to have agreed to reopen negotiations, on the lines accepted by their spokesman, Mr. Hodges, and this was undoubtedly true; but the discovery that half the members of the railway and transport unions would ignore the call as certainly exerted a powerful influence upon the attitude of their leaders, who perceived that a gigantic fiasco was imminent and hastily chose what was, from their point of view, the lesser evil, but was in fact, to the nation as a whole, an unmixed good. Once the strike had commenced it would have been tenfold as difficult to call a halt, and immense injury would have been inflicted upon the nation's interests both at home and abroad—while the remoter consequences might have been of the utmost gravity.

The leaders of the miners' allies showed a remarkable and lamentable dullness of perception if indeed they failed to realise what was common knowledge outside their councils—that striking with the object of compelling Parliament to grant a subsidy to others was a highly unpopular proposition, both from a constitutional and from a personal point of view. No one will accuse the railwaymen and transport workers of deliberate disloyalty or of a desire to upset the constitution, and the former, at any rate, at present are not nursing any grievance on the score of wages; hence the proposal to strike—on altruistic grounds—was distasteful to them. To strike in the face of public opinion and with their own followers half-hearted would have been to court defeat, and once more discretion proved the better part of valour. Will they not now learn that, sweet as it may seem to wield unfettered power, it were far better for them to submit such weighty issues to the secret ballot, and thus obtain the true opinion of their members before committing themselves to drastic action?

The forces of sedition have received a set-back which will long continue to cripple their activities, and all immediate danger of revolutionary movements has been dispelled by the common sense in the mass for which this nation is distinguished. But there still remains the great coal strike, which has now lasted three weeks, and already has caused widespread misery and privation, besides producing unemployment in many industries and threatening quickly to involve others. Ostensibly a dispute about wages, it is really nothing of the sort; the miners' representatives have steadily refused to discuss the question of wages, with the one exception of Mr. Hodges, whose resignation has been called for as the result of his action. The strike is mainly a political move, intended to force the Government to adopt a policy which is blatantly unwise and contrary to the national interests. But the political cause is lost beyond redemption, and it now remains only for the miners to do that which they should have done at first—to enter into a discussion of ways and means to make the best of the economic situation in which they find their industry. Why that once thriving industry has fallen on evil days we are not concerned to discuss, though we think a comparison between the output per man in 1913 and in 1920 would shed much light upon the question; but we are sure that no one in this country would willingly see the miner compelled to accept a standard of living lower than the highest that the industry can bear. To suppose that as a result of the war the standard of living in any grade of the community can be permanently raised is to trifle with the teachings of the most elementary common sense—after spending 8,000 millions sterling on unproductive objects the nation must necessarily be impoverished for years to come; but we are by no means the worst sufferers from the war, and if our people would only put their backs into their work and PRODUCE as abundantly and as cheaply as they could, we should soon recover our position and our national prosperity.

As reported in our last issue, the London branch of the Electrical Trades Union decided to take part in the intended general strike. The Electrical Power Engineers' Association, on the other hand, took a serious view of its obligations and responsibilities in the national emergency, and resolved to continue at work, in order to maintain the public supply of electricity. These decisions are in agreement with our anticipations.

The Industrial Situation.

Now is the time, in our opinion, for a broad and generous settlement between the coal miners and coal owners. So far neither help nor benefit has come from Government interference, and we venture to submit that the problem is eminently one for settlement within the industry itself.

The provision of an abundant supply of cheap fuel is perhaps of more importance to our industry than to any other, and is the foundation of all progress towards that flood of electrical power which was not long ago one of the main planks of the reconstruction programme.

It was, of course, notorious that the Government was making immense profits out of the export coal trade, and this fact, no doubt, was contributory to the "ca' canny" humour of the miners. It is also believed in many quarters that the owners were not anxious to exploit their best seams or to secure the highest possible profits so long as these profits were taken by the Government. The time has now arrived when the industry must stand upon its own feet, and the issue as between owners and miners really narrows down to a question of minimum wages.

In this matter we cannot withhold a word of sympathy for one phase of the miners' proposals. As a united body, representing practically all the workers in the coal mines, they point to the injustice which is involved when a man working upright in a six-foot seam receives the same price per ton, or proportionally a very much higher wage per diem, than the man who is working bent double in a seam three or four feet thick. Their proposal is that the fortunate mines in which coal is easy to get should contribute out of the wages paid to the miners, and out of the profits which the owners eventually hope to secure, to a pool which should be used to provide a minimum reasonable wage for miners in the poorer mines, or in less fortunate positions. On the face of it this appears to be a just and even generous proposition on the part of the miners, and one which could be carried into effect without seriously interfering with the natural variations in rates of profit as between mine and mine.

We quite agree with the Government contention that anything which would bring back, or tend to bring back, Government control would be an unmitigated curse, and that nothing should be done to destroy the incentive on the part of the owners to produce as much coal and profit as possible, and on the part of the miners to increase the output to the greatest possible extent. We have no doubt that, given favourable conditions, owners would soon be found doing their utmost to provide electrical and other equipment to ensure the greatest possible output per man, and on the part of the miners if a reasonable wage and satisfactory conditions of living could be arranged for every man in the industry, they, on their side, might be induced to return to their pre-war activity and output. Whether a restoration of the eight-hour day is possible is a matter for discussion.

We venture to suggest that owners and miners should get together as quickly as possible under the chairmanship of some able and impartial man, than whom no better could be found than Sir Arthur Duckham, K.C.B., and that they should proceed to set their house in order, without giving the opportunity for further outside interference or internal embitterment. The struggle has already lasted far too long, and the interests of the whole nation call for a prompt, generous, and permanent settlement.

French Enterprise in Germany.

One of the most extraordinary facts in connection with the French occupation of the district of the Saar is the inexplicable interest manifested by French financial and industrial companies in German iron and steel and engineering undertakings in that district, in which they are reputed to hold 60 per cent. of the total capital, and to these participations has now to be added a scheme for the French control of the Homburg generating station belonging to the Pfalz (Palatinate) Works Co., of Ludwigshafen. This station, which supplies a considerable part of the Rhenish Palatinate with light and power, is dependent upon the delivery of Saar coal for generating purposes, as Ruhr coal is unobtainable in sufficient quantities, and at the same time is too costly on account of the high transport expenses. It is now proposed to transfer the Homburg station to a new company having an ordinary share capital of 30,000,000 marks, and loan issues of 70,000,000 marks. Sixty per cent. of the combined capital and loans is, it is said, to be taken over by the Compagnie Générale d'Electricité of Paris, the French Thomson-Houston Co., and the Schneider Co. of Creusot, while the balance will be held by German interests. Before the war there were many instances of friendly co-operation between French and German industrial interests. This question, however, does not come into consideration in connection with the requisition of 60 per cent. of the financial interests in Saar iron and steel and engineering works or the proposed absorption of 60 per cent. of the capital in the Homburg generating station. The key to the position—it is well to speak plainly—lies in the French State possession of the Saar coal mines, as it appears from the Versailles Treaty, in perpetuity; coal is the lever which has given the French the great hold on the Saar works, and coal is again the lure in the case of the Homburg electricity works. It is easy to understand the desire of the French authorities to obtain permanent markets for Saar coal in face of the present impossibility of doing so, or of even keeping the miners on full working shifts. On the other hand, the idea cannot readily be dismissed from consideration that French industrial interests would have been better occupied in developing their own resources and those in redeemed Lorraine, rather than in extending their sphere of activity to works in the Saar and beyond, because it is a foregone conclusion that the Saar region must remain German property, as the Treaty provides that when the plebiscite takes place 15 years from ratification, only those resident in the district of the Saar at the date of the signature of the Treaty will be entitled to record their votes.

The Electricity (Supply) Bill.

According to the daily Press, some 50 Members of Parliament have given notice to move the rejection of the Electricity (Supply) Bill introduced by Sir Eric Geddes, on the second reading. As it is the desire of the Government to avoid contentious legislation during this session, there is reason to fear that the Bill may not be passed, in which case the work of the Electricity Commissioners will be sadly hampered. So far as a cursory examination reveals, the contents of the Bill are identical in every respect with those of the Bill introduced at the end of last session and reviewed in our issues of December 24th and 31st, 1920.

The Building Trades Exhibition.

It had been understood that, in electrical circles at least, it was strongly held that all new buildings should be wired for an electricity supply, and that wherever the least possibility of success was apparent no effort should be spared to bring about this, from every point of view, desirable consummation. Moreover, it is obvious that an exhibition organised by the building trades is the place for exhibits illustrative of wiring systems and all kinds of domestic electrical apparatus.

With the above-mentioned considerations in mind, a visit was paid to the Building Trades Exhibition, now in progress at Olympia, in confident anticipation that such an exceptional opportunity of enlisting the interest and sympathy of all connected with housing and the building trade in the subject of "electricity in the home," and the innumerable benefits and economies that are bound to result from the use of electricity, not only for lighting, but also for cooking, heating, and power, would have been fully utilised by the electrical interests concerned.

Alas! what does the visitor find? Out of some 295 stands about a dozen of more or less electrical interest (with the emphasis on less), and only four or five of those that could by any stretch of imagination be described as "all electric" ones. One stand devoted to cooking and heating devices—not a single exhibit of installation materials or wiring systems; not one of lighting fittings!

What a record! Worse even than that of last year, and a truly disheartening one. While the gas interests are on every occasion conspicuously in evidence, electricity is relegated to the background—and with what effect? The visitor notices the absence of electrical exhibits and draws his own conclusion. We can only hope it will be a charitable conclusion, but assumptions are dangerous.

When will the electrical people cease hibernating, and bestir themselves from their torpid state to the realisation of the fact that they need publicity, and that to obtain it they must seek it, in the right way, and at the opportune moment?

The E.T.B.I.

On Monday next the annual general meeting of the Electrical Trades Benevolent Institution will take place. It is not usually an occasion for "standing room only"; in fact, it must be regretfully confessed that the attendance is generally meagre. Is it pressure of work, counter-attractions, or lack of interest that keeps the members away?

This is a very necessary and wholly laudable institution, whose sole purpose is the intensely human, but divinely inspired motive that is instilled by the story of "the good Samaritan"; but in this case the victims of misfortune are of our own nationality and of our own profession—hence their cause should appeal to us even more urgently. May we not hope that some of the supporters of the Institution will make it their business to step aside for an hour and give the benefit of their advice to the Committee of Management, and make themselves acquainted at first hand with the affairs and the work of the Institution? Their presence will be most welcome, and the evidence of their personal interest will hearten the Committee, and encourage its members to greater efforts. There is nothing so depressing as indifference—active hostility would be a powerful stimulant, but cordial support, after all, is the very best spur.

The Romance of the Turbine.

The classic paper read before the Institution of Electrical Engineers by Mr. K. Baumann should prove a "landmark" in the development of the steam turbine. It is a mine of information on present-day theory and practice, and though in some respects it lacks completeness, the author cannot be reproached on that account; the 59 pages are closely packed with matter of the highest interest and value, and papers read before Institutions are not intended to be exhaustive treatises. The Institution is to be congratulated on securing, for the second time, so useful a contribution from this author.

The history of the steam turbine is an engineering romance. We well remember seeing one of the earliest of Sir Charles Parsons's machines at the Glasgow Exhibition of 1888, mounted on a stand about the size of an office desk, and running at a speed of something like 10,000 revolutions per minute. The attitude of the Clydeside engineers towards the little spinner was highly charged with scepticism, if not open disapproval. They gave it the opprobrious title of "steam-eater," and it was, in fact, regarded as little less wasteful than an open pipe through which the steam could blow at will. The Clyde built monster vertical marine engines towering 40 feet above their bedplates, which looked down upon their tiny rival as an elephant might regard a mouse, with dignified toleration. But what a change has taken place since then—how are the mighty fallen! Clydeside has built steam turbines of the largest size, and the giant quadruple expansion engine has followed the beam engine into the limbo of the past, together with the huge flywheel alternator.

With all due deference to Hero of Alexandria, De Laval was the first to build a practicable turbine, of the impulse type; but it was Parsons that doggedly persevered with the development of the machine, on the reaction principle, in the face of countless difficulties, and established its position as the premier heat engine for large powers—an achievement by which for all time he has crowned British engineering with glory. Splendid work has been done abroad, but Parsons hewed the track to success. In the early 'nineties we saw his machines supplying part of Newcastle-upon-Tyne with electricity; in 1899 we went to see his 1,000-kW sets destined for Elberfeld, which marked the opening of a new era in the history of the turbine; and in 1913 we recorded the dispatch of his 25,000-kW set to Chicago, which set the seal on his success. It is a proud record. In 1892 a 200-h.p. Parsons turbo-alternator consumed 27 lb. of steam per kWh, "thus rivalling the performances of the best compound condensing reciprocating engines." In 1900 the Elberfeld 1,000-kW set consumed 20¼ lb. per kWh; and in 1913 the 25,000-kW set consumed 11¼ lb., a result within 0.6 lb. of the best recorded in Table 22 of Mr. Baumann's paper. According to the *Electrical World*, the total steam power equipment installed in the United States in 1920 was 11½ million h.p., of which 15½ per cent. was credited to reciprocating engines, and no less than 84½ per cent. to steam turbines; in 1907 only 1¾ million h.p. was installed, of which 44 per cent. was provided by turbines. Thus the reciprocating engine practically reached its limit 14 years ago, while the turbine accounts for almost the whole of the additional power installed since that time.

THE FINAL ADJUSTMENT OF PRECISION INDUCTANCES.

By G. E. MOORE.

General Considerations. This is a subject about which there is little definite published information. There are, of course, several methods adopted by makers of inductances and by experimentalists for the attainment of high accuracy, and in the following article the writer has endeavoured to present several examples of these. The inductances referred to are of the ironless type, and of fixed value; both self and mutual inductances are dealt with. The information contained herein will, it is hoped, prove generally useful, but particularly so to workers in electrical test-rooms and laboratories.

An inductance is invariably made up with some form of fixed support, this, as a rule, being the convenient bobbin. If precision is not desired, and a mere approximate or round-figure value suffices, then the natural thing to do is to adjust to one turn. With a high self-inductance—say, of one henry, which can be attained with about 2,350 turns and a mean diameter of 15 cm. it is possible to reach an accuracy of 0.1 per cent. or even 0.02 per cent. with one-turn adjustment; with low values (say, of less than 100 millihenries), adjustment to one turn is useless for precision work. This can readily be understood when it is remembered that self-inductance is proportional to (No. of turns)^2; [the reciprocal of (No. turns)^2] × value of the self-inductance roughly gives the one-turn value, this being relatively much greater for low than for high self-inductances.

In the case of mutual inductances, where, if you double the turns of one component winding you double the m.i. value, one turn represents a definitely important amount.

Whatever the inductance may be, the calculated value must be checked by actual test; with high values and the application of a really reliable formula, quite good results are obtainable, especially as one- or two-turn adjustment suffices, but in low values calculation cannot be so fully relied upon, and the check-test (as well as adjustment to other than one-turn accuracy) becomes imperative. Under most working conditions, however, it is found that, whatever the size of inductance, the calculated value is to be regarded as an approximate stipulation only, finality as regards number of complete turns and part-turn being decided on test.

If consistent precision is required, an open coil without any really solid support should be deprecated. It is quite possible—in fact, easy—to adjust such an inductance very accurately; but when eventual working conditions are taken into consideration such construction must be abandoned, unless the inductance is merely required for brief experimental purposes. Temperature effects (including heating from the air and by accidental overloads), inherent changes, and possible rough treatment preclude the adoption of such form for prolonged use.

A solidly confined coil, then, is imperative. The support which appeals most from the point of view of convenience in manufacture is the round bobbin form with a square-cut slot; other kinds are met with, including the rectangular former type, but the bobbin is universally favoured and, in the practical details which follow, this is the form treated. Most of the directions, however, are not applicable *solely* to the bobbin coil.

The most effective material for the bobbin is marble, and it is used for standards, but Cuba mahogany and similar hard woods thoroughly seasoned and impregnated, are good substitutes. Insulating materials and fixing media should be of reliable quality, non-hygroscopic, and of such nature as to set rigidly. Drying-out in vacuo is a wise precaution. In practice, such steps as the latter and polishing of the wood, &c., should be carried out before actually beginning the final adjustment; in this case it is advisable to adjust roughly and leave on an excess number of turns, preferably protecting the exposed layer. Finality of adjustment can afterwards be safely undertaken.

When this latter stage is reached several alternative methods whereby precision is secured are possible. Conditions will determine which is the best. For example, the size and construction of a given bobbin, and particularly the position of its terminals, will point to whichever method is applicable; on the other hand, it may be feasible to make the bobbin to suit a particular method.

I. *Self-inductances.*—At first thought the obvious course in lieu of the one-turn is to start the last turn and to return before completing it—keeping the outgoing and the incoming wires apart. Except in single- and perhaps two-layer inductances the effect is negligible, and even in the case of the exceptions this ruse is of little real use; this is also the result with the artifice of winding on a last turn of curly form. The practical alternatives now set forth are classified as far as possible:—

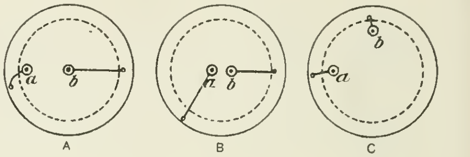

Fig. 1.

(*a*) The position of the terminals is important. In fig. 1 are shown three simple alternatives wherein the terminals are disposed on the flat of one cheek. The left illustration shows a very convenient method whereby the last turn is finished exactly where the required precision value is reached, and the terminal *a* placed to suit; this arrangement is apt to cause trouble with the outside leads. The second illustration (B) shows the two terminals *a* and *b* located in the centre of the cheek. In both of these alternatives the short lengths of wire on the cheek should preferably be sunk into the latter.

The terminals may both be placed near the periphery of the cheek, as in fig. 1 C; this plan suffers from the disadvantage of arrangement A. In fig. 2 the terminals are shown close together, in one case being near the cheek edge, and in the other on the bridge of ebonite or the like—a design which has certain advantages. The terminal connections from the winding can be disposed as in fig. 3 A, but a better alternative is finally to adjust in the winding slot itself. If one or more turns on the last layer are wound *with a greater diameter than that of the latter* the self-inductance can be reduced. This can be carried out by placing the adjusting turn(s) on the inside of one cheek, as shown by the arrow in fig. 2 A. A more convenient alternative is to separate the turns from the last layer by a suitable number of windings of insulating strip, or to run a length of sleeving on the said turns of wire. Provided there has been an excess number of turns to start with there should be no need to solder on an extra length of wire.

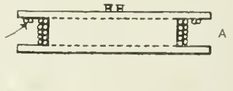

Fig. 2.

(*b*) A crude, but, so far as regards ease of adjustment, effective arrangement is to place the last layer on the outside of one cheek (*vide* fig. 3B), connection being made to the terminals; the shape and position of the loop so formed are varied until satisfactory accuracy of value is obtained, cleats and hard wax or the like being applied during the operation. This method is suitable for inductance bobbins enclosed in protective cases.

(*c*) The previous device can be modified so as to sink the adjustment itself in the cheek; it is difficult to cut a suitable groove for the kind of loop referred to in (*b*), but a circular pit can be cut at the centre of the bobbin, and one or more loops placed in this, the hole afterwards being filled in and preferably covered—say, by a name-plate or terminal block.

(*d*) If the self-inductance be adjusted to one turn *under* required value the latter can be reached by connecting in series another inductance wound on a very much smaller bobbin, rough accuracy on this giving the required precision on the composite inductance. Such an arrangement is conveniently carried out, but the component bobbins must not be allowed to change their relative positions; further, the existence of two fields is a source of difficulty in actual application. In a modification, the little inductance is placed in the winding slot over the main inductance. Several positions are possible, and one can place the coil non-inductively to the main coil or with the two fields opposing or assisting. Permanence of position is naturally imperative.

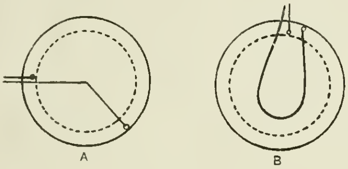

Fig. 3.

(*e*) In the case of solenoidal windings one can frequently have recourse to the spacing-out of a certain number of turns. This is very effective with tiny inductances. One of a microhenry, for example, can be made up with four turns of (say) 30 S.W.G. wire on a 3-cm. diameter tube, and the turns can be spaced out over a winding length of about 0.5 cm. Further, with these small values the self-inductance of the internal terminal leads can sometimes be utilised.

II. *Mutual Inductances.*—(Fixed types being presumed) the two windings may be applied concentrically in a single winding slot of one bobbin; or a bobbin with two adjacent winding slots can be utilised; or two separate single-slot bobbins may be adopted. In many ways the first-mentioned, in which the windings occupy the same mean plane, is the best. As regards precision adjustment, this is generally carried out by altering the number of turns on *one* winding only—the winding which is most accessible, particularly if one of them is to have a required value of self-inductance; both this and relative position may decide the m.i. of the two-bobbin arrangement.

In the adjustment of one winding, recourse may be had to any of the methods utilised in (*a*), (*b*), (*c*), (*d*), and (*e*) above. If one of the windings is composed of wire which is much thicker than that of the neighbouring coil, it is advisable finally to adjust, and so to predispose the windings, as to carry this out with the thinner wire.

Whilst on this particular topic it may be of interest briefly to mention the method of final adjustment used in Campbell's Variable Mutual Inductance ("V.M.I.").* In this the two *fixed* secondaries are wound with cable composed of ten sections, each section consisting of four strands of silk-covered wire. The primary and the two fixed secondaries are placed on a couple of concentric bobbins spaced out by three supporting pillars. Each of the secondaries is finally adjusted by a loop of the cable on the cheek of the outer bobbin, in the manner shown in fig. 4 A, and rigidly retained in place by cleats and wax.

Every section of a secondary cable in the "V.M.I." represents a definite value of mutual inductance, and the ten sections being connected in series, the total m.i. should equal ten times that of one section. It is sometimes very difficult in practice to make the sections precisely equal, and the author therefore introduced the "split cable" device shown in fig. 4 B. At the point *a* of the adjusting loop the cable is opened out into the ten sections and after the solid portion of the loop has been disposed to give a mean m.i. value, final adjustment is carried out by the little exposed length of each section.

Conclusion.—This article is concerned mainly with the constructional aspect of inductance adjustment, but it will not be out of place to mention briefly a few points in connection with actual measurement. Certain precautions must be observed, or the care taken in accurate adjustment will be rendered more or less useless and the precision valueless. Stress has been laid on the possible effects of inside leads in small self-inductances, external temporary leads also require consideration, for their inductance and/or capacity may militate against test accuracy. Generally the leads can be "shorted" while the test zero is determined, and this should be carried out with as little change as possible in the disposition of the leads relative to the inductance. When using a.c. for test purposes, fair constancy of frequency is essential—in some cases absolutely imperative; the writer remembers trying circumstances under which he used an inductor alternator driven by a motor, the speed of which carefully adjusted itself according to the by no means inconsiderable pressure variation of the works' mains, the set and its control gear being well out of his reach.

Stray fields and the mutual effect between the test apparatus and the inductance must be counteracted. Placing the inductance at a distance necessitates lengthy leads, and these are inadvisable. It should be turned through 180 deg. after a first reading and another then taken—the mean of these readings being accepted; in addition, the inductance under test should, so far as is possible, be placed non-inductively to the inductive portion (if any) of the measuring apparatus, the axes being on the same plane. Mutual inductances are somewhat troublesome in this respect. In any case, stray fields and adjacent metallic articles must be avoided if possible; a glance under the test-bench sometimes proves enlightening!

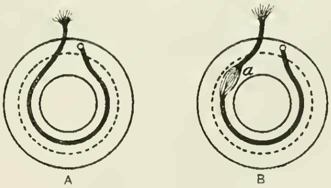

Fig. 4.

The behaviour of large sub-divided self-inductances is worthy of mention, the effect of self-capacity being rather curious. Each section is wound and adjusted in turn, the terminal inductance (so to speak) having a cumulative value. On remeasuring the inductance of the first section, it is found to be no longer accurate, and, with all sections still remaining in series connection, it must be readjusted—this treatment being applied to all divisions.

In conclusion, it may be noted that an inductance can possess a temperature coefficient (percentage inductance change per degree), the value of which may or may not be erratic, and should not be serious; big temperature changes are naturally to be avoided.

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* These details by kind permission of the Cambridge & Paul Instrument Co., Ltd.

DOMESTIC TARIFFS AND THE QUESTION OF CHEAP METERING.

(Communicated.)

In the Electrical Review of February 6th, 1920, there appeared a very suggestive article from the pen of Mr. C. W. Marshall entitled "The Need for a Cheap House Service Meter." In this article Mr. Marshall drew attention to the high proportion of the total cost of giving a supply to the domestic consumer represented by the cost of the meter, and dealt briefly with the possibilities of reducing this cost. The discussion following this article did not shed very much light on the problem, but mainly turned on the suitability of the shunted electrolytic type of meter. The writer of the article referred to hinted that he would at a later date publish some proposals for a solution of the problem of reducing the cost of metering the supply to domestic consumers, but, up to the present time, little of value has been written on this subject. There are one or two aspects of the metering problem that seem to have escaped general notice, and the object of the writer of this article is to endeavour to show the bearing they have on the problem of cheap metering.

The first of these points which it is proposed to develop turns on the present consensus of opinion regarding the correct method of charging for domestic supplies. Experience has shown that the old system of two flat rates, the one for lighting and the other for heating, has many disadvantages, the most important being the need for duplicate wiring and duplicate meters. For large radiators and cookers a separate wiring system will probably always be a necessity owing to the restricted size of the lighting wiring, but for small heating devices, such as irons, toasters, kettles, and so forth, the ordinary wiring would be sufficiently heavy. The impossibility of using the lighting wiring under the old tariff, except by paying for electricity used for heating purposes at the high rate, has seriously retarded the use of electricity for small heating devices. This was a grave disadvantage of the old tariff, for although the individual consumer's load factor for the energy used for such small devices may be very low, yet the diversity factor of such a load was high, and the additional units were sold with but a trifling augmentation of the maximum demand at the generating station. The use of two meters further increased the already high cost of giving the consumer a supply, and entailed a heavy expenditure on the part of the supply authority which met with but a poor return in view of the negligible margin of profit at which the heating rate was fixed.

These considerations largely tended to focus attention on the domestic contract system of charging, under which the consumer agreed to pay a fixed sum per quarter, which was intended to cover his equitable contribution to the standing costs of the undertaking, plus a charge for energy consumed for all purposes, based on the actual running cost of production. Such a system allows the full use of the ordinary lighting installation for any purpose up to its safe carrying capacity, and so encourages the use of electricity for heating purposes, and also abolishes the need for a second meter. In fixing the charge for electricity supplied for any period, there are two quantities to be measured, calculated, or estimated: The energy consumption, and the fraction of the station maximum demand to be allocated to the consumer. No really satisfactory method of determining this second quantity has yet been devised. The measurement of the maximum demand of the consumer by means of an indicator connected in series with his installation does not give an accurate solution of the problem, in that the maximum demand of the consumer does not represent the proportion of the station maximum load that should justly be allocated to him. The further factor to be taken into account is that of diversity, and this factor is one concerning which there is now considerable uncertainty, even where a well-defined class of consumer is being considered. The provision of a demand indicator, moreover, perpetuates the disadvantage of a second meter. For these reasons, efforts have been made to devise an equitable system of assessing the proportion of the standing charges to be borne by the consumer, by basing this charge upon some such easily determined figure as rateable value, connected load, number of rooms, or area of floor space.

Such methods are now well recognised, and have met with a considerable measure of success, although it is quite evident that the connection between the quantity taken as a basis and the actual fraction of the station maximum load due to the consumer's demand is not necessarily one of proportionality. The standing charge allocated to the consumer should, however, be based on the unknown demand he makes upon the station at the time of maximum load. As this cannot be measured, or determined, but only, at the best, estimated, it follows that a domestic contract system of charging can only be approximate, so far as the fixed charge per quarter is concerned. In other words, the amount payable is not proportional to the service rendered. The second portion of the charge to the consumer is proportional to the energy consumption as given by the registration of the meter. The effect of inaccuracy of the meter is interesting to consider. In the first place, it would appear that high accuracy of metering is somewhat futile when applied to the one part of the charge, when the other part is founded either on an approximate estimate, or upon some quantity that is not a function of the quantity that should fix this part. This view is perhaps hardly sound, as there is no reason why, because one part of the charge is inaccurate, the other part should not be based on as correct a measurement as possible. The most vital point to consider is the effect of inaccuracy of the meter upon the consumer's bill. When the flat rate tariff is in use, a certain inaccuracy of the meter makes a similar difference to the amount of the consumer's account. With the domestic contract system of charging this is no longer true. Where the standing charge is high and the running charge low, it is clear that for an ordinary domestic load factor a relatively large meter inaccuracy will make a very much smaller percentage difference to the total charge to the consumer. To illustrate this point a concrete case may be taken of a house supplied on the rateable value system, the standing charge being 15 per cent. of the rateable value per annum, plus 1.25d. per unit. Taking the rateable value as £40 per annum, and the electricity consumption for all purposes as 600 units per annum, the charge to the consumer will be made up as follows:—

Standing charge per annum, 15 per cent. of £40. = £6.

Running charge, 600 units at 1¼d., £3 2s. 6d.

Total charge per annum, £9 2s. 6d.

If the overall inaccuracy of the meter had been 5 per cent. slow, the energy consumption would have been registered as 570 units, and the total charge would have been diminished by 3s. 1d. The percentage error of the charge for the twelve months would then have been 1.6. The load factor of the house in question would, on the assumption that the standing charges of the electricity undertaking were £12 per annum per kW of station maximum demand, be 18.2 per cent., allowing for diversity. In the case under discussion, it is easily calculated that the meter inaccuracy may be as high as 7.3 per cent. before the percentage error of the charge to the consumer reaches 2½.

The foregoing inquiry shows that, with load factors likely to be met with for ordinary domestic consumers, the need for high meter accuracy is small where a domestic contract tariff compounded of a fixed standing charge plus a low rate per unit is in use. Not only is the standing charge payable by the consumer determined by methods which are unscientific and which cannot lead to accurate results, but the effect of a certain percentage meter inaccuracy is a very much smaller percentage error in the consumer's account. This latter inaccuracy is, of course, the one that is vital. Where a flat rate tariff is in use the inaccuracies of the meter and of the consumer's account are identical, but with the domestic contract system this is not so, even with a 100 per cent. load factor. This being so, it appears that there is a case for the use of meters of inferior accuracy in connection with domestic contract tariffs, as compared with those requisite to be used in connection with the flat rate system. The sacrifice in accuracy could reasonably be expected to result in a cheaper meter being possible commercially.

The second aspect of the question of the cost of metering domestic supplies to which it is desired to draw attention is the matter of meter rents. The charge for the use of the supply meter has been condemned by many supply engineers, and several undertakings have abolished such charges. This policy seems to be an unwise one for two reasons. In the first place, the meter rent is one that most people are accustomed to pay. The charge is made by most gas supply authorities, and the custom of making such a charge is now well established. In the second place, the charge for the meter is a thoroughly scientific one, and is in conformity with the doctrine that the charge for electricity supply shall depend strictly upon the cost of giving such supply.

The commonly held view that the total charge to a consumer of electricity should be divided into two portions—the standing and the running charge portions—is an erroneous one. The division should be threefold, the three divisions being, (*a*) the running charge based upon the energy consumption, (*b*) the standing charge based upon the estimated portion of the maximum station load to be allocated to the consumer, and (*c*) the capital and other charges incidental to the consumer himself. These latter charges include the charges on the capital outlay on the service and meter, together with the cost of reading the meter, rendering the account, collecting payment, and issuing the receipt. Such charges are, or should be, if the strictly scientific basis of charging be adopted, the concern of the consumer alone, and the whole of such charges should not be pooled and divided. The possible amount of such charges can easily be calculated for an average case in present-day circumstances, as follows:—

Capital charges on service, 10 per cent. of £10, £1.

Capital charges and maintenance of meter, 15 per cent. of £4, 12s.

Reading meter, rendering account, &c., 3s. 6d.

Total per annum, £1 15s. 6d.

Strictly speaking, this charge of £1 15s. 6d. per annum should be paid by the consumer, in addition to the cost of his energy, and his proportion of the true divisible standing charges. Such a course would, of course, penalise the small consumer, for these special charges do not increase in proportion to the maximum demand or the energy consumption, and the principle of expediency has led to the practice of lumping together all consumers' charges and adding them to the standing charges to be divided in the ratio of the consumer's demands. The effect of such practice can easily be calculated for an undertaking having 6,000 consumers, and a maximum load of 10,000 kW. Taking an average consumer charge of £2 per annum to cover cases where two or more meters are installed, the total consumer charges are £12,000, or £1.2 per kW. The amount paid by a consumer with a proportion of station maximum load of 500 watts will therefore be 12s. per annum only.

According to this reasoning, it is clear that the meter rent charge is a logical one, as being a contribution towards the cost of supply applicable directly to the consumer. There appears to be little reason why meter rents should not be increased to meet the increased cost and maintenance of meters. It should be remembered that a meter rent of 2s. per quarter, or 8s. per annum, will represent a return of 10 per cent. on a capital expenditure of £4 on a meter. The meter rent can, therefore, be regarded either as the payment by the consumer of the capital charges on the meter itself or as payment of the maintenance cost of the meter. If the meter rent be retained and regarded in this way, it would appear that the relatively large outlay required to provide a meter for domestic supply is met by a direct payment by the consumer of the charges on this outlay.

The suggestion regarding the relaxation of the standard of accuracy of consumers' meters is doubtless a far-reaching one, and it would doubtless be a legal question as to how far this was permissible. It may be remembered that provided that the inaccuracy were determinable, and that the true energy consumption could be calculated by applying a suitable correcting factor to the readings of the meter, there would be little objection to the proposed step, as the inaccuracy of a meter in dispute could always be determined by connecting a high-grade meter in series for a short time. The chief point of the argument is that a relatively large inaccuracy of the supply meter can be allowed without the charge to the consumer being altered by more than 2½ per cent.

The question how far the cost of meters could be reduced by a relaxation of the requirements regarding accuracy, is one for the manufacturers. In this connection it must be borne in mind that a sacrifice of accuracy would not imply a sacrifice of reliability, and that, therefore, it would not be legitimate by cheapening the design to increase the solid friction error. A brief consideration of the various types of meter in use may serve to indicate the possibilities of a reduction in price by a sacrifice of accuracy.

The electrolytic type of meter is not likely to be used largely in connection with domestic tariffs, owing to the fact that the use of heating apparatus intended to be encouraged by these tariffs would require the use of a meter of higher rating than is usually deemed advisable with the type in question. Mercury motor meters might conceivably be simplified by diminishing the correction for fluid friction. Direct-current commutator ampere-hour meters would not appear to offer great possibilities of simplification by a sacrifice of accuracy, as experience has shown that these meters, as at present constructed, do not retain a very high standard of accuracy after having been in circuit for a few months. Alternating-current induction meters, again, appear to offer few opportunities for simplification, although the fact that a domestic load is almost invariably of approximately unity power factor would suggest that accuracy of quadrature of the pressure flux is not of great importance.

THE KINEMA ON ACTIVE SERVICE.

By F. C. DREIER.

Much is known concerning the soldier's entertainment during the war so far as regards concerts, Y.M.C.A. huts, regimental affairs, &c., but little is perhaps known of the part played by that most popular device, the kinema. The writer had some months' experience in this connection while on active service, and has set down in the following article a few brief remarks relating to kinema work in the war zone.

First, it should be pointed out that touring by road in France during the war was not comfortable, even in the most luxurious of cars, and as it was impossible except at the bases like Boulogne, &c., for the soldier to go to the "pictures," the "pictures" had to be taken to him, by means of lorries, or "mobile kinemas."

The electricity for lighting and supplying power to the projector, &c., was obtained in two ways. Some of the lorries which were used for daylight shows were fitted with a generator on brackets in the driver's cab, this being belt-driven from the lorry engine, so that room could be given inside the lorry for the projector and operator, the pictures being thrown on a transparent screen at the rear of the vehicle. The other units, used for ordinary indoor shows, were generally fitted with a complete petrol generator set fixed inside the lorry, the picture in this case being shown as in an ordinary kinema from the front, and a solid or light resisting screen used.

Now we come to the projector (and, incidentally, some more troubles, which are not met with at home). This is a delicate piece of machinery, and must be kept in perfect working order so that such accidents as frequent film breakages, tearing of perforations, and fire, may be prevented as far as possible. This is not a very difficult matter when, as in a town kinema, the projector is fixed permanently to the floor, and needs only slight minor dismantling for cleaning purposes, but out there, we were extremely handicapped for space, and it was impossible to carry such a delicate machine inside a lorry, completely fixed up for use, as the jolting set up by the terrible condition of some of the roads would have damaged it so much as to render it unfit for use. Therefore it had to be dismantled completely, and carefully packed after each show, and sometimes—in the writer's case at least—shows were given at seven different places in one week. It will be seen, therefore, that the projector had to be re-fitted, adjusted, cleaned, and refocused for every move made, before a show could be given.

Now let us see the difference between the soldier's kinema and ours at home.

At home we could go to our "kinema de luxe," and see perfect pictures in perfect comfort. "Out there" pictures were seen at rare intervals, and when they did come, the "palace" was either the open air, or a barn, an old stable, or even a ruined building, shot-riddled from some previous attack. During hostilities also they were sometimes near enough to the line to be unpleasant. I myself have given a show under an old railway arch, and have had to "scrounge" (as we used to say) some old sand bags, canvas, and tarpaulin to fit up at both ends so that the light and also the elements might be, at least, partly shut out, and also have had to fix up something like a firm stand or flooring for the support of the projector. It was hard work, but we did not mind, and, after all, the job had its humorous side.

The films were kept in lock-up, galvanised iron boxes, and two or three programmes were carried by each unit, and when one complete tour of the circuit allotted to a unit had been made the programmes were changed at depots for that purpose, and the tour recommenced. Sometimes we have packed up at 8.30 and left one place, travelling 30-odd miles to a depot to change programmes, and then going out a further 20 miles in order to give a show the same night. I remember visiting one place, after the armistice, and on our arrival in the early morning we found the hut we were to give the show in was still unfinished, there being about 14 feet at one end to wall up and roof, and a door to be fixed. However, with the help of a few of the "boys" and half a company of prisoners, the hut was finished by tea-time, and all ready for a show at 6.30. We remained here for three days giving a show each day.

I may say that the record time for fixing up my own unit, from time of arrival to time of showing, was two and three-quarter hours; this included unloading, re-assembling, and adjusting projector, trimming carbons fixing cable and wiring up for six lights, and making an improvised operating box, also winding films (7,000 feet); our staff consisted of four men.

We were sometimes called upon, unofficially, to help others in trouble. I recollect at one place a gentleman in civilian clothes was introduced to me, and said he had come "to lecture on Canada." He was one of a group of educational lecturers sent over by the Government to tour France.

He had been informed, he said, that he would find electric light laid on at the camp, and would only have to connect up. The installation, however, was dismantled, and the wiring system so badly cut and disarranged that it presented the appearance of a Chinese puzzle rather than an electricity supply. Would I supply him with electricity and also lend him our screen? I agreed to do this, and proceeded to examine his lantern and effects. I found, however, that the arc in his lantern was of the low-current type, taking about 5 amps. at 200 volts, while my generator produced 100 amps. at only 60 volts, and I had no means of converting it. I did not want to disappoint the troops so, having three hours at my disposal before the lecture, I looked round and discovered a sort of sub-station, about half a mile away, belonging to another camp. I explained my requirements to the man in charge, and he consented to start up half an hour before his time if I could get fixed up. We found a drum of unused cable on an R.E. dump close by, and with this and some of our own wire, laid supply wires from the generator to the hut, half a mile distant. It was tiring work, but still it was something apart from our usual procedure, and we at last got all ready for the lecture.

Then the lecturer confronted me with a box of 120 or so slides, asking me to screen them, as his assistant was not at hand (I don't think he had one). His instructions left him almost breathless. However, all went well, and I was asked to see the lecturer first thing next morning, and was loaded with thanks (and I had had visions of a ten franc note in my sleep that night).

At another camp we visited, we had to drive over some filled-in trenches, and having got in safely and given a three-day show, were about to drive out with our load when, having gone about a dozen yards, the rear wheels of the lorry sank into one of the trenches up to the hubs—it having rained hard all night. After an hour and a quarter's digging, jacking up and bedding of planks, we drove her out of the hole; this was no easy job, as our full load and the lorry together weighed 12½ tons.

On another occasion we were departing after having shown for four days in a fairly well populated village. We found it necessary to turn round in a very narrow street in which some of the walls of the farms had been repaired with a mixture of mud or clay, sand, straw, and a little cement, interlaced with faggots, and were not quite hard.

Our screen box projected from the back of the lorry for about two feet, and in allowing the driver distance in which to back I forgot this, and let him get to within six inches of the wall, with the result that the box went completely through the wall. An irate Frenchman appeared, who shouted he would "*Parlez ze officer.*" However, we took him to a café near by and calmed him down. We parted friends, thankful to have got off so cheaply.

AN ELECTRIC PHONOGRAPH MOTOR.

A New Induction Disk Machine.

Virtually all the small commutator motors that have been placed on the market from time to time for driving phonographs and such like machines are arranged to operate in a vertical position, and to drive the phonograph disk by friction through a pulley mounted on the lower end of the motor shaft and bearing against the outer edge of the disk. A machine produced by the American General Electric Co., and described in a recent issue of the *General Electric Review* is, however, of an entirely different form, and has decided advantages over other types so far as starting torque and speed are concerned, its principle being essentially that of the induction type watthour meter. A prominent phonograph company has decided to incorporate the new type of motor as standard equipment on its machines.

An induction disk motor consists of four essential parts: The stator magnetic circuit, energising coils, phase splitting parts, and the disk rotor of non-magnetic material. The first three elements are necessary in order to create a flux of two component parts out of phase with each other, thus generating "a shifting a.c. field." Part of the flux is used by induction to generate currents and magnetic fields in the disk in such a way that the interaction of the disk and field causes torque. Motors of this type have been used for some time as a component part of measuring instruments wherein accuracy of performance is essential, but they have been sadly overlooked as small power units whose special characteristics, inherent in their type, make them very useful.

The torque-speed curve, fig. 1, is a straight line starting at maximum torque at standstill and finishing at zero torque at maximum speed. The maximum speed is determined by the ratio of the torque to electro-magnetic damping. The no-load speed is generally seldom over 300 r.p.m., and the speed under load is determined by the amount of torque necessary; the greater the load the lower the speed. The machine is essentially a small power motor on account of its low speed and poor efficiency, and a power-speed curve, fig. 1, shows that the power is always a maximum at half of the free speed and, of course, zero at standstill and maximum speed.

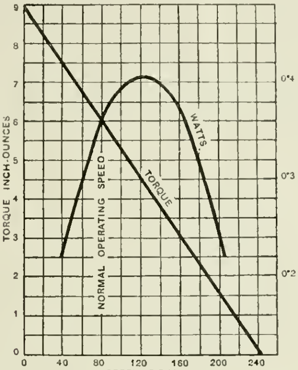
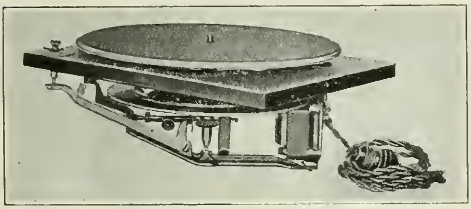


Fig. 1.—Speed-torque and Power Curves of 110-volt Disk Motor.

Since it is an induction motor, the machine is directly affected by a change in frequency; in a motor designed to operate at 60 cycles, the torque reaches its maximum at 40 cycles on account of a much larger input than at 60 cycles. It decreases at lower values because the effectiveness of the frequency is falling off at a greater rate than the increase of input. At the higher values the input is decreasing more rapidly than the increase of effectiveness of the frequency, but a given motor may be operated over a considerable range of frequency provided the minimum torque is sufficient to carry the load.

Figs. 2 and 3 give a general idea of the mechanical design and arrangement of the machine and its parts. The motor consists of a rotor mounted on the main shaft, the upper end of which supports the turntable carrying the record. The rotor consists of a ring of copper, about 9 in. outside diameter, supported on a cast aluminium spider, and the rotor ring, about 1½ in. wide, revolves through a shifting magnetic field produced by field coils wound on laminated magnetic circuits similar to those in an ordinary watt-hour meter as regards shape, size, and method of producing the shifting field. Thus, with the torque-producing element directly on the main shaft, all necessity for high-speed gearing, belting, or friction drive has been entirely eliminated.

Fig. 2.—Motorboard and Turntable.



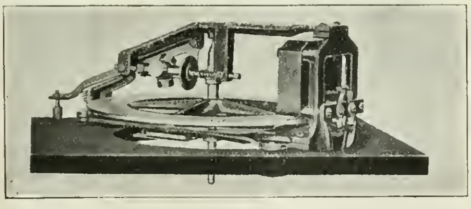


Fig. 3.—Inverted Side View Showing Terminal Arrangement and Governor.

The main shaft is supported in an adjustable hardened steel ball thrust bearing in the lower bracket, while it is held in place by a guide bearing of phosphor bronze in the upper bracket. The lower bracket also supports a governor of the conventional type, which is geared to the main shaft by a silent worm wheel. Reference to fig. 1 will show that the motor exerts maximum torque at standstill, which gradually decreases with increasing speed to the free-speed no-torque condition. This type of curve is particularly suited to phonograph service, since quick acceleration and good speed regulation are possible. Any tendency to slow up while running is counterbalanced by an increase in torque, which results in very close speed regulation under widely varying loads.

Considerable difficulty was experienced in eliminating the magnetic hum, due to the 60-cycle circuit, but it was finally accomplished by a proper design of the supporting brackets and spider, as well as by the elimination of vibration in the motorboard itself. It was found that an aluminium spider was very much quieter than a cast-iron one when supporting the same weight of disk. In the final arrangement the motor was suspended from the motorboard.

The outstanding advantages of this form of electric phonograph motor are: First, due to its extremely simple construction (only two moving elements), its stationary windings, and the elimination of commutator and other sliding contact, there is no successful competitor for reliability. Secondly, the very small amount of power absorbed in bearing friction not only makes this design very effective with regard to weight and power consumption, but gives it a life which is probably limited only by deterioration of the insulation. Thirdly, the motor has been built and attached to the board as a unit, making it completely interchangeable with the spring motor, and weighs only 7.69 lb., as against 10.88 lb. for the spring motor. Fourthly, no damage to the rotor or windings or increase in watt loss results from stalling the motor under full voltage, so that the ordinary type of friction brake may be used.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A 30-volt Bowl Fire.

Having regard to the desirability of low-voltage apparatus for domestic use, and to the fact that there are few appliances suitable for use with small country house lighting sets, we learn with interest that Messrs. Drake & Gorham Wholesale, Ltd., 67, Long Acre, W.C. 2, have placed a 30-volt bowl fire upon the market. This appliance has a 300-watt loading, and is very compact. It is only 9 in. high, and the diameter of the bowl is 5¼ in., which makes it convenient for use on a desk or table. The reflector is swivelled, and a wire front makes it possible to use the fire for boiling, &c.

A "Midget" Fuse-switch.

Messrs. Berry's Electric, Ltd., of Switch House, 86, Newman Street, W.1, have recently added to their already large number of designs of foolproof switchgear a "midget" fuse-switch for capacities up to 10 amps., 250 volts. We give illustrations herewith showing exterior and interior views of this fuse-switch (fig. 1). The usual "foolproof" features are embodied in this design, namely, the switch cover is internally locked by movement of the switch to its "on" position, and in addition to this the base contacts of the switch are sunk into the porcelain, which makes it practically impos-

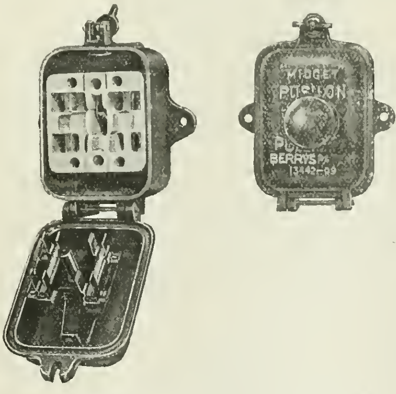


Fig. 1.—The "Midget Masta" Fuse-switch.

sible for an attendant to come into contact with any live metal. The parts which are required to be handled when inserting new fuse elements are swung well away from the live contacts. This small fuse-switch has been named the "Midget Masta." The fuse carrier consists of an asbestos tube, through which fresh fuse wire may be threaded as occasion arises. The switch case is provided with a single inlet and outlet screwed for conduit, but bushes can be fitted where required. The switch case is of cast iron and of very substantial design, and the manufacturers claim that this switch will undoubtedly replace the 10-amp. coupled tumbler switches with separate porcelain fuses, which are fast becoming obsolete, and quite unsuitable for many of the purposes to which they are put. The price of this ironclad combined fuse-switch compares very favourably with the old-fashioned apparatus which it is designed to supersede.

An Automatic Charger for Electric Vehicles.

The Acme Electric and Manufacturing Co., Cleveland, Ohio, has recently introduced a charger for the batteries of industrial trucks. The charger, known as the "Acme," is intended to charge the battery at the rate recommended by the battery manufacturer. This feature is said to eliminate much of the trouble incidental to the use of too high a charging rate, which will overheat and ruin a battery, or too low a rate, which will "starve" it.

The following points are brought out by the manufacturer: The chargers automatically take care of the charging rate without the use of rheostats; they give a tapering charge, which prolongs the life of lead batteries; they maintain a constant ampere-charging rate; and a safety control on the switchboard ensures protection to the operator. All high-voltage parts are enclosed.

To operate the charger the ampere-hour meter is set to correspond to the truck meter and the charger is started by means of the automatic switch handle. When the battery becomes fully charged the ampere-hour meter actuates a trip in the switch and the motor is shut down, the battery being disconnected simultaneously.

The charger takes up a little more than a square foot of floor space. Its motor is of liberal capacity and built for heavy service: and the generator is constructed to suit the battery. The shaft is one solid piece, rotating on ball bearings, the dynamically balanced armature and rotor both being mounted on it. The commutator has a large radiating surface and maintains a low operating temperature. Cool operation is afforded by a Sirocco-type fan, which ventilates the machine by drawing air through the windings.

An automatically operating panel accompanies the charger. It is made of rubber-finished electrical slate mounted on an angle-iron frame and contains the following equipment: Volt-ammeter for indicating the battery charging rate and voltage, field rheostat for regulating the generator voltage, fuse for protecting the generator, ampere-hour meter for automatically controlling the charger, this meter also containing a dial which indicates the progress of the charge, and an automatic oil switch for controlling the motor and for disconnecting the battery on completion of charge.—*American Machinist.*

The "Nilfisk" Suction Cleaner (Correction).—In our description of this appliance, in our last issue, we stated that the dust was retained in a cloth receptacle. This, however, is not the case, the cloth acts as a screen to prevent dust from getting into the turbine; the dust is deposited in a metal container facilitating emptying.

THE BUILDING TRADES EXHIBITION.

For the first time since the inauguration of these exhibitions this year sees an annual instead of a biennial one at Olympia, W.; it is the second of a series of three exhibitions to be held in succession, but once again it is disappointing from an electrical point of view.

Mr. J. W. Simpson, the president of the Royal Institute of British Architects, opened the exhibition on the 12th inst., and it will remain open to the public until Tuesday next. The list of popular lectures has this year been considerably extended, and a series of meetings and conferences has been arranged to take place during the run of the show. Out of a total of some 295 stands only about a dozen are of any electrical interest, and not more than four of the latter could be termed "all electrical" stands, which fact is regrettable, since an exhibition of this nature seems to be an exceptional opportunity for enlisting the interest of all connected with housing and the building trade in the subject of "electricity in the home," and the innumerable benefits and economies that are bound to attend the use of electricity, not only for lighting, but also for power, heating, and cooking.

Road engineers visiting the gallery will notice the display made by Messrs. Shell-Mex, Ltd., depicting the application of "Mexphalte" to the processes of road construction. The instruments for determining the ductility and penetration of bitumen are indicative of the scientific work which the company carries out, and specimens of the various grades of bitumen for industrial purposes, such as the manufacture of bituminous compositions, paints, varnishes, waterproof papers and packing materials, roofing felts, damp coursings, hot-neck greases, rubber manufacture, and electrical insulation, form another feature of the exhibit.

Another exhibit of electrical interest on the gallery is that of the Telephone Manufacturing Co. (1920), Ltd., showing a series of automatic intercommunicating telephones ranging from single to 50-line installations of both the desk and wall patterns

Of the stands on the ground floor that of Carron Company may be mentioned as showing a selection of electrical cooking and heating apparatus in various styles and finishes, and the manner in which electric heaters can be attractively fitted in existing chimney breasts is effectively illustrated.

Amongst the exhibits of Messrs. Parker, Winder and Achurch, Ltd., the "Utility" floor cleaning and polishing machine may be seen, by the aid of which it is claimed that 2,000 sq. ft. of floor space can be scoured and waxed in one hour's time. The device is electrically self-propelled, is fitted with ball bearings, and is claimed to be dust and waterproof. It should prove a useful labour saver in hospitals and similar institutions.

Several electrically-driven vacuum cleaners are shown on the stand of the Staines Kitchen Equipment Co., Ltd., in addition to machines intended for such operations as potato peeling, silver burnishing, &c.

Electric lift makers are represented by Medway's Safety Lift Co., Ltd., showing a complete passenger lift in operation and fitted with dual control, that is, push buttons and a switch worked by an attendant in the cage. Messrs. Waygood-Otis, Ltd., also exhibit a full-size passenger lift, which is used for carrying visitors up to the gallery.

Builders' ironmongery and brass foundry products are on view on the stand of Messrs. Nettlefold & Sons, Ltd., as well as electrical conduit fittings, while Messrs. H. C. Slingsby show a selection of transportation trucks, including an electric battery locomotive such as is used in mines for haulage purposes.

The well-known manufactures of the Sturtevant Engineering Co., Ltd., are represented by turbine vacuum cleaning and ventilating plant, blowing and exhausting fans, &c. A cleaning plant electrically driven by means of an 8-h.p. motor is shown, besides two portable sets, one of the latter being a ½-h.p. set and the other driven by a 4-h.p. electric motor.

Self-contained electric generating plant suitable for lighting country houses, &c., is exhibited on three stands; a small Webber set is to be seen on the stand of Messrs. S. Smith and Blyth, Ltd., while "Clayford" power and lighting sets together with portable engines ranging in size from 2½ to 15 b.h.p. are shown by Messrs. Cliffords, Ltd., and "Electra" petrol or paraffin engines suitable for a multitude of purposes, by Messrs. F. Sage & Co., Ltd. The last firm also exhibits the "Minor-Domo," 1,000-watt, 32-volt set, and a "Major-Domo" 2,000-watt, 50-volt model. An exceptionally small set seen on this stand will be described in a subsequent issue.

The British Electric Transformer Co., Ltd., the manufacturer of "Tricity" apparatus, shows, in conjunction with a maker of anthracite stoves, an interesting combination of a central fire for water heating, also operating an oven, and in the same equipment electric hot plates, an electric grill, and an arrangement of electric heating elements in the oven. This combination gives great flexibility, the electrical heating elements being able to operate the oven themselves, or act as a supplement to the fire heat, so giving complete cooking power at all states of the fire, in fact, introducing into cooking the "topping-up" idea as between electricity and the use of crude fuel.

Amongst the numerous machines for the production of concrete building blocks and imitation stone there is an interesting device for tamping or ramming the material in the moulds. This consists of an electrically operated machine on a wall bracket with jointed arms and belting driving a light and handy vertical rammer. The first suggestion arising in the mind of an engineer witnessing the use of this apparatus is, that it would be extremely useful in large foundries for ramming up the sand, and it may be worth the attention of electrical engineers in the metal working areas.

Electric Motors in Holland.—The report of the Eleotromotoren Fabriek Dordt. dealing with a period of 18 months from July 1st, 1919, to December 31st, 1920, states that the imports of foreign motors were delayed longer than had been expected, foreign rivalry having been of little account in the first 14 months. It was very difficult to procure raw materials; a period of from 8 to 12 months was required to secure the delivery of dynamo sheets and insulated copper wire, and it was, therefore, essential to order larger quantities of these materials than were necessary for immediate needs. A sudden fall in prices however, set in. Besides, raw materials being offered at considerably reduced prices, and for more prompt delivery, the country was inundated with foreign motors in a few weeks. In order to meet this state of affairs, it was necessary to write down the stocks of manufactures and of semi-finished products, and make reserve provision for goods on order last December, but not yet received by the company, so that the net profits only amounted to 34,000 florins. It is not intended to pay any dividend, but to transfer the profits to the reserve fund, and carry a small balance forward.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession*

The Gatehouse Lamp Patent.

In your reference to the late Mr. Gatehouse, you mention a patent in connection with incandescent lamps. Some 38 years ago, when as a boy I was working for the Pilsen, Joel and General Electric Light Co., Malden Factories, Kentish Town, part of my duties was in connection with what I understood was the patent mentioned.

The lamp filament was mounted on platinum spirals, about 3/32 in. in diameter and about 1 in. long; the gauge of wire depended upon the voltage and candle power of the lamp, but was thin. I wound many thousands of these spirals.

The wire acted as a resistance to the somewhat varying pressure of supply of that period.

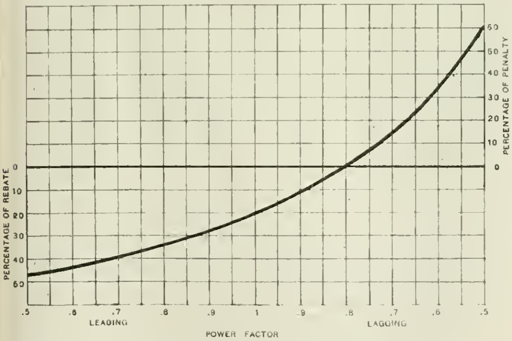
S. F. Emerson.

West Kirby.
April 13th, 1921.

Charging for Idle Current.

The ingenious method devised by Mr. Carrothers (your issue No. 2,262, p. 404) in substitution for Prof. Arno's method of charging for idle current has certain advantages. Although Arno has shown that it is quite easy so to modify a cosine meter that it will register with fair accuracy the equivalent of the kWh corresponding to any combination of kWh and kVAh, the use of a specially constructed meter alone will be always looked at with suspicion by the customer, and he will require an ordinary cosine meter in addition. The two meters will (except for p.f. unity) not agree, and the customer has no means of checking the correctness of Arno's meter to see whether it really registers what Arno calls the complex charge (his term is "carico complesso"). A third ordinary sine meter will, therefore, have to be added. Under the Carrothers method only two meters are required, a sine and a cosine meter, both of which are of the ordinary construction, and therefore easily obtainable from any meter maker. From these two meters the average p.f. over a given period for which the account has to be made up can easily be calculated, and even if the customer himself is not sufficiently versed in trigonometry to calculate the cosine from the ratio of the two readings, his engineer can do this.

Under Arno's method the customer is penalised equally whether he takes a lagging or leading idle current; under Carrothers's method there is some discrimination, but not enough. In both systems the chief idea is to penalise for bad p.f., and not to give a bonus for good p.f. Dynamo makers have succeeded in producing self-starting synchronous motors which are advertised to take leading components down to 0.6 p.f., but what is the good to the consumer of such a motor if under the Arno system he is penalised to the same extent whether his p.f. is due to a lagging or leading component of the current he takes, and under the Carrothers method the discrimination can only be small? The power companies are quite alive to the fact that an increase in the p.f. over the whole system is of great commercial value; they also recognise that the large number of motors of bad p.f. already connected to their systems cannot be scrapped, and therefore allow their customers a certain minimum p.f. without penalty. The principle of granting a rebate on good p.f. becomes, therefore, necessary. To my knowledge, this principle has been adopted by a large power company with good results, but there are probably others.



Let, for instance, the permissible p.f. for lagging current be 0.8. Sine and cosine meters are installed, and the average p.f. over a certain period (a month or a quarter) is calculated from the meter readings. If it comes out at 0.8 the account is presented in the usual way as it stands, including coal clause and rebate for quantity. If the average p.f. comes out at some other figure, say 0.7 lagging, the account made up for kWh in the usual way is multiplied with a coefficient which is the ratio of 0.8 to 0.7, or 0.8/0.7 = 1.14. The customer would, therefore, have to pay 14 per cent. more per unit than if he had kept his p.f. to the contract value of 0.8. If, on the other hand, the average p.f. comes out from the meter readings at 0.9, the coefficient is 0.89, and he would get 11 per cent. rebate on the cost per unit at the agreed p.f. of 0.8.

The question now arises how the account shall be reduced if his average p.f. comes out at less than unity, but leading. This will be shown by the sine meter running backwards. In such a case the denominator might be calculated as $2 - \cos \varphi$. Under this system the penalty or rebate in percentage of the charge for kWh supplied is given in the accompanying chart. The method suggested by Mr. Carrothers is retained, and only its application is altered to encourage customers to improve their p.f. as well as to discourage them from taking current at a bad and lagging p.f.

Gisbert Kapp.

Birmingham.
April 14th, 1921.

Electricity Supply without Statutory Powers.

I am at present in charge of an estate electricity works and wish to extend my mains, and we are an unauthorised undertaking. Am I bound by the Electric Light Act of 1888? Also what obligations am I under as regards the protection of telephone wires against my power wires falling? I may say that all the roads on the estate are private roads, upkept by the estate.

Inquirer.

April 18th, 1921.

[Many inquiries of this kind come to hand, and are answered by letter; it appears, therefore, that a general statement may be of interest to a good many of our readers.

Before the Act of 1909 was passed, the unauthorised supplier had a free hand; he could commence business anywhere, and supply electricity by overhead lines (but not by underground mains) at pleasure, to anyone. He was—and is—not hampered by the necessity of compliance with the regulations imposed upon authorised undertakers, with the exception that he must erect his lines in accordance with the requirements of the Board of Trade and the Postmaster-General. No local authority could veto his plans or interfere with his business in any way, with one exception—if the local authority owned the "fee simple" of the roadway (a rare case) it could withhold permission to carry lines across it. He could charge whatever price his customers were willing to pay, and he could go out of business if he chose, while he was under no obligation to supply any person.

The passing of the Act of 1909 did not alter the position of those unauthorised suppliers who were then supplying electricity, but it provided that in future no such business should be commenced within an area over which any authorised undertaker had powers to supply, unless the supply of electricity were a "side-line," subsidiary to the main business of the unauthorised person or company.

The Act of 1919 went further, by rendering the establishment of a new station or the extension of an existing one subject to the consent of the Electricity Commissioners (who have to hold a local inquiry before they can withhold such permission or impose conditions). No penalty is specified in the event of a station being built or extended without permission, but intending suppliers would be well advised in obtaining the consent of the Commissioners.

In the case of our correspondent, he is at liberty to extend his mains at pleasure, and need only comply with the regulations for overhead lines issued by the Ministry of Transport (successors to the Board of Trade) and the requirements of the Postmaster-General with regard to telephone wires. As the roads are private, he can use underground cables if he wishes.—Eds. Elec. Rev.]

The Training of Kinema Operators.

With regard to Mr. F. C. Drier's letter *re* kinema operators, being an electrician operator of several years' experience, I should be much obliged if you would allow me to voice my opinion. First of all, Mr. Dreier says he thinks most of the fault is with the institution teaching operating; but if anyone desires to be an electrician he does not go to a catch-penny school—if young enough, he becomes an apprentice, and enlarges his knowledge by study and attending technical evening classes. If he is too old to become an apprentice, it is hard for a man to get on; this ought not to be so. Exceedingly few electrician operators learned at a school; they attended the real thing, and educated themselves by book knowledge, not being able to attend technical classes. No school tuition is of much service; operating is like other trades, you have to serve your time to it. Age ought not to be a barrier. Some kinema managers run operating down, and say they can put anybody on the job, hence the number of lads getting sweated wages. If a manager has to pay a decent wage suitable for a fully-qualified man, and he has a dud operator, the remedy is in his own hands, there are hundreds of operators out of work, some good men, too. A kinema trade paper runs a set of test questions, and allots certificates to successful candidates; this has been going on over a year, and yet only 21 out of all England have so far been successful in obtaining certificates. Certification of operators would improve the general status; but will it ever be?

Electrician Operator.

Bolton.
April 3rd, 1921.

Fuses for Sub-stations.

With reference to the article in the Electrical Review dated April 15th on the above subject by a "Central-Station Engineer," it may be of interest to your readers to know that the firm whom I represent in this country (The Electrical Apparatus Manufacturers, Sprecher & Schuh Co., of Aarau, Switzerland) are makers of the particular types of fuses for medium pressures recommended by your contributor.

After many years' experience they have evolved two types of fuses for these pressures, one being for heavy currents up to 3,000 amperes of the open replaceable type with horn break, and the other being of the handle type with clip contacts for currents up to 600 amperes, the fuse strips being of zinc, which combines the advantages of a low melting temperature and a minimum explosive effect. The fuse carriers in this type are made of a specially tough fireproof insulating material.

J. B. Rudkin.

London.
April 16th, 1921.

The Grading of Mains Engineers.

I think that every charge engineer in the country, and especially those in large stations, fails to see the reason why mains engineers should be graded on a higher level for pay than themselves. It would be absurd for anyone to argue that their qualifications for the superintendence of wire-laying work entitle them to higher pay than that paid to charge engineers, whose responsibilities in large stations are enormous, and who have to take their regular turn on night and Sunday duty. If I may have an opinion, I think this is a matter that should be considered by the National Joint Board of the Employers and Electrical Power Engineers' Association. There is a wide belief, too, that there is far too much favouritism shown by chief engineers to "kow-towing" men when there is a promotion to be given, or vacancies are to be filled. In a station near London where I was employed for a short time some years ago, I found that the station superintendent was a man without any electrical engineering qualifications whatever, but he was possessed of special ability as a "kow-tower" to the chief, and as a coarse bully to his subordinates.. The result was that no self-respecting young engineer remained at the station for more than a few months.

N. B.

April 18th, 1921.

The Heating of Buried Cables.

In my letter to you of the 6th inst., an unfortunate slip occurred in the fourth line of the fourth paragraph. The word "considerably" should not have been inserted. The sentence should read: "The losses in unarmoured cables are in each case greater than those in armoured cables . . ."

A. M. Taylor,
Hon. Major, S.O.2, W.B.A.M.

Birmingham.
April 16th, 1921.

LEGAL.

The Nash Fish Hydrophone.

On Monday last, before the Royal Commission on Awards to Inventors, the case was commenced of Mr. George Howard Nash, C.B.E. (chief engineer and a director of the Western Electric Co.), Mr. A. A. Mack, Mr. Bertram B. Grace, and Mr. G. E. R. Penny, who put forward a claim in respect of the Nash fish hydrophone and the Western Electric hydrophone equipment—apparatus used for the purpose of detecting the presence of submarines in the late war.

The Court was presided over by the Hon. Mr. Justice Sargant, with whom were Sir Charles Ellis, Sir James Dobbie, Mr. Temple Franks, Mr. Young, and Mr. Norton.

The applicants were represented by Mr. Hunter Gray, K.C., Mr. Barrington Ward, K.C., and Mr. Caradoc Rees (instructed by Messrs. Hyman Isaacs, Lewis & Mills) solicitors. The Crown was represented by Sir Arthur Colefax, K.C., and Mr. Moritz.

Mr. Hunter Gray, K.C., in opening the case, explained that the Western Electric Co. were not the claimants, although the company were entitled to the greatest credit for the work which they performed in connection with the matter. It was a claim by four gentlemen who were employés of the Western Electric Co., and it was in respect of what was known as the Nash Fish, which was not an instrument, but a system embodying several instruments, used very largely for the detection of submarines, and which enabled them in many cases to be destroyed by depth bombs. It was in April, 1915, that the German submarine menace became a real danger, and the danger increased until in the autumn of 1916 it caused a great deal of anxiety in this country. The menace went on increasing until the middle of 1917 when something like one million tons of shipping was being destroyed per day. The Commission would understand that during the whole of that period it was vital that some means should be found to prevent, if possible, that tremendous destruction of shipping. Many elaborate investigations were carried out for the purpose of finding some solution. Among them were mines which were laid in the traffic areas of the submarines, nets, the "Q" boats, &c. Some of the best scientific brains had directed themselves to the problem. He would not tell the Commission in detail all that Mr. Nash did—it was sufficient for the moment to say that from the beginning of the war the Western Electric Co., and the four claimants, were working on devices of various kinds for war purposes, and in November, 1916, Mr. Nash in particular turned his attention to the problem of dealing with the German submarines. From that time until April, 1917, the work which Mr. Nash and his colleagues did in that connection was almost superhuman. The problems to be faced were multitudinous, but in the end they succeeded in perfecting a system which was eminently useful for the purpose for which it was designed. By October or November, 1917, there were something like 180 trawlers, all of which were built for the purpose, and fitted with the system. Although Mr. Nash was a scientific man of very great skill and knowledge, he began with the very elements of the subject. He consulted every book which he could find which gave him any information on the conductivity of sound in water, and having equipped himself with that knowledge, he proceeded to work out the various elements in the problem, and he began with the microphone. The first problem Mr. Nash had to solve was to get a microphone which would be affected on both sides. Some of the other scientific men who were working on the problem had solved that, but not to the knowledge of Mr. Nash. In addition to both sides of the diaphragm being equally affected, it was necessary to know not only that it was in the line of the diaphragm, but they must know from what direction the sound came, whether from the right or the left. The next problem which Mr. Nash had to tackle was to invent a unidirectional hydrophone, and that was eventually accomplished. Counsel explained how by an arrangement of the two microphones it was possible not only to get the direction of the line to the submarine, but the "sense" of it. He was, he said, instructed that that device was absolutely new at the time Mr. Nash invented it. Another problem which Mr. Nash had successfully solved was moving the hydrophone transmitters through the seas at high speed without affecting their efficiency. Such a device might have been suspended from the ship itself, but the difficulty there was that they would have had trouble with the noise of the engines, and by the surging of the water, and therefore Mr. Nash took the quite original step of suspending his fish at the extremity of a long, steel composite rope about 200 ft. long. That was towed behind the ship, and the rope contained all the conductors that were required in addition to the necessary material to enable the towing to take place. It would be realised that all those problems required a great deal of experimenting to perfect them, but once the instruments were standardised, it was possible for the operator on board a ship to tell within 10 per cent. the distance the submarine was from the vessel, and then depth charges were dropped above the spot where the submarine was supposed to be. Before Mr. Nash invented his "fish" it was recognised that no single device had succeeded in overcoming the water noise, and the result was failure in every case. Mr. Nash had solved every single problem, and 184 ships were fitted out with the apparatus, and a very large number of submarine "hunts" were carried out, and he (Mr. Gray) was going to submit to the Commission that the effect of those devices was practically to destroy the danger of the German submarines. When they were used the submarines could be "hunted" in a way that was never possible before: and they could be followed for hours and hours together until eventually they were destroyed.

Learned counsel had not concluded his address when the hearing was adjourned until Monday next.

Semco, Ltd., v. Spooner.

In the Shoreditch County Court, on April 14th, before Judge Cluer, Messrs. Semco, Ltd., of High Street, Shoreditch, electrical manufacturers, sued Mr. R. J. Spooner, of Forest Gate, butcher, to recover £7 8s. 6d. for repairs to an electric motor.

It appeared that the defendant had a small electric motor running in his shop which he wished to have repaired. The work had been done satisfactorily, but it was stated that the price was excessive.

Mr. Holt, of 127, St. Stephen's Road, East Ham, an electrician, was called for the defence, and said that if he had been offered the work to do he could have carried it out properly and made a profit by charging £3 15s.

Judge Cluer found for the plaintiffs for £5 and costs.

Postmaster-General *v.* Liverpool Corporation.

An action seeking to recover the cost of repairing the damage to telephone cables, the result of an explosion which occurred in August, 1918, was heard at the Liverpool County Court, when the Postmaster-General sued the Liverpool Corporation in respect of the sum of £40.

On behalf of the Postmaster-General, it was stated that when the Government took over the telephone system from the National Telephone Co., certain agreements between the company and the Corporation lapsed. The Postmaster-General claimed that he was entitled to obtain the cost of the repairs to the telephone cable which it was alleged had been damaged by a faulty electric light cable of the Liverpool Corporation.

The Corporation contended that the fact that the Postmaster-General had taken over the telephones did not entitle him to treat agreements entered into between the Corporation and the National Telephone Co. as having lapsed. It was argued that the Corporation should not be liable through the telephone and electric light cables being in contact.

His Honour Judge Thomas, gave judgment for the Corporation with costs. He said the Postmaster-General was still bound by the agreements referred to. He found that the telephone cable had been negligently and improperly laid by the Telephone Co. in contact, or practical contact, with the Corporation's electric cable.

Colliery Fireman Fined.

Before Sheriff Macdiarmid, at Airdrie, Robert Hendry, colliery fireman, Lang Street, Coatbridge, admitted a charge of having failed to keep the removable handle of the electrical firing apparatus in his personal custody, he being authorised to fire shots electrically, and allowing it to be in the custody of two others. The Sheriff imposed a fine of £5, with the alternative of 30 days' imprisonment.

Bastian Electric Co., Ltd.

The petition of W. F. N. May and others for an order for the compulsory winding-up of this company was before Mr. Justice P. O. Lawrence in the Companies Winding-up Court on April 12th. The petitioners were judgment creditors, and the petition was adjourned for 14 days.

Portable Electric Motors (1919), Ltd.

Upon the petition of Electric Tools & Motors, Ltd., Mr. Justice P. O. Lawrence, in the Companies Winding-up Court, on April 12th, made an order for the compulsory winding-up of this company. The petitioners, it was stated, were judgment creditors for £160. There was no opposition.

Workmen's Compensation.

At the Southport County Court, on April 12th, an application was made for an order regarding certain compensation moneys respecting the death of an electrician in the employ of the Vulcan Motor & Engineering Co., named John Gilbert Anger, who was killed as the result of an accident arising out of his employment in November last. Mr. A. J. Mawdsley, solicitor, said that since the commencement of an application for arbitration the Vulcan Co. had paid into court £300 which, he understood, was the maximum sum payable on death in such circumstances. The judge consented to the paying out of £75 to the widow for the discharge of her debts, which included £40 for furniture, the balance to be invested with liberty to apply for its apportionment as between the widow and the children.

Hackney Borough Council to be Summoned.

It is reported in the daily Press that on Saturday last Mr. S. Y. Tilley, solicitor, applied to Mr. Disney at North London Police Court on Saturday for a summons against the Hackney Borough Council for failing to supply electric power to certain premises, contrary to the provisions of the Hackney Electric Lighting Order, 1893.

Mr. Tilley explained that his client had made formal application for a supply of electricity, which the Council was bound to give, and had employed a master man to do the wiring inside the premises. While this work was in progress the electrician received a visit from a person representing himself as a shop steward from the Council's electricity department, who requested to see his "ticket." "What ticket?" asked the electrician. "Your union ticket," was the reply. The electrician answered: "I am a master man and do the work myself. I employ no labour." The shop steward informed him that as he did not belong to the union the Council's men would refuse to connect the premises, and this decision was afterwards confirmed by the borough electrical engineer. Under Section 26 of the Order the Council became liable to a penalty of 40s. a day for refusing to connect the premises.

Mr. Disney granted the summons.

MERSEY AND WEST LANCASHIRE ELECTRICITY DISTRICT.

We have received the following communication from the Electricity Commission:—

The Electricity Commissioners having considered the evidence submitted at the recent inquiry at Liverpool into the two schemes submitted respectively by the Conference of Mersey and West Lancashire Electricity Authorities, and by the Corporations of Wallasey and Birkenhead, have arrived at the following conclusions:—

1. The area provisionally determined is confirmed subject to the inclusion of the urban districts of Lymm, Haydock, Northwich, Middlewich, and Winsford, and the rural district of Northwich.

2. A Joint Electricity Authority will be formed for the whole district, subject as hereinafter appears.

3. The advantages to the Local Authorities of the Wirral Peninsula of independent combination will for some years outweigh those of inclusion in the scheme for the whole area. Subject to liaison with the Joint Electricity Authority, a separate Committee will be established representative of the Local Authorities for the following districts, namely, the county boroughs of Birkenhead and Wallasey, the urban districts of Hoylake and West Kirby, Bromborough, Higher Bebington, Lower Bebington, and Neston and Parkgate, and the rural district of Wirral (hereinafter referred to as "the Wirral Area").

Although the Commissioners have arrived at this conclusion after a critical comparison of the estimates laid before them by the promoters of the two schemes as subsequently amended by the Commissioners, they are of opinion that it may be found advantageous to merge the Wirral Committee in the Joint Electricity Authority at some future date.

4. A capital station in the neighbourhood of Liverpool, and a transmission system connecting it with Liverpool, Bootle, Prescot, and St. Helens, are immediately required, and will be of advantage to the neighbouring districts.

5. The fullest and most efficient use should be made of the generating plant of the Mersey Power Company, Limited. The company, by arrangement with the Joint Electricity Authority, and with the approval of the Commissioners, and subject to suitable conditions, may be empowered to extend its operations by bulk supply or otherwise into neighbouring districts. The Company will have separate representation upon the Joint Electricity Authority, to which it will elect one member.

6. The areas of the Wirral Committee and the Mersey Power Company, Limited, should in due course be linked up with the remainder of the area.

The Electricity Commissioners have accordingly decided to prepare a draft Order providing (*inter alia*):—

(*a*) For the establishment of a Joint Electricity Authority for the whole district, including the additional areas enumerated in paragraph (1), and the Wirral area.

(*b*) For the establishment of an independent Committee for the Wirral area.

(*c*) For any consequential modifications in the constitution of the Joint Electricity Authority proposed in the scheme of the Conference of Mersey and West Lancashire Electricity Authorities. The Wirral Committee will elect one member of the Joint Electricity Authority.

(*d*) For the inclusion of outlines of the technical schemes to be undertaken by the Joint Electricity Authority and the Wirral Committee respectively, but will provide that modifications thereof may be made with the approval of the Commissioners.

(*e*) For the Joint Electricity Authority and the Wirral Committee respectively being required to submit, within a period of two years from the date of their formation, proposals for giving or securing a supply in unoccupied areas where there is a reasonable prospect of such supply being remunerative.

(*f*) For the *administrative* expenses of the Joint Electricity Authority being met by contributions from each of the interests represented on the Authority, and for any deficiency on revenue account which may arise from the supply of electricity being, by a re-adjustment of charges or otherwise, met only by those undertakings which are connected with the Joint Electricity Authority's transmission system.

(*g*) For the necessary financial powers being conferred on the Joint Electricity Authority and the Wirral Committee, subject in the former case to the enactment of the Electricity (Supply) Bill now before Parliament.

Pending the establishment of the Joint Electricity Authority and the Wirral Committee, the Commissioners will ask the parties concerned to form two small provisional committees with which the Commissioners may consult from time to time with regard to any development of supply in the Electricity District and the Wirral Area respectively.

The observations of the parties represented at the recent inquiry will be invited on the clauses of the draft Order before the Commissioners hold the further inquiry required by Section 5 (4) of the Electricity (Supply) Act, 1919.

A communication in the above terms is being made to all parties represented at the inquiry.

BUSINESS NOTES.

Bankruptcy Proceedings.—J. Skinner (Foster, Skinner and Co.), electric fittings dealer, Liverpool.—First and final dividend of 1s. 3¼d. in the £, payable April 22nd, at the Official Receiver's Offices, 11, Dale Street, Liverpool.

John Vincent Bell, 21, North Bar Within, Beverley, East Riding, Yorkshire, electrical engineer.—The adjourned public examination of this debtor was held recently at the Guildhall, Alfred Golder Street, Hull. It appeared that debtor commenced business in February, 1920, after being apprenticed to the trade. The statement of affairs showed liabilities of £449, against assets estimated to realise £455, or a surplus of £6. He attributed his position to a general falling-off in trade since September, and damage done to his business by reason of his arrest. It was further stated that the charge on which he had been arrested had been withdrawn. The examination was closed.

L. P. Howse & G. H. B. Snell (Howse & Snell), electrical engineers, Margate.—Trustee, Mr. J. C. Goldsack, 5, Cecil Square, Margate, appointed April 11th.

Company Liquidations. — British Rubber Manufactures, Ltd.—A first and final dividend is to be declared. Proof of debts has to be made by May 2nd. The liabilities are £80,000. The assets estimated available for dividends are £4,800. Mr. H. Brougham, 33, Carey Street, W.C., is liquidator.

Orizaba Tramways Syndicate, Ltd.—Meeting of creditors called for Monday last at Sardinia House, W.C.

Anglo-Foreign Tramways Syndicate, Ltd.—Meeting of creditors called for Monday last at Sardinia House, W.C.

Wigan Electro Metallurgical Works, Ltd.—Winding up voluntarily. Liquidator, Mr. J. Airey, 8, Victoria Street, Liverpool, to whom particulars of claims should be sent forthwith. Meeting of creditors called for April 27th.

Dissolutions of Partnership.—Saunders, Garner and Mothersdill, electrical, motor, and mechanical engineers, 249, Regent Road, Salford.—Mr. F. Garner and Mr. F. Mothersgill have dissolved partnership. Debts will be attended to by Mr. F. Garner, who will continue the business under the style of Garner & Co.

British Telephone Supply Co., 14, Snow Hill. Birmingham.—Messrs. G. H. Hanson, W. C. Carter, and A. H. Hanson, have dissolved partnership. Debts will be attended to by Messrs. Carter and A. H. Hanson, who will continue the business under the same name.

Trade Announcements.—Messrs. George Nobbs, Ltd., of 89, Cleveland Street, Fitzroy Square, London, W. 1, have taken over the sole selling rights for the world of "Provoi" electrical insulating composition, which takes the place of what has long been known as Chatterton's compound. For the last five years their entire output has been absorbed by about 12 British manufacturers of generators and motors, and certain telegraph, telephone, and traction companies.

Messrs. Berry & Moodycliffe, late of the South of Scotland Electrical and Mechanical Engineering Co., Ltd., have commenced business as electrical engineers, at Milldamhead, Annan Road, Dumfries.

The Commercial Cable Co. has opened a new cable office at 75, Edmund Street, Birmingham, for the convenience of this large industrial centre.

Premises at 7, Victoria Square, Truro, have been opened as showrooms by the Electric Light, Motor and Engineering Co., of which Mr. H. Colling Hall is the manager.

Mr. Neil Cameron and Mr. Campbell Gardner, of 44, Upper Arthur Street, Belfast, and 68, Dame Street, Dublin, have entered into partnership and commenced business at the above addresses as electrical and mechanical engineers' agents and wholesale factors. Catalogues and price-lists requested.

Catalogues and Lists.—The London Electric Firm, Brighton Road, Croydon.—Leaflet No. 274, giving sizes and prices of flexible steel wire ropes; Leaflet No. 275, a price list illustrating and describing winches, ropes and pulleys; also two circular letters, one regarding stocks of searchlight mirrors of various types and sizes (priced), and the other (with blue prints) advertising a stock of disused steel and wood poles suitable for lighting, telephone lines, &c.

Messrs. L. G. Hawkins & Co., 116, Charing Cross Road, W.C. 2.—"The Electrical Link," Vol. I, No. 3, advertising "Universal" electric washers and other products; also two illustrated pamphlets dealing with "Universal" toasters, percolators, vacuum cleaners, immersion heaters, &c.

Messrs. S. G. Leach & Co., Ltd., 26-30, Artillery Lane, E. 1.—List FCM 11, a priced pamphlet giving particulars and illustrations of desk, bracket, and oscillating electric fans; also an illustrated price sheet of fractional h.p. motors, ranging from $\frac{1}{30}$ to $\frac{1}{4}$ h.p.

Messrs. Ferranti, Ltd., 180, Fleet Street, London, E.C. 4.—Illustrated and priced leaflet, List Ga 354, giving full particulars of the Ferranti-Hawkins system of cable protection.

Messrs. Mossay & Co., Ltd., 7, Princes Street, Westminster, S.W. 1.—A catalogue giving numerous illustrations of "Orwell" industrial electric vehicles applied to various businesses. Particulars of running costs are given.

The Edison Swan Electric Co., Ltd., Ponders End, Middlesex. Leaflet No. A.A. 214, dealing with "Ediswan" circuit-breakers, and Leaflet B.B. 215, advertising "Ediswan Acme" accumulators.

The Benjamin Electric, Ltd., Brantwood Works, Tariff Road, Tottenham, N. 17. Catalogue L-6.—This is an extremely well-produced publication divided into seven sections as follows:—(1) Industrial lighting fittings; (2) outside lanterns and well-glass fittings; (3) electric lighting devices; (4) shop-window lighting material; (5) industrial signals; (6) automobile accessories; and (7) accessories and spare parts. Each section is profusely illustrated, some excellent photographs of lighting systems being included, and a great many data are also supplied. Prices are given where possible.

The British Thomson-Houston Co, Ltd., Rugby.—Descriptive List No. 2,531—A. This is a copiously-illustrated brochure dealing with "Fabroil" pinions and their applications. A great amount of technical data in this connection is included in the publication.

Athol Engineering Co, 9, Peru Street, Higher Broughton, Manchester.—A price-list (C 3. 150,421) of sheet celluloid, with conditions of sale, &c.

Messrs. Hyatt, Ltd, Thurloe Place, South Kensington, S.W. 7. A list giving drawings and dimensions of roller bearings for loose pulleys and countershaft boxes.

Electricity Supply Rifle League.—The following are the results of the matches shot during March:—Shoreditch 583, Central, 557; City Co. 561, Fulham 481; City Co. 571, Central 552; Shoreditch 583, St. James's 554; St. James's 555, Brompton 534.

Book Notices.—"Riffelbekämpfung und Riffelmessung." By F. Sohrey. Pp. 19, figs. 5. Vienna: From the author. Price M.20.—This is a pamphlet on the removal of corrugations on railway track by means of a track-grinding rail motor-car, and the measurement of corrugations on tramway lines, issued by the chief inspector of the municipal tramways in Vienna. It deals with the cost of removal of corrugations on rails by various processes, and contains a description with illustrations of a new device for measuring corrugations; it is the result of investigations made under the superintendence of the author by the municipal tramway department of Vienna.

"The Metropolitan-Vickers Gazette," Vol. VI, No. 96, March, 1921.—In this issue, Mr. Juhlin's paper on "The Temperature Limits of Large Alternators," read before the I.E.E, is reproduced. Other articles are:—"Electrical Drive in Cotton-Spinning Mills," by V. Mallalieu; "Radiology Applied to the Testing of Materials," by A. P. M. Fleming, C.B.E., and J. R. Clarke, M.Sc.; and "The Electric Road Vehicle," by W. D. Sheers.

"Science Abstracts." Vol. 24, Part 3. Section A—Physics (88 pp.); Section B—Electrical Engineering (54 pp.). London: E. & F. N. Spon, Ltd. Price, single numbers, 2s. 6d.

"Engineering Abstracts from Current Periodical Literature," new series No. 7, April, 1921 (275 pp.). London: The Institution of Civil Engineers.

"Contact," the *Journal* of the National Association of Supervising Electricians. Vol. II, No. 4, April, 1921. London: The Association.—This number contains illustrated articles on "Battery Control by Ampere-hour Meter," and "Progress in Lighting," a report of proceedings at the annual dinner, &c.

Electrical Manufacturing in Australia.—Protests were recently lodged with the Sydney City Council against the decision of the Electric Lighting Committee to recommend the purchase of a transformer of local manufacture at a price some 20 per cent. in advance of the tenders from oversea manufacturers. The Australian Overseas Committee of the British Electrical and Allied Manufacturers' Association emphatically protested against such preference. The British manufacturers, the letter stated, had to allow in their tenders for freight, insurance, exchange, &c., as well as duty, in the case of the transformer 30 per cent. *ad valorem*, so that in this way alone local manufacturers were protected to the extent of approximately 45 per cent. The general impression was that the new rates of duty were fixed in such a way as to give the necessary preference to local manufacturers over the British, and that it was no longer necessary to give a further preference to local manufacturers. It was, therefore, surprising that in this instance a preference of 20 per cent. was recommended. If this policy was adhered to, it would seem useless for British firms to continue tendering, and in the circumstances it would leave the field entirely open to local manufacture, eliminating healthy competition. It would be recognised that the total load of 65 per cent. could not possibly be faced by British manufacturers. The letter further pointed out that no preference should be given to local over British manufactured articles, on account of duty, &c., which was already intended to serve that purpose. It would be glad if the Council would define its policy on the question in connection with future contracts. A second letter in similar strain was received from Messrs. Noyes Bros. (Sydney), Ltd. The Council, however, agreed to the recommendation of the Electric Lighting Committee, that the tender of the English Electric Co. of Australia, for the transformers, involving a sum of £13,700, be accepted.—*Industrial Australian and Mining Standard.*

New Italian Companies.—There has been formed at Antrona Piana, province of Novara, the Società Forze Idrauliche Valle Antrona, with a capital of 1,000,000 lire, for the generation of electricity from the River Antrona.

At Oliveto Citra has been embodied the Società Idro-elettrica Valsele, for the utilisation of energy generated from the River Inceglia. Its capital is 1,000,000 lire.

The Photographic Fair.—A Photographic Fair is in progress at the Horticultural Hall, Westminster, where all phases of the art are to be seen. Naturally cameras, plates and lenses form the greater part of the exhibition, but several electrical appliances are on view. There are numerous small articles shown, such as the Richardson dry-mounting fixing iron, which is similar in appearance to an electric soldering iron. This has a small loading, and is suitable for attaching to an ordinary lampholder. Then there is an electric printing box; this is for use where a supply of electricity is not available. It consists of a box in which is placed a small electric lamp supplied by a pocket battery. Prints upon "gaslight" paper can be obtained in a very short time by this means. Messrs. John J. Griffin & Sons, Ltd., of Kemble Street, Kingsway, show a "Barkay" reflector which, it is claimed, increases the actinic value of the rays from a gasfilled lamp by 800 per cent. The reflector is of glass, silvered on the back. The surface of the reflector is a series of tiny depressions and convexities, so that within the main light beam (which is not visible, and does not photograph) are myriads of secondary light pencils striking at every angle. The effect gained is as though the light originates from an incandescent mass of some 150 sq. in.—the whole area of the Barkay—instead of from a small filament or arc alone. As a result, the outline of cast shadows is softened and "fluffy." Diffusing screens, which frequently absorb 70 per cent. of the light, may be dispensed with, or reduced to a very small size just sufficient to mask the direct rays from the light source.

Messrs. Newman & Guardia, Ltd., 17-18, Rathbone Place, Oxford Street, W. 1, exhibit "Triumph" outfits for photographic work. The 5-A set shown comprises a 1,000-c.p. lamp and Mangin reflector, with a sliding resistance to vary the intensity of the light. This can be operated from house wiring, or an accumulator battery can be employed.

Messrs. Ross, Ltd., Clapham Common, S.W. 14, have on view an example of their kinema projector. The special lenses used in this machine result, it is stated, in a considerable saving of current while giving brighter illumination than the machines of most other makers. The arc is of the six-movement type, making adjustment a simple matter. A specially-designed shutter is supplied with the machine. It is the outcome of many experiments in connection with light transmitting power and the elimination of flicker. In this shutter the alternate "cover" and "open" segments are covered with translucent gelatine; the "cover" segments are violet-coloured. This arrangement ensures that the light is never cut off from the screen, and the usual flicker, therefore, is absent. The ⅛th-h.p. motor which is embodied in the machine is swung and counterbalanced, so that the tension in the pulley-driving belt is maintained constant.

Messrs. W. Butcher & Sons, Ltd., Farringdon Avenue, E.C. 4, exhibit, *inter alia*, kinema projectors, and samples of the "Klimax" parallel arc for studio work, projection, &c.

N.A.S.E's New Address.—The registered office of the National Association of Supervising Electricians is now at Room 29, Metropolitan Buildings, 63, Queen Victoria Street E.C. 4. Telephone, "City 7381."

New French Companies.—Under the style of Etablissements Nioca has been formed a company at Paris (Rue Volney, 6) for the manufacture, sale, and purchase of electric porcelain and other articles of electric equipment. The capital is 1.120,000 fr. in 500-fr. shares, of which 1,800 are apportioned to MM. Moatti, as consideration for their assets.

Le Micalas (Société Française des Isolants pour l'Electricité) is the title of a recently-formed company for the manufacture of and trading in electric insulators and the accessory chemical products. The capital is 6,000,000 fr. in 100-fr. shares, of which 24,000 A shares are allotted to M. Herrmann in partial payment for his assets. Offices, 6, Rue Volney, Paris.

There has been embodied at Paris (66, Avenue de la Bournnais) the Comptoirs d'Electricité Industrielle (Anciens Etablissements de la Motte-Rouge), for the working of the goodwill of an electric furnisher's business. The capital is 300,000 fr., of which 2,300 100-fr. shares are allotted to MM. Motte-Rouge and De Pontaumont as compensation for their assets.

The Société Luxembourgeoise pour Enterprises Electriques is the name of a company formed at Paris, with a capital of 3,000,000 fr., to trade in electric material of all kinds.

Engineering Wages and Conditions.—According to the *Manchester Guardian*, the Engineering Employers and Unions recently met in conference to discuss in the first place certain actual disputes which had arisen about overtime, manning of machines, and the apprentice question. These disputes led to a number of local stoppages in particular factories. In the second place the conference was expected to discuss the employers' application for a general reduction in wages throughout the industry. When the conference met the employers apparently asked the Unions whether they would agree to recommend a general resumption of work in the factories in which stoppages had taken place over these questions. To this the Unions refused to agree. The employers thereupon intimated that, in their view, this created a serious situation, that full powers of action had been placed in the hands of the Federation by the constituent associations, and that they would have immediately to consider their position. They thereupon adjourned the conference without any discussion on the wages question.

"The view in Trade Union quarters is that this means that a serious crisis, in which the wage reduction question will inevitably become the principal issue, whatever the ostensible cause of the dispute may be, is imminent."

Scottish Electricians' Strike.—The strike of electricians in Scotland is now in its seventh week. No conference between the two parties has been held. The employers throughout Scotland, states the secretary of the Electrical Contractors' Association of Scotland, have recently been advertising for men at the new rate of 2s. per hour, and there has been a considerable number of responses. Some firms are already fully staffed. There is no doubt that a very considerable number of those who have applied are not members of the Electrical Trades Union, but, on the other hand, it seems clear that members of the Union are also seeking employment at the new rate. Practically the whole of the employés of one large firm returned to work on April 15th, and it is reported that the employés of another firm returned on April 12th, both at the new rate.

Mr. Higgins, the district organiser of the E.T.U., points out in connection with this statement that, so far as the members of the Union are concerned, it is not true. He admitted it might be true that some employers were able to engage men, but those were non-Unionists. What the employers desired most was competent electricans, and Mr. Higgins said he doubted whether those men were competent workers. So far as Glasgow was concerned, he said no firm had succeeded in securing a full staff.

Social Events.—At the invitation of the Mayor of Leigh (Mr. Geo. Holden), Callender's "Anchor" Works Musical Society recently gave two performances of Gilbert and Sullivan's opera, "The Pirates of Penzance," in the Leigh Hippodrome, in aid of the local infirmary. This laudable effort resulted in the Mayor, on behalf of the Infirmary Board, receiving a cheque for £302, representing the gross proceeds of the evening's entertainment. The whole of the expenses (£110) were defrayed by private subscriptions, thus avoiding the heavy entertainment-tax. In acknowledging the cheque, the Mayor highly complimented the "Anchor" Works Musical Society on their excellent performances. The interest in the event was enhanced by the fact that, with the Society's double set of principals, two "houses" were run during the evening to crowded audiences. Mr. Alec Hill (conductor), Mr. Jos. Hull, A.R.C.O. (accompanist), Mr. W. T. Thornley (stage manager), and Miss Casstles (who was responsible for the costumes), togther with the principals and chorus, were the recipients of well-merited congratulations. The arrangements were carried out by a Town Committee, with the Mayor as chairman, Messrs. J. A. Smith and W. Hulme Jones (hon. secretaries), and Mr. W. Higenbottom (hon. treasurer).

The staff of the Midland Electric Manufacturing Co., Ltd., have formed a Staff Social Club, and held their first dinner and musical evening at the White Horse Hotel, Birmingham, on April 14th. Over 40 members were present; Mr. W. L. Barber (managing director) presided.

The annual dinner of the Willesden District Council Electricity Department was held at the Social Club Room, Salusbury Road, Kilburn, on Saturday, 9th inst. Councillor W. A. Hill, the chairman of the Electricity Committee, who presided, was supported by Mr. A. W. Blake, and members of the Electricity Committee and other friends, including Messrs. W. Wyld, borough electrical engineer of Hampstead, H. Howard, and R. Hughman. The party numbered approximately 80. Unique table decorations were devised by members of the staff. The toasts included "The Electricity Committee," "The Officers of the Council," and "The Visitors." In responding to the toast of "The Electricity Department," Mr. Blake gave a brief *résumé* of the work of the department during the past year. Twenty-one miles of new cable had been laid, 473 new consumers had been added, and the electric vehicle department had completed its first full year of working. Of the 14 electric vehicles which were operating on house refuse collection in the district, one had run without any loss of time whatever throughout the 12 months, one lost ½ hour, one lost 1 hour, one 2 hours. and one 2½ hours, and taking the whole 14 vehicles, the whole time lost was only 99½ vehicle hours, which represented only ·3 per cent. of the whole working time. He instanced this as a record which would be hard to approach by any other form of road transport. The plant at the Acton Lane Garage was also being used for charging industrial trucks and other electric vehicles, and the increasing use of these in the factories of the districts showed that the great advantages of these trucks in the handling of goods were being more and more realised by manufacturers. A much-enjoyed musical programme was contributed by various members of the staff.

The concluding social evening of the Ediswan (Bristol) Staff was held at the company's showrooms on the 6th inst. A varied programme was given by members of the staff and their friends.

E.D.A. Activities.—The Electrical Development Association, Hampden House, 84, Kingsway, W.C. 2, has recently published two interesting articles upon Switzerland. One (E.D.A. 152), deals with electrical enterprise in that country, and the other (E.D.A. 155), is an abstract of a lecture delivered by Herr Paul Beuttner to a Society of Engineers in Switzerland. This deals with electric heating by "heat accumulation" methods using high load-factor appliances.

Salaries in Electricity Works.—We regret to learn from the minutes of the Hammersmith Borough Council for April 20th that the Salaries and Wages Committee (No. 2) has recommended the withdrawal of the Council from the various Joint Industrial Councils and Boards representing employers and employés, and proposes instead to hold conferences with representatives of the Council's staff and employés.

Lead.—In their report, dated April 16th, Messrs. James Forster & Co. state :—"The market for lead, as for other metals, has been remarkably steady, notwithstanding the gravity of the labour difficulties, but the position is very artificial, and the steadiness is certainly not due to trade demand, which has been of a most meagre description. Not only is the consumption of lead for building trades much less than it was, but the electrical cable trade has fallen off considerably during the last month or so."

Undergrounding of German Overhead Wires.—It is expected that the long-distance cable connections between Berlin and Rhineland will be completed in the next few months. In connection with this work it is stated that as soon as the financial situation will permit, the German telegraph authorities propose to substitute cables for the most important Press and telegraph wires. In order that all technical experience may be utilised in the construction of cables, and also secure the greatest possible economy and efficiency by simplification, it is intended to form a company under the title of the Deutsche Fernkabel G.m.b.H., of Berlin, with the co-operation of the State and the firms to be entrusted with the manufacture. Hitherto only the Siemens & Halske Co. has supplied long-distance telephone cables to the telegraph authorities. The Felten & Guilleaume Co. and the A.E.G. will now participate in the new company, which will also embody other cable makers later on.

Italian Electrical Preparations.—In the course of the report for 1920 of the Società Anonima Italiana Gio. Ansaldo e Cia., the directors state that the company's programme covers a series of manufactures in mechanical and electrical engineering and shipbuilding, complemented by the production of special qualities of electric steel. Dealing with the transposition from war to peace work, the report mentioned that the Sampierdarena works is producing turbines, marine boilers, and locomotives. The artillery works of Vittoria had been transformed into a great works for the construction of three-phase machinery and electric locomotives, while the old electrical workshops remained intact for the building of continuous-current machines. The great railway transformation which the country was preparing for the substitution of electric for steam locomotion and the necessity for the carrying out of new hydro-electric works would feed these establishments with work. The electric steel plant at the Aosta works and the sheet-rolling mill were now in full operation, and one of the two electric blast furnaces would soon be able to start production.

Belgian Cable Works.—The report of the Société Belge pour la Fabrication des Cables et Fils Electriques states that the results obtained in 1920 show that the company was not affected by the crisis which in the second half of the year succeeded the period of prosperity in 1919. During the year a copper-drawing mill was added to the cable department, permitting of a considerable increase in the production of insulated wires and cables, and a reduction in the prime costs. As it had been impossible to recover many of the machines requisitioned in this department by the Germans, the directors had obtained substitutes for some of them. The department for insulating tubes had been extended as a result of the recovery of all the machines which had been seized, especially the cold rolling mill, shears, &c., which were again placed in service during the year, together with others constructed for the company. The net profits earned in 1920 amounted to 1,248,000 fr., and a dividend at the rate of 45·62 fr. per share had been declared.

N.F.E.A. Dinner.—At the annual dinner of the Bradford branch of the National Federated Electrical Association recently, when the President of the Association (Mr. Percy Collinson, of Bradford), and the general secretary (Mr. L. G. Tate) were present, and at which Mr. A. Smith presided, Mr. Douthwaite, of the Electrical Factors, responding to the toast of "The Guests" (proposed by Mr. Harry Moss), suggested the establishment of an Electrical Club in the city, open to all engaged in any branch of the electrical industry. In proposing "Success to the Bradford Corporation Electricity Department," Mr. Collinson congratulated Bradford upon the harmonious relationships between the municipal undertaking and the electrical traders. Mr. C. E. Allsop, of the Department, responded. "The Contractors' Association," was proposed by Mr. J. Dyson, and replied to by Mr. Tate.

The E.P.E.A. and the Strike.—On April 14th the E.P.E.A. issued to the Press the following announcement as to its position and intentions :—

In connection with the present crisis the Electrical Power Engineers' Association desires it to be made clear that it does not propose to withdraw its members. After a conference with the London District Committee of the Electrical Trades Union it has decided to issue the following instructions to its members :—

1. That members of the E.P.E.A. employed on railway or tramway systems will carry out their normal duties only, and not do the work of any employé on strike nor supervise or instruct any volunteer labour that is introduced.

2. That, in respect of the electricity supply stations, the members of the E.P.E.A. will maintain, supply and use every endeavour to prevent this industry being involved in the present dispute. Before any action is taken which is likely to affect the electricity supply industry, a conference of the Unions concerned is to be called.

To Confer with the Chancellor.—On Thursday the Chancellor of the Exchequer was to meet representatives of the Federation of British Industries and the Association of Chambers of Commerce in order to discuss the valuation of stocks and other questions arising out of the termination of E.P.D.

The Trade of Siam.—The Department of Overseas Trade has issued a report (H.M. Stationery Office, 1s. 3d.) on the commercial situation in Siam at the close of 1920. It has been prepared by Mr. T. H. Lyle, C.M.G., H.M. Consul-General at Bangkok. The situation of the import and export trade is reviewed, as are such matters as shipping, railways, aviation, and company developments. Importations of iron, steel, and machinery, which ceased entirely during the war, show encouraging signs of restoration.

In "metals of all kinds in the rough," there is a steady increase in the United Kingdom direct import, while Japan shows a marked movement in the reverse direction. The United Kingdom share in machine tools increased from a merely nominal sum to ticals 49,200 (£4,360), but failed to overtake the United States at ticals 73,728 (£6,536). For the year ended March, 1914, the United Kingdom provided 52,620 ticals' worth (£4,047) of machine tools out of a total import of ticals 59,918 (£4,609). In machine belting there was a general decline, though the United Kingdom still retained four-fifths of this business at ticals 247,588 (£21,949). Other branches of metal manufactures in which the United Kingdom proportion showed satisfactory increases were bars and sections, sheets and plates, galvanised sheets (from nil to ticals 410,363, or £39,039), wire and manufactures thereof, screws and rivets, cutlery and tools, and railroad material. In most of the items herein enumerated, corresponding decreases occurred in the shares of Japan and the United States, save that Japan, with 142,285 kg. valued at ticals 210,216 (£18,639) doubled her quantity of enamelled goods as compared with the previous year, and the United States partook of the general increase in sheets and plates, screws and rivets, railroad material, and cutlery and tools.

There is a satisfactory increase to ticals 264,295 (£23,430) in the United Kingdom share of electrical goods and apparatus, apparently at the expense of Holland and Japan. In this branch, Sweden is this year amongst the prominent suppliers, with a total of ticals 266,291 (£23,607), due to the purchase in that country of a new turbine plant by a public utility company in Bangkok which is responsible for much of the electric lighting and tramway power of the port. The United States, with £41,175, is responsible for one-third of the total imports of electrical goods, an increase in value on last year's figures, though the actual quantity of goods supplied is reduced by 55,000 kg.

The reduction of telegraph rates between Siam and India and Burma commenced to take effect on August 1st, 1920. Previously the rate had been 75 cents per word to India and 65 cents to Burma. Henceforth the charge is to be 45 cents in the case of either India or Burma. The Siamese Ministry of Marine proposes to establish, by way of experiment, a wireless installation on the outer Red Lightship at the bar at the mouth of the Menam river to enable incoming ships to communicate with Bangkok, in conjunction with the naval wireless station. An attempt is also to be made to introduce night signalling from the same lightship to show ships entering or leaving what depth of water there is on the bar.

The Trade of Finland.—A report has been issued by the Department of Overseas Trade on the economic, financial, and industrial conditions of Finland. The pulp, timber, textile and other industries are reviewed. The total production of the engineering works in 1919 is put down at 236,349,600 Finnish marks; lighting and power transmission, 52,293,100 ditto; tools, 1,030,000 ditto. During 1920 Finnish industries did very well on the whole. The metal industry suffered much from the lack and high cost of raw materials, increased wages, and high price and scarcity of coal. Among other matters it is mentioned that a large water-power station is being built at Æsä, about 70 km. east of Bjorneberg. About 7,0 0 h.p. will be transmitted to the industrial establishments at Bjorneberg. The power station, which is being built by the Bjorneberg Power Co., with a capital of 2,000,000 Finnish marks, is expected to be ready in April, 1921. In the railway construction programme for 1921 there is a sum of 350,000 Finnish marks assigned for planning the complete electrification of the railways in Finland. The imports for the first nine months of 1920 included :—Electrical machinery, 773,842 kg., 15,470,680 Finnish marks; insulated wire, cables, &c., 370,042 kg., 6,447,377 marks; electric glow lamps 75,888 kg., 6,888,754 marks; steam engines, 168,931 kg., 1,505,640 marks; water turbines, 53,031 kg., 406,233 marks. The machinery, turbines, and appliances imported were received chiefly from Germany (78,793,021 Finnish marks), and from Sweden (53,245,352 Finnish marks); Denmark came next with 6,820,154 Finnish marks. Metals and metal-work entered chiefly from Germany, Sweden, Great Britain, U.S.A., and Denmark.

Reduction in S. African Railway Rates.—The South African Railways and Harbours Administration announces that, with effect from Monday, April 11th, a reduction of 1s. per 2,000 lb. has been made in the net railway rates to Union ports and Delagoa Bay on export coal shipped beyond South or South-West Africa, and coal used for bunkering ships carrying a full cargo of export coal beyond South or South-West Africa.

Wages in the Rubber Industry.—Flat Rate Cut Preferred.—Employees in the india-rubber manufacturing industry have proposed a decrease of payments by 10 per cent. all round. To discuss the question a conference between the Manufacturers' Association and the Amalgamated Society of India-rubber Cable and Asbestos Workers was held in Manchester. The workers' representatives pointed out that if a reduction was inevitable it should be of a uniform sum of money which all could afford. A fortnight's postponement was agreed to.—*Manchester Daily Dispatch*, April 12th.

Platinum Production in British Columbia.—The production of platinum, it is believed, will soon be greatly increased in British Columbia, investigations conducted during a number of years having disclosed the fact that the Fraser River and adjacent territory constitute one of the principal platinum deposits of the world. A plant is being erected, and it is expected reduction work will commence in the spring. It is believed that for 250 miles along the Fraser River and 150 miles on tributary streams 75 per cent. of the black sand deposits can be dredged, and concentrates to the extent of 8 to 40 lb. per cb. yard of earth obtained.—*Reuter's Trade Service* (Victoria, B.C.).

Neuhausen Aluminium Industry.—The report of the directors of the Aluminium Industrie A.G., of Neuhausen, refers to the obstacles experienced in obtaining raw materials in 1920. Although relief had been perceptible for so memonths past, the difficulties continued in consequence of economic measures in surrounding countries. The works in German Austria had again been set in operation. During the final months of 1920 the effects of the general business crisis were also felt by the company. A severe decline in prices had been produced through the stagnation in sales and the pressing offers made specially by the new works which were established during the war, and the price fall had not yet come to a standstill. Coming to consider the company's interests in France, the report states that the directors had succeeded in securing the removal of the sequestration of the works and in recovering the management, with the co-operation of French friends. An order had also been obtained for the removal of the wartime requisition of the works installations and of individual mines, and the directors hoped to secure the execution of this decision at an early date. Including the balance forward, the accounts show net profits of 7,629,000 fr., as compared with 8,821,000 fr. in 1919, and it is proposed to pay a dividend at the rate of 16 per cent. on share capital of 42,000,000 fr., as against 18 per cent. on the same amount of capital in 1919 and 20 per cent. in each of the four preceding years.

The Russian Electrical Industry.—The official Soviet gazette, *Prarda*, of Moscow, publishes some interesting figures regarding the electrotechnical industries in Russia. According to this journal, the Erikson works turned out 10,000 pieces of telegraph apparatus in 1916; at present it is turning out only 250. The Russian Siemens-Schuckert works formerly supplied machinery to the extent of 24,000 kW a year; at present it is scarcely 6,000 kW. The cable works formerly used about 250,000 Russian poods of copper per year; the present use is only about 25,000 poods. The Russian branch of Siemens & Halske formerly supplied 7,500 Morse instruments per year, while to-day the production has decreased to only 150 instruments. Measuring apparatus, radio-telegraphic apparatus and similar articles are not manufactured at all. The Soviet authorities are making great efforts to obtain the necessary workmen for the electrotechnical industries, for the telephone, as well as the telegraph, service is in a most deplorable condition. It is stated that the want of men is chiefly responsible for the conditions prevailing in the electrotechnical industries. In former times more than 30,000 hands were employed in these industries; to-day there are scarcely 6,000. Formerly nearly 70 per cent. of the workmen were skilled labourers; at present hardly 10 per cent. are skilled. The paper adds that in the district of Peterhof, where the large Putilow works are situated, the whole telegraph and telephone service is entirely out of order, and no communication is possible. On account of lack of material and skilled workmen no repair work can be undertaken.—*Electrical World.*

New York Electrical Show.—The New York Electrical Exposition will be held during the 10 days beginning September 28th. As in former years the show will display electrical equipment for the home, motor-driven machinery for industrial purposes, electrically-operated material-handling machinery and electric vehicles.—*Reuter's Trade Service.*

Lamp-bulb Makers' Propaganda.—Over 600 members of Parliament each recently received a mysterious little package which looked as though it might contain a belated Easter egg; in reality, each case contained a perfectly good electric lamp bulb made in England [not a complete lamp, but only the globe of fine glass], and they had been sent by the British Chemical Ware Manufacturers' Association by way of proof that English manufacturers and workmen were capable of producing that delicate glass work. The plea was for protection from the dumping of foreign bulbs at low prices made possible by the difference in money values in England and on the Continent. "This country uses up 1,000,000 electric lamps a week," said Mr. T. Lester Swain, the Secretary of the Association, to an *Evening News* representative. "Our factories, of which eight are still struggling on against the foreign competitor, can turn out, of course, not only the glass bulb, but the complete lamp. All the Government proposes to do is to put a 33⅓ per cent. duty on imported bulbs and lamps; but that, which is a provision of the Key Industries Bill, is not enough. If the English industry, which could give much more employment, is to be saved, we want prohibition of the foreign article, for a time at any rate, and now the manufacturers mean to take every means of reminding members of Parliament of what they regard as the Government's duty to an infant British industry."

For Sale.—Todmorden Corporation Electricity Department wants offers for surplus generating plant, including two Belliss & Morcom compound engines, generators, two Lancashire boilers, superheaters, shovel stokers, piping, &c. Winchester Corporation Electricity Department has for disposal one 225-kW d.c. Belliss-Mather & Platt generating set. See our advertisement pages to-day.

The Swedish Jungner Accumulator.—The report of the Svenska Ackumulator A. B. Jungner states that an increased turnover took place in 1920, notwithstanding the long strike at the beginning of the year. New markets for Nife accumulators had been found, among others, in connection with ship installations and wireless telegraphy, and the batteries were being increasingly used for electric transport arrangements, and train lighting, for which large orders were received. The company's English subsidiary had also worked successfully. Among others, contracts had been concluded for large annual deliveries of batteries for mining lamps. The Norwegian subsidiary had obtained orders for train lighting batteries for the Norwegian State Railways. The accounts show net profits and balance forward, amounting to 841,000 kr., and it is proposed to pay a dividend of 16 per cent. on the preference shares, and 8 per cent. on the ordinary shares, this result comparing with 18 per cent. and 10 per cent. respectively in 1919.

Census of Production Postponed.—In view of the urgent need for economy, the Government has decided not to proceed with the Census of Production, of which notice was given in the Order of the Board of Trade dated December 22nd, 1919. A census in 1923 in respect of the production during 1922 is in contemplation, and should this be decided upon, an Order under the Census of Production Acts will be laid before Parliament in the course of the current year.—*Board of Trade Journal.*

Inquiry.—A correspondent asks for the name and address of the manufacturers of "Litho Premier" non-shock switches.

LIGHTING AND POWER NOTES

Barnsley.—Proposed Mains Extensions.—The Electricity Committee has recommended the Corporation to seek sanction to a loan of £22,000 to defray the cost of mains extensions in the Huddersfield Road district.

Belfast.—Progress of Extensions.—At a meeting of the City Council, the Electricity Committee was criticised for accepting a tender, in connection with the new power station buildings, which was considerably in excess of other tenders. The chairman of the Committee explained that the action was taken on grounds of expediency and urgency, and the minutes were adopted. It was also stated that a 6,000-kW generator had been installed, and only half the necessary boiler power had been provided. It was explained that the installation of a 12,000-kW generator was being expedited, and that the course taken with regard to temporary boiler power was the most economical.

Blackburn.—Proposed Extension of Supply.—The Rural District Council has passed a resolution supporting the request of prospective users of electricity in its area. The Corporation proposes to obtain powers to extend its cable to various parts of the rural district to meet the demand.

Carlisle.—Loans.—The Town Council has received sanction to a loan of £5,300 for electric lighting work in connection with the housing scheme, and a loan of £9,705 for switchgear, water circulating system, &c., has been applied for. It is proposed to install temporarily a 3,000-kW turbo-alternator at an estimated cost of £40,000, pending extensions of the works on a new site.

Carmarthen.—Increased Charges Approved.—The Carmarthen Electric Light Co., having applied to the Town Council for higher public lighting rates, a sub-committee was appointed to inspect the company's accounts. This committee reported to the Council on April 12th that it had compared the average cost of production for the three years 1912-14 with the cost for the three years 1918-20, and found there was an increase of about 70 per cent. It therefore recommended the Council to grant the company an increase of 70 per cent. over the original contract; the recommendation was adopted.

Chester.—Important Scheme.—Mr. S. E. Britton, the electrical engineer of the Chester Corporation, has prepared a report on the scheme for the utilisation of H.M. Factory at Queensferry for the supply of electricity. The full rated capacity of the apparatus installed at Chester is 2,170 kW, which, with one set in reserve, is capable of meeting a demand of 1,890 kW, provided that the batteries are maintained in a condition which will produce their rated capacity. At present there are additional demands waiting for a supply amounting to 400 kW. There are three methods of providing additional capacity:—(1) To complete negotiations with the War Office for a supply from H.M. Factory at Queensferry, where there is installed plant capable of generating 5.500 kW; (2) to obtain temporary oil-driven plant and install it at different parts of the city where the demand for electricity is greatest; (3) to install additional plant at the New Crane Street works. The Chester Electricity Committee has recommended the City Council:—(1) To authorise the Committee to effect an agreement with the War Department for a supply of electricity in bulk from the factory; (2) that application be made to the Electricity Commissioners and the Ministry of Transport for the latter to install transformers at the factory, and to erect a transmission line from the factory to the New Crane Street Works at an estimated cost of £21,800; (3) that application be made to the Electricity Commissioners for sanction to borrow £24,500 for providing converting plant, sub-stations, and underground cables for the distribution of electricity in Chester; (4) that the Committee be authorised to (*a*) arrange terms and conditions with the Commissioners and the Ministry of Transport with regard to the provision and maintenance of the transformers and transmission line, and (*b*) to enter into contracts for purchasing the converting plant and cables, and for the erection of sub-stations and works. Another recommendation is to the effect that, in the event of the Ministry of Transport being unable to install the transformers and the transmission lines, application be made to borrow £21,800 for that purpose, and the Committee be authorised to enter into the necessary contracts.

Continental.—France.—A far-reaching scheme, destined to effect 20 Départements, including that of the Seine, and as a consequence, Paris itself, is that associated with the recent visit of the President of the Republic, accompanied by the Minister of Public Works, to the site of the projected barrage on the Rhone at Génissiat, for a 200,000-h.p. electrical installation. Soundings are taking place to ascertain if the subsoil possesses the necessary strength, &c., to bear the projected massive 120-metre high dam wall. Should the result be unsatisfactory, recourse will be had to another site, near Malpertius, where the outflow from Lake Leman passes.

The Société Force et Lumière des Pyrénées has been granted a concession for the distribution of electricity in 17 communes of the Upper Pyrénées.

Financial difficulties and the bad faith of Germany in the matter of reparation payments notwithstanding, the French Chamber, by a recent law, is doing its best to meet a pressing situation by authorising the erection by State departments of a high-pressure system of electricity supply in the devastated departments in the North and East of France. The law is applicable to the whole of France, but, for urgent reasons, its principles are to be first applied in the regions ravaged by the German invasion. Generating stations are to be set up at the most favourable spots—waterfalls, mines, ironworks, &c.; further, it is intended that all these stations shall be linked with one another, and with the various distribution centres, and that these works shall be carried out by the State or by private individuals, under the control of the State. The general scheme provides for a reduction of the number of generating stations, and an increase of their productivity. Each working company or group of *concessionnaires* will have to carry out the general plans on lines laid down by the Government, which will advance a part of the outlay whether for the repair of partly destroyed or newly erected stations and systems. The State undertakes to complete the new station of Hirson, partly built by the Germans. The transmission lines will run from Lille to Paris, and from near St. Dizier to Chambley in Lorraine, having a total length of about 1,500 km.

Ealing.—Disposal of Street Lamps.—The Town Council offers 22 arc lamp standards now in Uxbridge Road to any firm that will remove them and reinstate the pavement free of charge. The Council has also decided, with a view to economy, that street lamps shall not be lighted in Ealing, except in the main roads, during the summer months. About £650 will be saved.—*The Times.*

Edinburgh.—House Lighting.—The Housing Committee of the Corporation has decided to adopt electricity as the illuminant in the houses in course of erection at Willowbrae.

According to a statement made at a meeting of the electorate by the Convener of the Electricity Committee, the new electricity undertaking is expected to cost about £1,750,000.

Objection has been made to the supply of electricity for lighting and gas for cooking for the houses being erected by the Corporation, on the ground of the cost of installing both services. It has been found impracticable to light low-ceiling houses with gas. The question of the double service has arisen all over the country. Under the statutes, neither the gas nor the electricity department is under obligation to lay mains, and this is being pointed out to the Ministry of Health.

Glasgow.—New Sub-Stations.—At a meeting of a special Sub-Committee of the Electricity Committee the manager reported that the property in Elliott Street for a sub-station could be acquired for £12,000, and that the estimated cost of erecting a new sub-station on the ground in Lancefield Street was £21,500, that the additional cost of laying cables to the site would be £5,000, and that, after making allowance for the cost of alterations and improvements on the property in Elliott Street, there would be a saving of £7,000. The special Sub-Committee, after carefully considering the proposed purchase, agreed to recommend that an offer of £12,000 be made for the property.

Hove.—Loan.—The Electricity Commissioners having intimated that they are prepared to approve a loan of £7,600 for the provision of h.p. mains between the North Road sub-station of the Brighton Corporation and the Hove station in Davigdor, formal sanction is being sought to the borrowing of this amount.

India.—Resistance to Reservoir Scheme.—In connection with the new Tata hydro-electric scheme near Poona, which includes the construction of a great reservoir for the supply of water power, there has been a strong movement of protest on the part of the inhabitants of the area which is to be submerged, and who will thus have to remove from their villages and farms. They are now offering passive resistance to the progress of the operations by lying on the ground where the labourers are working, with the result that constructional work has practically been brought to a standstill.—*Reuter* (Bombay).

Liverpool. — Economy Measures. — On April 15th severe restrictions upon the use of electricity were put into force. Its use in kinemas and other places of amusement is confined to the hours from 6.30 to 10.30 p.m. Electricity for power purposes must only be used from 10 a.m. to 4 p.m., and from 10 p.m. to 6 a.m. The tramway services are only run from 7 to 10 a.m., from noon to 2 p.m., and from 4 to 11 p.m.

London.—St. Marylebone.—The Electric Supply Committee has decided to postpone the proposed transfer of the eastern district sub-station from Rathbone Place to a position nearer the centre of the load. Protective devices for two e.h.p. cables are to be installed at the existing sub-station at a cost of £81.

Luddendenfoot.—House Lighting.—The District Council has considered terms proposed by the Sowerby Bridge District Council for a supply of gas for houses of the Warley Wood scheme, and as a result has decided that an estimate of the cost of electricity in place of gas be prepared. It was resolved also that when the Housing Commission approved the substitution of electricity for gas, application should be made to the Yorkshire Electric Power Co. to supply electricity for light and power at £3 per house, plus 2d. per unit, for the 20 houses on the site until the Electrical Distribution of Yorkshire, Ltd., could supply on general supply terms. The Council decided to support the application of the Electrical Distribution of Yorkshire, Ltd., for an order to supply the Luddendenfoot area.

Midlands.—Electricity Supply.—At a meeting at Birmingham on April 14th of the Standing Committee of the District Joint Industrial Council for the Electricity Supply Industry, representative of the employers and employés of various undertakings throughout Warwickshire, Staffordshire, Worcestershire, and Shropshire, it was made quite clear that the constituent parties would be called together before the electricity undertakings in the area would be affected by the action of the Triple Alliance.—*Morning Post.*

Monaghan.—Electric Light Scheme Abandoned.—At the recent monthly meeting of the Urban District Council various estimates of the cost of the proposed electric lighting scheme were considered. It was stated that the expenditure would involve the imposition of a rate of 10d. in the £, and it was decided, therefore, to take no further action in the matter.

Newark.—Opposition to Scheme.—Arising out of the Corporation's proposal to proceed with an electricity scheme at an estimated cost of £200,000, a number of firms, which hold that the present is an inopportune time for any avoidable expenditure, have intimated their refusal to take supplies on the terms quoted.

New Zealand.—Lake Coleridge.—Referring to the diversion of the Harper River to augment the volume of water in Lake Coleridge, the Minister for Public Works recently stated in Christchurch that the work was being pushed on with all haste. The present intake at Lake Coleridge took in 110 cb. ft. per second, which was too heavy a drain on the resources of the lake in its present state. It was expected that the Harper diversion would be so far completed within a month as to allow the water to enter the lake. The extra volume of water thus obtained would be sufficient to deal with all immediate requirements made by the electrical system, and would also be instrumental in bringing the lake back to its original level. There would be sufficient water to meet the demand to be made in connection with the installation of the new plant, through which another 4,000 h.p. would be ready to supply to consumers by June. With a regular supply of water by the diversion, said the Minister, he was assured by the engineers that no further diversions would be necessary even when the system was developed to its ultimate capacity of 40,000 h.p.—*Auckland Weekly News.*

Rochester.—Grant to Company.—The Town Council has decided to pay the sum of £400 to the Kent Electric Power Co. in respect of its contract for installing electric lighting in High Street. The contract price was £570, but owing to the war the actual cost was £1,223, and the £400 granted is in respect of the loss of £653 on the work.

Rotherham.—Opposition to Order.—At a meeting of the Electricity Committee, the Town Clerk reported that the Electrical Distribution of Yorkshire, Ltd., had made application to the Electricity Commission under the Electricity (Supply) Acts, 1882 to 1919, for a special order empowering it to supply electricity in, amongst other areas, the Rotherham and Wortley Rural Districts. The Committee recommended that the Town Clerk be instructed to take the necessary steps to oppose, on behalf of the Corporation, the application made for this order.

Runcorn.—Progress of New Station.—The Mersey Power Co. has made substantial progress with its new power station at Percival Lane, Runcorn, and it is expected that the energy will be available in August next. It is further hoped that the transmission cables to Ellesmere Port will be completed, and power supplied there in June. The higher costs involved by the past delays and the large extensions required to meet the growing demands will, it is stated, necessitate the raising of more capital by the company in the near future.

South Molton.—Proposed Water-power Plant.—The Town Council, on April 12th, discussed the possibility of utilising water-power for generating electricity. Mr. Stewart, electrical engineer, of Barnstaple, said that the water at the Collar Factory would be sufficient for the greater part of the year, if it were used only for lighting the town; it would not be sufficient for the town and the factory.

Stretford.—Cost of Extensions.—At a meeting of the Electricity Committee, the clerk and consulting engineer reported upon an interview with the Electricity Commissioners relative to the Council's application for sanction to electrical extensions. Consequent upon the modifications which had been made in the estimated expenditure on new works, the approximate cost of the proposed extensions had been reduced to £157,000, details of which were explained by the consulting engineer.

Sunderland.—Loan.—The Town Council is applying to the Electricity Commissioners for sanction to borrow £20,000 for mains work. It is intended to expend at present £15,928 on a low-pressure network.

Uruguay.—Water Power.—The idea of utilising the Salto Grande waterfall for the generation of electrical power has been revived recently. It is estimated by technical experts that the power obtainable from this source would benefit more than half of the Republic.—*Review of the River Plate.*

Winchester.—Loans.—The Town Council has applied for the following loans:—Feeder and distribution cables, £3,500; 450 kW turbo-generating set, £11,000: "Olipel" remote control gear and switches for street lighting, £1,200; mains and services, £3,000; meters, £2,500.

Woodstock.—New Works.—The Electric Light Co. has commenced the establishment of works at Hoggrove Hill, and it is hoped to have a supply of electricity available by October.

Worthing.—Report Required.—The Electricity Committee has asked the electrical engineer to report the capacity of, and the probable additional demands upon, the generating plant at the electricity works, and the desirability of installing new plant to meet the requirements of the undertaking in the future.

Wrexham.—Colliery Plant Destroyed.—Damage estimated at £30,000 was caused by fire on the 18th inst. at Plas Power Colliery, near Wrexham, one of the largest in the North Wales coalfields. The outbreak occurred in the power station, and the whole building and its contents were destroyed. This power station feeds two other collieries, and it will be several months before the three collieries can be got ready for work again. The outbreak is said to have been caused by a workman dropping a lighted match into the well of the fly-wheel.—*The Times.*

TRAMWAY AND RAILWAY NOTES.

Carlisle.—Proposed Postponement of Track Removal.—At a meeting of the Highways Committee it was reported that the Carlisle Electric Tramways Co. had written suggesting the postponement of the removal of the double track over Eden Bridge from its present position to the centre of the roadway, owing to the excessive cost of labour and materials, and in view of the coming decline. The Committee resolved that a reply should be sent requesting the company to commence the work not later than June next, on the assumption that it will be completed within three months from the date of commencement.

Continental.—Italy.—The Italian Government has perfected plans for the electrification of 4,000 miles of the State Railways and certain of the privately-owned systems. The project will involve the outlay of 800,000,000 lire (nominally £32,000,000), and the time required to complete the undertaking is estimated at 10 years. The construction will be taken in hand partly by the State Railway Administration, and partly by private firms under the immediate direction and supervision of the Ministry of Transportation.

Before the whole plan could be adopted, many difficult technical questions had to be decided, and some variation of the accepted project may yet have to be considered. The first work will be the extension of the three-phase 16-cycle system now in use on the lines already electrified.

Electric traction is giving results so satisfactory, particularly in the case of lines crossing the mountains, that the State Railways have trebled their traffic.

Owing to the wide variation in the voltage and frequency of the electricity produced in Italy, 46 per cent. of which is 42 cycles, and 41 per cent. 50 cycles, the State Railways, up to the present, have required the construction of special power plant to supply 16-cycle power. In connection with the plans now adopted this policy will be discontinued, and provision made for the conversion of the available power to the required type. The present type of electric locomotive not being deemed entirely suitable for the purpose, special designs are being prepared for locomotives adapted to the two new systems with which experiments will be conducted. Already standard types of overhead equipment have been established, and it is intended to place all orders for such manufactures with Italian firms wherever possible. Many firms which mean to tender have already extended their plant with a view to increasing their productive capacity.

The consulting engineers of the State Railways are of opinion that, for the most part, the power required can be provided by the power plants already in existence or now in course of construction. It will be necessary to erect a few powerful hydro-electric stations and their construction will be undertaken by the State in certain localities in order to fill in gaps in the existing system, and to provide a suitable reserve. Competitive bids will shortly be invited from private firms for other lines, in order that the maximum amount of progress may be made. The object of the Ministry of Public Works is to amalgamate the interests of the State-owned and privately-owned lines, so that a minimum electrification of 500 km. of the lines in the kingdom shall be completed each year.—*Reuter's Trade Service* (Milan).

France.—The Municipal Council of Paris has ratified the proposals of its Commission for the deferred taking over of the Compagnie du Métropolitain Railway. By the new arrangement the company becomes a simple manager, interested, however, to a certain extent in the good results of the working, and the city undertakes the completion of the network and the payment of its bonds. The company is assured a net return of 11,500,000 fr. per year at the lowest, rising to upwards of 14,000,000 or 15,000,000 fr., according to the forecasts of the traffic and of the lowering of the cost of coal. A sum of 26,000,000 fr. has been disbursed by the city to the company in settlement of the charges of the war.

Darlington.—Deficit.—Sir Charles Starmer reported on April 7th that the tramways revenue during the past 12 months showed an increase of £5,542, while the actual loss had been £3,156, as against an estimated loss of £2,000. The difference between the amounts was largely accounted for by extra track repairs costing £500, and a loss of £500 revenue, mainly due to unemployment. Unless something unforeseen occurred, he had every reason to hope that during the ensuing year the income would balance the expenditure.

Durham.—County Council's Bill Rejected.—On April 14th the Bill in which the Durham County Council seeks powers to construct tramways, &c., was considered by the House of Commons. The opposition to the measure was so strong that the usual practice followed in the case of private Bills, *i.e.*, a second reading and consideration by a Committee, was abandoned, and the matter was put to the vote. The motion for a second reading was rejected by a large majority.

Glasgow.—Relief of Traffic Congestion.—In a report recently presented to the Corporation, the general manager of the tramway undertaking (Mr. James Dalrymple) considers several proposals for relieving the present traffic congestion of the city. Overhead systems, such as those employed in the United States, are dismissed as too noisy and unsightly. The underground system is considered in a favourable light, but the employment of motor omnibuses on routes already served by tramcars is not thought suitable. The construction of an additional bridge and the carrying out of tramway schemes already sanctioned are recommended.

Keighley.—Increased Receipts.—A report of the general manager for the year ended March 31st last shows that the number of passengers carried on the tramways increased by 262,459, and the receipts by £1,232. On the trackless system the receipts rose by £1,027, and the number of passengers by 50,097.

Leeds.—Extension of Time.—The Ministry of Transport has extended the time of the Leeds Corporation Act, 1914, for the completion of the tramway, until August, 1922.

London.—Automatic Ticket Machines.—The Underground Co. has installed, as an experiment, an automatic ticket-delivering machine at the Leicester Square station. By means of this device, the issuing of tickets is expedited to a very large extent, and it is probable that the machine will be applied to other busy stations.

L.C.C. Tramways Deficit.—It is stated in a report presented to the London County Council by the Highways Committee that the approximate aggregate expenditure on the Council's tramways for the 12 months from April 1st, 1920, to March 31st, 1921, was £5,464,339, while the aggregate traffic receipts during the same period were only £4,794,567, leaving an approximate deficit during the 12 months of £669,682. After taking into account receipts from other sources, such as advertisements, rents of lines worked under agreements, &c., it is anticipated that this deficit will be reduced to about £540,484.—*Morning Post.*

Track Renewals.—A portion of the Edgware Road tramway track at Hendon is to be reconstructed at a cost of £137,000.—*Evening News.*

Northumberland.—Motor 'Buses.—The Tyneside Tramways and Tramroads Co. has applied to the Minister of Transport for consent to the running of omnibuses in the County of Northumberland in extension of or in connection with the company's tramways.

Newcastle-on-Tyne.—Motor 'Buses.—The Corporation has applied to the Minister of Transport for consent to the running of motor-omnibuses along certain routes outside the City and County of Newcastle-on-Tyne.

Sunderland.—Improvements Deferred.—On account of the industrial disquietude, the Town Council has deferred a scheme to widen and improve Ryhope Road between Langham Tower and Villette Road, at a cost of £52,500, to which the Government was to contribute £15,975 and the tramway undertaking over £12,000.

St. Helens.—Track Renewals.—The Tramways Committee has decided, with the approval of the Town Council, to carry out the work of relaying 2 miles of the St. Helens junction tramway track by contract or direct labour, and instructions have been given to the borough engineer to obtain alternative tenders for carrying out the work :—(*a*) By taking on a proportion of the unemployed men from the labour exchange in accordance with the conditions laid down by the Unemployment Grants Committee ; (*b*) Without any restrictions as to taking on unemployed men.

TELEGRAPH AND TELEPHONE NOTES.

U.S.A.—Pocket Wireless Apparatus.—Every policeman in Chicago is to be equipped with wireless telephone apparatus so small and light that it can be carried concealed in the tunic, says *The Times*. By means of it the officer will be able to communicate direct with police stations, fire-patrol boats, and fire stations.

Cable Laying by Aeroplane.—A 6-mile stretch of land telegraph cable was laid and put into service in eight minutes by an aeroplane that came from its station 40 miles away in Sweden recently. Of the eight minutes, six were spent in flight and the other two in making connections. Great possibilities, both military and commercial, are seen by air service officers in this new enterprise. Equipment of planes for cable laying is simple and inexpensive. The cable is unreeled from the machine in flight with a flag marker at the end to guide signalmen on the ground to it. When over the point at the other end of the stretch of ground to be covered, the wire is cut from the reel and the free end weighted, marked, and dropped. The men below merely have to pick it up and connect it to begin talking with the forces at the other end.—*T. & T. Age.*

Holland.—New Telephone Cable.—It is hoped to lay, in the near future, a telephone cable between England and Holland.

Wireless Telephony.—An arrangement was recently come to between the Nederlandsche Seintoestellen Fabriek, a Dutch wireless company in which the Marconi Co. has a considerable interest, by which, over an experimental period of three months, Stock Exchange prices were reported by wireless telephony to a large number of banks throughout Holland. The experiment ended a few days ago, after having proved completely successful. The British and Dutch Governments have granted a licence to the Marconi Co. to experiment with wireless telephony between the two countries. A station for the purpose has been erected in this country, but the station on the Dutch side is not yet constructed. The Marconi Co. is also constructing experimental wireless telephone stations to operate between London and Birmingham, and believes that communication can be rendered free from interruption and "tapping," and that the ordinary apparatus used by every telephone subscriber will be able to be utilised to communicate with the local wireless telephone stations, and that connection for the long-distance wireless telephone messages may be thus obtained.—*The Times.*

Jersey.—Wireless Communication. — Strong representations, says the *Daily Telegraph*, are being made to the proper quarter with a view to a wireless station being established in Jersey. The station has been dismantled, and at present the island is cut off from the outer world when the General Post Office is closed.

Press Cable Rates to Canada.—The *Empire Press Union Circular* announces that the Newspaper Proprietors' Association and the Newspaper Society have been invited to participate with the Union in a deputation to Mr. Winston Churchill on the subject of Press cable rates to Canada. According to *The Times*, at the present time a great deal of the cabled news from England reaches the Canadian Press *via* the United States, owing to the low charges of American news syndicates. The deputation will seek to obtain as a remedy for the present situation lower Press rates and a better service between England and Canada.

The Telephone Service.—During the Bedford by-election activity in the rural area of the constituency, the villagers seized the opportunity of the Postmaster-General's visit to press upon him the necessity for extending telephone facilities in rural areas by making village telegraph offices and telephone call offices as well. Mr. Kellaway said that he had no idea that the desire for these facilities was so keen. He undertook, if he was returned, to give immediate attention to the subject of village telephones, and if it could be shown to be economically possible, he would introduce them. Mr. Kellaway declared that the Post Office must be made self-supporting.

Mr. Pike Pease, Assistant Postmaster-General, in answer to a question in Parliament, said, on Tuesday, that satisfactory speech was obtained with Berlin (over 800 miles) before the war in the course of experiments. The most distant point with which communication was now obtainable was Marseilles (720 miles). Regular connection could be obtained by London telephone subscribers with Paris and Brussels, and when sufficient land-lines were available in France a similar service would be available with Switzerland.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Argentina.—June 13th. The Department of Overseas Trade has been informed by telegram that the Department of Sanitary Works is calling for tenders for the supply and erection of electric-power batteries and lighting plant at Mar del Plata. Local represention is essential. When a copy of the specification is received by the Department of Overseas Trade it will be made available for consultation.

Australia.—Melbourne.—Postmaster-General's Department. May 31st. Telephone switchboards (Schedule No. 1,670).*

Postmaster-General's Department, May 31st. Supply and delivery to several States of manual telegraph transmitting devices (Schedule No. 1,680). (April 8th.)

May 31st. P.M.G. 29,500 porous cells, No. 1 size to specification (Schedule No. 1,685) ; 20½ tons ammonium chloride (Schedule No. 1,683).*

May 31st. Victorian Electricity Commissioners. Morwell power scheme : Street poles (Specification No. 47) ; copper cable (Specification No. 66). (April 15th.)

June 15th. Victorian Government Railways. 50 oil-immersed single-phase track and signal transformers for power signalling (Contract No. 33,901). Tenders to Victorian Railway Commissioners, Spencer Street, Melbourne, accompanied by a preliminary deposit of ½ per cent. of the total amount of the offer. Local representation is essential. Specification may be consulted by British firms at the Department of Overseas Trade in London (Room 59).

June 22nd. One electric lifting magnet (capacity ½ ton), one 440-V motor generator.

June 29th. Supply of 1-ton platform type industrial storage battery trucks, also battery charging equipment.—*Reuter's Trade Service* (Melbourne).

August 10th. 250 core-type impedance bonds for power signalling, with a capacity of 1,000 amperes per rail ; also 50 miles of solid insulated copper wire, No. 14, Brown & Sharpe gauge, and 50 miles of solid insulated copper wire, 16 standard gauge.

August 17th. 3,000 sets of renewals for caustic soda primary cells.—*Reuter's Trade Service* (Melbourne).

August 30th. Board of Works. Four electrical centrifugal pumps, each with a capacity of twelve milion gallons daily.—*Reuter's Trade Service* (Melbourne).

Perth.—May 25th. Postmaster-General's Department. Ironwork, as per Schedule 704. (See this issue.)

Belgium. — May 27th. The Service d'Etudes et de Controle des Applications de l'Electricité, 52, Boulevard du Regent, Brussels. For the supply and installation of ten electrically-operated capstans in connection with the locks on the Upper Scheldt.

April 28th. Municipal authorities of Saint-Gilles-lez-Bruxelles. Cooling plant for the electricity generating station. Specification from the Service de l'Electricité, R 40, Rue de Bethléem, Saint-Gilles, near Brussels. Tenders to the College Communale.

Brussels.—May 11th. Belgian Post and Telegraph authorities at La Salle de la Madeleine, Brussels. Supply of a quantity of telegraphic and telephonic apparatus, including 600 Morse manipulators and 250 milli-amperemeters.

Buenos Aires.—June 3rd. Board of Sanitary Works. Supply and erection of the plant and accessories for a new generating station, previous tenders having been called for in 1919 and 1920. The plant comprises three four-cycle Diesel engines of 375-h.p., and adapted to run on crude petroleum from Comodoro Rivadavia, and three three-phase alternators, each of 250-kW, 2,200 volts between phases, 50 cycles and a power factor of ·8.*

Farnworth.—April 28th. Electric wiring of 20 houses, for Urban District Council. Specifications, &c., from Mr. W. J. Lomax, 11, Fold Street, Bolton. Deposit, £2 2s. (returnable).

Fiji Islands.—The municipality of Suva invites tenders, closing June 30th, for the supply and erection of a 200-kW, 480/520-V, three-wire, d.c. generator, directly coupled to a 300-h.p. vertical Diesel oil engine, together with accessories for generator and panel.—*Reuter's Trade Service* (Melbourne).

Ipswich.—Electricity Supply Department. One 500-kW rotary converter or motor converter. (April 15th.)

Jugo-Slavia.—May 1st. The Serb, Croat, and Slovene Ministry of Public Works. Erection of a power-station, main conductors and transforming stations in connection with an electrical scheme at Kostolac for the supply of energy to Belgrade, Semlin, &c.*

Commercial Secretary to H.M. Legation at Belgrade has received an inquiry from a local contractor in regard to plant, &c., required for the electric lighting of a town in Serbia. The inquirer wants offers from United Kingdom firms for two

40-kW dynamos and 50 km. of overhead cable, &c., for the supply of current to about 1.200 houses. The Serb-Croat-Slovene State is one of the countries to which the Export Credit Scheme applies. The name and address of the inquirer may be obtained on application to the Department of Overseas Trade in London.

Kearsley.—April 23rd. Electric wiring of 20 houses, for Urban District Council. Specification, &c., from Mr. W. J. Lomax, 11, Fold Street, Bolton. Deposit, £2 2s. (returnable).

London.—Fulham.—May 4th. Electricity Department. Two Green economisers or other approved make of 400 and 440-tube capacity respectively. (See this issue.)

Manchester.—May 2nd. Electricity Committee. Three steam turbine-driven boiler feed pumps. (April 15th.)

New Zealand.—June 28th. Public Works Department. Ten s.p. oil-filled transformers for the conversion of three-phase current at 50 cycles, the voltage ratio being 50,000/11,000, for Waikato power scheme. Tenders must be accompanied by a deposit of £100, and sent to the Secretary, Public Works, Tenders Board, Government Buildings, Wellington. Specifications may be seen at the Department of Overseas Trade, 35, Old Queen Street (Room 59), Westminster, S.W.1.

June 28th. Supply and delivery at Lyttelton of two 50-kVA, two 100-kVA and two 200-kVA condensers in connection with the Lake Coleridge electric power supply (Section 116). Tenders to Secretary, Public Works Tender Board, Government Buildings, Wellington. Deposit, £50. Specifications, &c., may be seen at the Department of Overseas Trade (Room 59) in London.

South Africa.—Pretoria.—May 10th. Municipality. Switchgear. Tenders, marked "Electric Light and Power Department, 1920 Extensions, Contract No. 5," to Deputy Town Clerk, Municipal Offices, Pretoria. Deposit, five guineas. Further particulars may be obtained from the general manager of the Electric Light and Power Department, or from the consulting engineer, Mr. G. M. Clark, 40-42, Meischkel's Buildings, Johannesburg.

St. Anne's-on-Sea. — Electricity Department. One natural draught cooling tower. (April 15th.)

St. Helens.—May 1st. Electricity Department. One d.c., 3-wire, distributing switchboard, complete with supporting steelwork. (April 8th.)

Swinton.—April 30th. Electric wiring of 30 houses on Temple Lodge estate, Manchester Road, for Swinton and Pendlebury Urban District Council. Specifications from J. Knight, architect, Haworth's Buildings, 5, Cross Street, Manchester.

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Aberdare.—At last week's meeting of the District Council it was reported that three tenders had been received for service cable, one from a Danish firm, for £151, one from a German house for £179, and another for £281 from an English manufacturer. One member moved that the Danish tender be accepted, and Mr. E. Stonelake, in seconding, said they should have no qualms of conscience in accepting the lowest tender owing to the "ring" among English manufacturers. Another member suggested putting off the work for a month in order to see whether a fall in prices occurred which would allow them to place the order with the English firm; but the Electricity Manager (Mr. Abraham) said a postponement of the order might interfere with the connections owing to a shortage of cable. An amendment for the postponement of the order was defeated, and the Council decided to accept the Danish tender.

Australia. — Melbourne. — The Victorian Railways Department has rejected the tenders received for the supply of an electrical furnace at the Newport workshops, owing to falling prices. The department will shortly again invite tenders, closing in September. The cost is now estimated at £50,000. Particulars can be obtained from the Agent-General.—*Reuter's Trade Service* (Melbourne).

Bradford.—At a meeting of the City Council, Alderman M. Conway moved the reference back to the Tramways Committee of a minute in respect of the placing of a contract with the Anglo-Belgian Improvements Corporation, Ltd., for a hundred steel tramway tires. Alderman E. Priestley (Chairman of the Tramways Committee) replied that the Belgian quotation was nearly 50 per cent. below that of any English tender, and the Committee had decided, upon reconsideration, to let the tender to the Belgian undertaking. Alderman Conway contended that this was a matter on which further information ought to be given and fresh tenders ought to have been invited. The amendment referring the minute back was carried.

Edinburgh.—Corporation. Accepted:—

Electrical fittings for the Corporation houses at Abercorn, £2,406.—Cole & Co.

London. — L.C.C. Stores and Contracts Committee. Tenders accepted during the three months ended March 31st, 1921:—

Electric traction lamps for the Tramways Department (Schedule No. 17a). 14 firms invited to tender.

British Union Lamp Works (estimated value, £366).
English Electric and Siemens Supplies, Ltd. (estimated value, £8,505).
Stella Lamp Co., Ltd. (estimated value, £432).

Highways Committee. L.p. cables in connection with the construction and reconstruction of the tramways from West India Docks to Mare Street:—

Western Electric Co., Ltd.	**£3,767**
W. T. Henley's Telegraph Works Co., Ltd.	3,888
Johnson & Phillips, Ltd.	3,920
Callender's Cable & Construction Co., Ltd.	3,9 8
Siemens Bros. & Co., Ltd.	3,947
British Insulated & Helsby Cables, Ltd.	3,975
Union Cable Co., Ltd.	4,011
W. T. Glover & Co., Ltd.	4,035

Hammersmith. — Borough Council. Electricity Committee. Recommended:—

Push-plate overhead coal conveyor, £1,679.—W. & D. Conveyor Engineering Co., Ltd.
Electric crane, £2,100.—New Conveyor Co., Ltd.
5,000 yd. 8-core e.h p. cable, £4,458; 500 yd. 6-core do., £256.—Western Electric Co., Ltd.
2½-in. centrifugal oil pump, £50.—Gwynne's Engineering Co., Ltd.
24 new cells fo the storage battery, £451; removing 91 cells to the new position, £180; 91 extra glass boxes for the existing cells, £153.—Premier Accumulator Co, Ltd.
Two auto-transformers in connection with the linking-up scheme, £650.—Hackbridge Electric Construction Co., Ltd.
Mechanical soot-blower, £210.—Diamond Blower Co., Ltd.
410 yd. single-way conduit in connection with the extension of the main from Church Wharf, Chiswick, to the Chiswick E.S. Corporation's generating station, £86.—Sankey & Co., Ltd.

Sunderland.—Corporation. Accepted:—

Pirelli-General Cable Works, Ltd.—Armoured low-pressure feeder cable, unarmoured low-pressure feeder cable, twin unarmoured low-pressure network cable.
General Electric Co.—Two low-pressure feeder panels.
British Insd. & Helsby Cables, Ltd.—Two-feeder pillars.
Doulton & Co., Ltd.—Stoneware ducts.
Ferranti, Ltd.—54 d.c. meters, 250 a.c. meters.
C. H. Johnson & Sons, Ltd.—Band conveyor.
Babcock & Wilcox.—Parts for coal conveyor.
A.E.G. Co.—Nozzle plate for turbine.

FORTHCOMING EVENTS.

Edinburgh Electrical Society.—Friday, April 22nd. At the Philosophical Institute. At 8 p.m. Open night.

Physical Society of London.—Friday, April 22nd At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary meeting.

Royal Institution of Great Britain.—Friday, April 22nd. At Albemarle Street, W. At 9 p.m. Lecture on "Electro-Synthesis in Organic Chemistry," by Sir James Walker, F.R.S.

Thursday, April 28th. At Albemarle Street, W. At 3 p.m. Lecture on "Nationalisation and Bureaucracy," by Mr. H. S. Foxwell.

Technical Inspection Association.—Friday, April 22nd. At the Royal Society of Arts, John Street, Adelphi, W.C. At 7.30 p.m. Lecture on "The Physical Properties of Clay," by Mr. A. S. E. Ackerman.

Electrical Power Engineers' Association.—Lectures on "The Work, Aims and Scope of Association," will be given at Sheffield (the Royal Victoria Station Hotel), on April 23rd, at 7 p.m.; at Middlesbrough (Literary and Philosophic Institute), on April 28th, at 7 p.m.; and on Saturday, May 7th, at Maidstone.

Electrical Trades Benevolent Institution.—Monday, April 25th. At the Offices of the Cable Makers' Association, Sardinia House, Sardinia Street, W.C.2. At 2.30 p.m. Annual general meeting.

Illuminating Engineering Society.—Tuesday, April 26th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Discussion on "Ship-Lighting, in relation to Comfort, Safety and Efficiency." To be opened by Mr. W. J. Jones.

Institute of Physics.—Wednesday, April 27th.—At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Public inaugural meeting. Address by Sir J. J. Thomson, O.M.

Institution of Railway Signal Engineers (Incorp.).—Wednesday, April 27th. At the Midland Grand Hotel, St. Pancras. At 6 p.m. Paper on "Magnetic Storms: Their Effects upon Railway Signal and Telegraph Apparatus," by Mr. W. J. Thorrowgood.

Manchester Wireless Society.—Wednesday, April 27th. At the Albion Hotel, Piccadilly. At 7.30 p.m. Ordinary general meeting.

Institution of Electrical Engineers.—Thursday, April 28th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Discussion on "Tariffs." Papers on "Electricity Supply—Present Conditions and the Hopkinson Principles," by Mr. J. R. Blaikie; and on "Multi-part Tariffs for Domestic Electricity Supply," by Mr J. W. Beauchamp.

Informal Meeting.—Monday, April 25th. At the Institute of Patent Agents, Staple Inn Buildings. At 7 p.m. Discussion on "Engineering in Russia." To be opened by Mr. C. L. Lipman.

Students' Section.—Friday, April 22nd. At Finsbury Technical College, Leonard Street, E.C. At 6.30 p.m. Paper on "Searchlights as used for Coast Defence," by Mr. R. C. Hawkins.

Friday, April 29th. At the City and Guilds Engineering College, South Kensington. At 6.30 p.m. Annual general meeting. Paper on "Radio-Telegraphic Transmitting Apparatus," by Mr. A. C. Warren.

Liverpool Sub-Centre. — Monday, April 25th. At the Liverpool University. At 7 p.m. Annual general meeting and smoking concert.

North-Eastern Centre.—Monday, April 25th. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Ordinary meeting.

North-Midland Centre.—Tuesday, April 26th. At the Hotel Metropole, Leeds. At 7 p.m. Annual general meeting.

South-Midland Centre. — Wednesday, April 27th. At the University, Birmingham. At 7 p.m. Annual general meeting Paper on "Magnetos for Ignition Purposes in Internal-Combustion Engines," by Mr. E. A. Watson.

Scottish Centre.—Friday, April 29th. At Dundee. Ordinary meeting.

Junior Institution of Engineers.—Friday, April 29th. At Caxton Hall, Westminster, S.W. At 8 p.m. Lecturette, "Rambling Remarks on Expert Evidence," by Mr. W. A. Tookey.

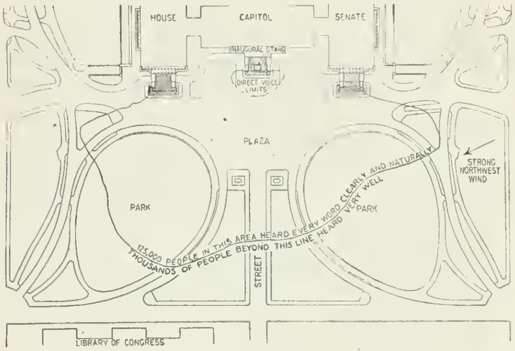
NOTES.

Patent Office Appointments.—The Civil Service Commissioners announce that an open competitive examination for not fewer than 20 situations as assistant examiner in the Patent Office, Department of the Board of Trade, will be held in London in July next, commencing on the 12th of that month. Limits of age: 20 and 25, with extension for service in H.M. Forces. Regulations and forms of application will be sent in response to requests by letter addressed to the Secretary, Civil Service Commission, Burlington Gardens, London, W. 1, on and after April 25th.

The Second Simplon Tunnel.—By the end of March, 10,369 metres on the southern, and 9,072 metres on the northern side of the second Simplon tunnel had been bored; this is 98·1 per cent. of the total length. It is now 10 years since it was decided to bore a second Simplon tunnel, and the work was undertaken by Switzerland in the following year. The first tunnel was begun in 1898, and opened for traffic in 1906.—*The Times.*

Radium in Bulk!—*The Times* states that President and Mrs. Harding will receive Mme. Curie in the White House on May 20th and present her with a gramme of radium value at $100,000 on behalf of American women.

An Audience of 250,000.—*The Transmitter*, which is the house organ of the Chesapeake and Potomac Telephone Co. and associated companies, recently gave a graphic description of the scenes at the Presidential installation at Washington on March 4th. By means of the Bell loud-speaking system a vast assembly of people, estimated at 250,000, was able to listen to the inaugural speech of Mr. Harding, and it is stated that fully 125,000 could hear every word distinctly. The great "Plaza" which the Capitol faces was crowded to its limits, the participants in the ceremonies being grouped upon a specially erected stand in the roof of which horns were fitted in concealed positions. The whole of the electrical equipment of the system was placed under the steps of the Capitol; transmitters on the stand picked up the tones of the speaker, and the vibrations set up were transmitted to the control-room, where eight successive stages of vacuum tube amplifiers magnified the energy, and the amplified vibrations were sent out in voice form from the trumpets at the top of the stand. The adjustment of these horns to secure uniform distribution occupied a great deal of time, but the results given were eminently satisfactory. People at a distance of 1,200 ft. heard the speech distinctly, and it is said that those near the stand could distinguish no variance between the President's natural voice and the amplified tones. Some idea of the meaning of the achievement may be gathered from the accompanying plan.


HOUSE
CAPITOL
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DIRECT VOICE LIMITS
PLAZA
STRONG NORTHWEST WIND
PARK
PARK
125,000 PEOPLE IN THIS AREA HEARD EVERY WORD CLEARLY AND NATURALLY
THOUSANDS OF PEOPLE BEYOND THIS LINE HEARD VERY WELL
STREET
LIBRARY OF CONGRESS

The Chesapeake Co. was congratulated by the chairman of the Joint Congressional Inaugural Committee upon the excellent results obtained.

Guaranteed Wiring in the United States.—In accord with new regulations adopted by the Maryland State Board of Electrical Examiners and Supervisors, all master electricians in the State who install electrical work of any kind must give a bond of $1,000. This is to ensure absolute responsibility for defective wiring. Under the new provision, any person who discovers within a year after the completion of an installation that such wiring was defective can appeal to the Board for damages.—*Electrical World.*

Educational.—Faraday House Entrance Scholarships.—As a result of the Entrance Scholarship Examination, held at Faraday House on April 12th, 13th and 14th, the following awards have been made:—

To H. G. Spencer, Erith County School, the "Maxwell" Scholarship of 50 guineas per annum, tenable for one year in college and one year in works.

To E. F. Smith, Emanuel School, an exhibition of 30 guineas, tenable for one year in college and one year in works.

To E. W. M. Scott, Oundle School, an exhibition of 20 guineas, tenable for one year in college and one year in works.

To W. A. Bennett, Mundella Secondary School, an entrance prize of 20 guineas.

The "Motor Effect" in the Ajax-Wyatt Furnace.—Dr. E. F. Northrup, of Princetown University, discusses the nature and explanation of the above effect in the *Journal* of the Franklin Institute. He first develops a formula for calculating the mechanical forces which arise by the interaction of a triangular circuit carrying a current upon any short section of the circuit. Numerical results are tabulated, and the values of the forces are given in the form of a chart. Formulæ are next derived for calculating the internal pressure-forces in a thin strip of conductor, and numerical results are again tabulated, and a curve giving the pressure as a function of the distance from the axis of the strip is appended. The third section of the paper sets out the necessary assumptions which were made in the calculations, and the last section explains the meaning and exactly defines the motor-effect. It is shown also that such an effect actually exists, and assumes considerable importance, in the "Ajax-Wyatt furnace." A chart shows the magnitude of the forces which produce the motor-effect, and a new experiment is referred to which conclusively proved that the motor-effect not only exists, but may be manifested apart from, and independent of, any internal pressure-effect. The effect of the mutual attractions of current elements in producing fluid motion are generally considered, and the internal pressure-effect is defined. The important conclusion is reached that the Ajax-Wyatt furnace secures both the internal pressure-effect and the motor effect in an advantageous way for obtaining practical results. It is further pointed out that the securing of these two effects at widely-separated sections of the conductor is a valuable and, as far the author knows, a novel result in furnace construction of the induction type.

Accidents.—On April 12th, John Hay, an electrician at the Corporation electricity works, Aberdeen, was working in a cable pit at the rear of a high pressure switchboard, when, owing to his coming into contact with a "live" part or to the fusing of a wire, he received severe burns on his face and arms. He was removed to the infirmary.

A sub section attendant of the Sunderland Corporation, George Cowling, was attending to some plant at the Sunderland Shipbuilding Co.'s yard, when he received an electric shock which rendered him unconscious.

Grants Towards Agricultural Appliances.—The French *Journal Officiel* of April 1st contains a decree of the Ministry of Agriculture stating the conditions on which subsidies may be granted to French farmers for the purchase of electrically-operated agricultural machinery, &c. When made in France, 25 per cent. of the cost of such machinery will be granted; but if the articles are imported from abroad only 10 per cent. will be advanced.

Fatalities.—While playing at Bargoed, Glamorgan, on Tuesday evening last, a youth named Evan Jones was seriously injured in, it is alleged, attempting to slide along the overhead transmission wires carrying electricity to the Powell Duffryn Colliery, thereby receiving a shock at 10,000 volts. When the lad was picked up it was found that one of his legs up to the knee and some of his fingers had been burnt away. He died the same night in hospital.

Appointments Vacant.—Two cable jointers for the Eccles Corporation electricity works; mains assistant (£293) for the Doncaster Corporation electricity department; research physicist in the Admiralty Department of Scientific Research and Experiment (£250 + war bonus): junior charge engineer, for the Coventry Corporation Electricity Department. See our advertisement columns to-day.

The Engineers' Club for London.—Without the aid of Aladdin's lamp—or to be up to date, shall we say, 'Alf's Button'—it is impossible to bring an engineers' club into existence in the twinking of an eye. Hence the eager supporters of the scheme must curb their impatience for a little while, and give the organisers a chance to lay the foundations well and truly, so that the superstructure may be perfect in its parts and honourable to the builder.

The Executive Committee is by no means idle; it has a big task in hand, but is hopeful of finding temporary accommodation, at any rate, which will enable the club to come into residence this summer, and the rules, &c., are being drafted in readiness for submission to a general meeting. Since the proposed conditions of membership were circulated, over 1,000 firm applications have been received, including many from engineers abroad and in the British Dominions. Those engineers who intend eventually to join, but have not yet communicated with the hon. secretary (Mr. Ed L Hill, 39, St. James's Street, S.W. 1), are invited to do so at once; the greater the number of prospective members, the easier will it be to secure suitable premises.

Electric Vehicle Charging and Garaging Facilities.—An alteration in the City of Birmingham Electric Supply Department's rates for electric vehicle charging and garaging has been made and will take effect as from July 1st next:—In the Department's Depôts, subject to accommodation being available from time to time, garaging charges per vehicle will be as follows:—(*a*) 4s. per day; 20s. per week (six or seven days); 2s. per visit during day time for boosting purposes. (*b*) The rate for electricity will be 2d. per unit metered into the consumers' batteries. Consumers are reminded that vehicles are charged and garaged by the Department at owners' risk, and should be protected by insurance or otherwise, accordingly. For vehicles charged on consumers' premises, provided arrangements are made for separately metered circuits, the rate of charge will be 1½d. per unit metered on the supply mains side of consumers' apparatus.

The Use of Electricity in the United States.—A recent issue of *Power* gives some statistics from a report of the Geological Survey, which give some idea of the magnitude of the electricity supply industry in the United States. The figures are gathered from repors for the year 1920 of about 3,000 undertakings with a capacity of 100 kW or more.

The mean daily output of electricity for each month of the year ranged from 115,600,000 kWh for May to 124,700,000 for January, and for the year, 120,000 000. The proportion of this output resulting from water power varied from 33 per cent. in January to 42 per cent. in May. The year's total production was 43,900,000,000 kWh, of which 37½ per cent. was from water power; this ratio was practically the same in 1919.

The year's production of 43,900,000,000 kWh was 12·9 per cent. greater than that of 1919. The amounts of coal, fuel oil, and gas used to produce this electricity, however, increased 6·0, 18·4, and 13·6 per cent. respectively. This disproportionate increase in the consumption of fuel oil has a significant bearing on the question of the diminishing oil supply.

If the fuel oil, gas, and wood consumed in generating electricity were converted to equivalent coal, the coal consumption in 1919 would have been 38,500,000 tons, and in 1920 it would have been 41,200,000 tons—an increase of 7 per cent. The increase in the production of electricity for the same period was 12.9 for cent., which indicated a gain of efficiency in the consumption of fuels during 1920. On the basis of equivalent coal coal consumed for each of the two years, a kilowatt-hour of electricity was produced in public-utility plants in 1919 by 3·17 lb. of coal and in 1920 by 3·01 lb. These figures show a gain in economy of fuel consumption of 5 per cent., or a saving of about 2,000,000 tons of coal in the production of electricity in 1920 as compared with the rate of fuel consumption per kilowatt-hour in 1919.

Slate and Profiteering Act.—On April 11th, his Honour Judge Snagge, at the County of London Appeal Tribunal, heard the appeal of J. J. Greenwool (trading as John Williams & Co.), slate manufacturers, against a decision of the Bermondsey Profiteering Committee. The original case was brought against appellant by the National Telewriter Co., Ltd., who complained that they had been charged £10 6s. 3d. for 25 pieces of slate. The Profiteering Committee held that the reasonable price of the material was £2 16s. 3d., ordered a refund of the balance, and decided to prosecute the present appellant. Counsel for appellant said that the slate did not come under the heading "Building Materials" included in the Profiteering Act, as the material was used for electrical purposes. His Honour Judge Snagge agreed with this presentation of the case and allowed the appeal.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Informal Meeting.—Mr. W. E. Bradshaw was in the chair, on April 11th, during the discussion which was opened by Mr. F. Creedy, on "Some Characteristics and Applications of Multi-speed a.c. Motors." Mr. Creedy confined himself to the pole-changing type as developed by himself. This he claimed, under certain conditions, was the best method obtainable to date. For motors having a gradual speed variation, the commutator motor was the only possible type, and there might be a field for these in sizes up to 50 h.p.; in larger sizes, however, they hardly could be considered commercially practicable. He explained in detail the windings and switchings which gave the variable speeds, and urged that speed ratios of the required duty should be carefully studied when the type of motor was under consideration. Broadly speaking, the relative advantages of the cascade and pole-changing methods depended mainly on the ratio of speeds; some ratios were very complicated for cascade and easy for pole-changing. He concluded with acknowledgments to Messrs. F. & A. Parkinson, Ltd., and the Electrical Construction Co., Ltd., his licensees, for diagrams and data.

Mr. W. E. M. Ayres, who spoke next, stated that the call for variable-speed motors was often mistaken, and it could be met by simple arrangements of ordinary motors. He mentioned a 100-h.p. colliery fan with two speeds which it had proved more economical to re-wind as a single-speed machine, and run with resistances during the week-ends. He also criticised the Scherbius and Kramer methods on account of the complicated switchgear.

Mr. J. K. Smith spoke from actual experience of the Creedy pole-changing machine, which he had found satisfactory in connection with heavy machine-tool drives previously operated by d.c. motors. He pointed out that in view of the substitution of polyphase for d.c. supply, some form of variable a.c. motor was essential to replace the d.c. variable speed one.

Mr. W. L. Wreford and Mr. G. J. D. Scott spoke of very definite demands for variable-speed motors, notably on printing machines and air compressors. Mr. B. P. Walker also referred to their application to express lift service. Mr. W. E. Bradshaw and Mr. H. Cooch also spoke.

Mr. Creedy, in concluding a most interesting discussion, reminded the meeting that the pole-changing a.c. motors under review had the same torque at all speeds, while d.c. motors, through weakening the field, needed to be built for the maximum horse-power at the lowest speed required, resulting in a larger machine than was the case with the a.c. constant torque multi-speed motor. With regard to the question of power factor, he pointed out that although the power factor suffered at low speeds, the actual wattless current taken from the line was constant at all speeds. The power-factor reductions, of course, were due to the watt component being reduced at the lighter load corresponding to reduced speed.

Liverpool Sub Centre of the North-Western Centre.—The nominees for election as officers and committee for the 1921-22 session are as follows:—Chairman, Mr. G. H. Nisbett; vice-chairmen, Messrs. B. Welbourn and E. M. Hollingsworth; hon. secretary, Mr. Oscar C. Waygood; committee, Messrs. A. J. Eames, J. Hamilton, A. E. Malpas, P. Priestley, and P. J. Robinson. Since the number of nominations corresponds to the vacancies, there will be no necessity for a ballot.

East Midland Sub-Centre.—On April 12th, at the Loughborough College, Mr. H. Cotton, of the Nottingham University College, delivered a lecture on "Electric Drives for Rolling Mills and Colliery Winders." The speaker dwelt with emphasis on the efficiency and convenience of the electric motor as compared with the steam engine, and gave interesting examples of the application of the electric drive to collieries and steel works.

Scottish Centre.—At a meeting of this Centre, held in Glasgow, Mr. E. T. Goslin presiding, Mr. C. W. Marshall, of the Glasgow Corporation Electricity Department, read a paper on "Continuity of Supply."

The following office-bearers were elected for the year:—Chairman, Mr. E. T. Goslin; vice-chairmen, Mr. A. S. Hampton and Mr. R. B. Mitchell; hon. secretary, Mr. Joseph Taylor; assistant hon. secretary, Mr. W. F. Mitchell; and chairman of the Students' Section, Mr. Alex. Lindsay.

On June 8th a paper on "The Hydro-electric Resources of the Scottish Highlands" will be read by Prof. Magnus Maclean; and on June 9th and 10th the members will take part in an excursion [forming part of the Institution's Summer Meeting] to the West Highlands, going by steamer to Fort William, and calling at the Kinlochleven works of the British Aluminium Co.

Warrington Electrical Society.—Addressing the members of the Society on the "Wonders of Electricity," Mr. J. B. Robertson said that they stood at the threshold of a new expansion, for the power stations were being linked together, and new stations were being erected with every refinement of economy in the generation of power in large quantities. Systems of electrical mains were being spread wider, both underground and overhead, so that in time the most remote districts would enjoy the service which was now the privilege of towns. As that movement progressed, the coal resources of the country would be utilised more and more in a limited number of efficient centres.

Physical Society of London.—At a meeting of the Society to be held to-day (Friday) at the Imperial College of Science, the following papers will be read:—"The Effect of Viscosity on Orifice Flows," by Mr. W. N. Bond, M.Sc.; "The Viscosity of Water at Low Rates of Shear," by A. Griffiths, D.Sc., and Constance H. Griffiths, M.Sc.; and "A Method of Measuring Frequencies," by B. S. Smith and G. F. Partridge, B.Sc.

At the meeting held on April 8th a paper, entitled "A New Registering Microphotometer," was read by Dr. W. J. H. Moll, of the University of Utrecht. The device employs a diminished image of a slit, on which the filament of a half-watt lamp is focused, projected by means of a microscope objective on the photographic plate or other object of which the absorption is to be measured. A second similar objective focuses an imagine of the slit, magnified up to its original size, on a second slit behind which is mounted a sensitive thermopile of the author's own design connected to an improved D'Arsonval galvanometer. By suitable gearing to an electromotor the photographic plate is given a slow motion at right angles to the beam of light, and at the same time a drum of photographic paper, on which the spot from the galvanometer is focused, is caused to rotate at a suitable rate. A record is thus obtained of the density of the plate at different parts encountered by the beam of light. The arrangement is dead beat and so quick in response that intensity curves of close spectrum lines, Zeeman triplets, &c., are accurately recorded.

A new method of using the quadrant electrometer for the measurement of electrical power was described by Mr. Hubert Parry. This involved the use of a potential-divider across the supply circuit, and a standard non-inductive resistance in series with the load. An ammeter and a voltmeter were employed to measure the supply voltage and the load current. An example of its application to determine the power-factor of a condenser was quoted.

Electrical Trades Benevolent Institution.—The annual general meeting of the Institution will be held at the offices of the Cable Makers' Association on Monday, April 25th, at 2.30 p.m., to receive the Report of the Committee, and to pass the accounts for the year 1920; to elect members of the Committee of Management and Auditors, and to consider alterations of rules.

Glasgow and District Radio Club.—At the meeting held on March 30th Mr. T. Senior lectured on "Aerials." Mr. Senior was well qualified to speak on this subject, having had about 10 years' practical experience in the erection and fitting out of wireless telegraph stations. The various types of aerials in general use were illustrated by blackboard diagrams, and the advantages and disadvantages of each were emphasised. The different kinds of wire which could be used, ohmic resistance, skin effect of high-frequency currents, the necessity of good joints for efficiency were dealt with in turn, and fully explained. The most effective methods of insulation, the necessity for preventing swaying of the aerial wires, and the vexed problem of whether the free ends should be joined or left open, were also discussed.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

MR. F. GOLDING, chief electrical engineer and director of radio services in the Commonwealth of Australia Postal Department, has been appointed by the Commonwealth Postmaster-General as a commissioner to visit the United States, Canada, Britain, and the Continent, to inquire into various matters relating to telegraphy (including wireless) and telephony.—*Sydney Morning Herald.*

SENATOR MARCONI has left England for Italy, with the object, it is reported, of carrying out further wireless experiments on board his steam yacht *Elettra.*

MR. E. A. EDWARDS, A.M.I.E.E., of the Westinghouse Electric International Co., who is a captain in the Royal Corps of Signals (T.A.), has been appointed to command the 54th (East Anglian) Divisional Signals Defence Corps, with the rank of lieutenant-colonel.

The Times states that SIR GERALD CHADWYCK-HEALEY has been adopted as prospective Unionist candidate for the Newbury Division at the next General Election.

MR. J. J. SMITH, for 21 years borough electrical engineer at Stockton-on-Tees, has resigned owing to ill-health.

MR. H. E. ELLIS, managing director of the City Electrical Co., of London, is leaving England on April 29th, on a tour of his company's agents in North and South America, Canada, Australia, New Zealand, India, and South Africa. He is willing to place his opinion formed at any of these overseas markets at the disposal of others who may get into touch with him.

MR. J. W. MEARES, M.Inst.C.E., Electrical Adviser to the Government of India, has been appointed Chief Engineer, Hydro-electric Survey of India, in succession to Mr. F. E. Bull, retired.

On Saturday last the marriage took place at Loughborough of MR. F. S. GROGAN, M.I.E.E., A.M.Inst.C.E., manager of the Arora Co., and Miss C. K. Norrington, who is already known to several electrical friends.

The professional practice of the late MR. H. B. RANSOM, M.Inst.C.E., 3, Victoria Street, S.W.1, has been transferred to Messrs. Dolby & Williamson, consulting engineers, 8, Princes Street, Westminster, S.W.1, to whom all correspondence should be addressed.

NEW COMPANIES REGISTERED.

Donald-Bean Insulators & Engineers, Ltd. (11,689).—Private company. Registered in Edinburgh April 11th. Capital, £15,000 in £1 shares (3,000 preference). To carry on the business of insulators, mechanical, electrical, and constructional engineers, ship and boat builders, ship repairers, and outfitters, &c. The first directors are: W. M. Donald, 53, Bothwell Street, Glasgow; A. Bean, 1, Shandon Street, Govan, Glasgow; H. London, 1, Lynedoch Terrace, Glasgow. Registered office: 11, Great Wellington Street, Glasgow.

Victor Electrics, Ltd. (174,199).—Private company. Registered April 13th. Capital, £5,000 in £1 shares. To carry on the business of manufacturers of, dealers in and agents for, cars, carts, vans, bicycles, tricycles, conveyances, and carriages of all kinds, whether moved by mechanical, electrical, or other power; boats, launches, and yachts, &c. The first directors are: H. N. Outram, 5, Rectory Road, Southport; E. Outram, 76, Grange Road, Southport; H. Outram, 18, Balfour Road, Southport; A. Wilson, 7, Cumberland Road, Southport; W. Maitland, 7, Cypress Road, Southport; I. H. Lavery, 7, Grange Road, Southport; V. Barmas, 14, Bright Street, Southport. Qualification, 100 shares. Secretary: W. Ball. Registered office: Westminster Buildings, Lord Street, Southport.

Power Production Co., Ltd. (5,084).—Private company. Registered in Dublin December 10th. Capital, £1,000 in £1 shares. To carry on the business of designing, constructing, buying, selling, controlling, operating, and owning power plants of all kinds, &c. The subscribers (each with one share) are: D. J. Reilly, Trim, Co. Meath, solicitor; F. W. Forrest, Trim, Co. Meath, solicitor. The first directors are: J. Dornan and T. G. Price. Secretary: T. G. Price. Registered office: Commercial Buildings, Dame Street, Dublin.

British Sangamo Co., Ltd. (174,133).—Private company. Registered April 9th. Capital, £10,000 in £1 shares. To carry on the business of mechanical, electrical, and general engineers, manufacturers, suppliers and fitters of and dealers in apparatus, machinery, appliances, &c. The subscribers (each with one share) are: J. Brown, Springfield, Illinois, U.S.A., banker; R. C. Lanshier, Illinois, U.S.A., electrical manufacturer; S. B. Rogers, Great Eastern Hotel, E.C.3, electrical manufacturer. The first directors are not named. Solicitor: L. W. Croft, 2, Bond Court, Walbrook, E.C.

Greenlaw Electrical Supply Co., Ltd. (11,686).—Private company. Registered in Edinburgh April 7th. Capital, £4,000 in £1 shares (1,000 5 per cent. non-cumulative shares). To supply electricity in Greenlaw, Berwickshire, and district. The first directors are: J. Clapham, High Street, Greenlaw; J. S. Macgregor, High Street, Greenlaw; T. Clapham, High Street, Greenlaw; Sir John H. Campbell of Marchmont, Bart., Greenlawdean, Greenlaw; R. T. Kerr, Greenlaw Mill, Greenlaw; Dr. J. Marr, Ivy Lodge, Greenlaw; W. Middlemiss, Marchmont Road, Greenlaw. Secretary: A. Miller. Registered office: The Square, Greenlaw, Berwickshire.

Chisholm Bros., Ltd. (11,681).—Private company. Registered in Edinburgh April 6th. Capital, £1,200 in £1 shares. To take over the business of iron, coal, and steel merchants, and general exporters carried on at 190, West George Street, Glasgow, and to carry on the business of electrical, motor, and mechanical engineers, colliery furnishers, &c. The first directors are: J. Chisholm, 33, Calderwood Road, Rutherglen, clerk; G. G. Chisholm, 8, Clincarthill Road, Rutherglen, electrical engineer; J. Chisholm, 86, Stonelaw Road, Rutherglen, merchant. Registered office: 190, West George Street, Glasgow.

Oldham Electrical Contractors, Ltd. (174,140).—Private company. Registered April 9th. Capital, £1,000 in £1 shares. To take over the business of electrical engineers and contractors carried on by J. E. MacNamara and A. Atkinson at Oldham as the "Oldham Electrical Repair Co." The subscribers (each with one share) are: F. Lord, 74, Beever Street, Oldham, builder and contractor; J. E. MacNamara, 46, Barker Street, Oldham, electrical engineer; A. Atkinson, 13, Mount Street, Chorlton-on-Medlock, Manchester, electrical engineer. F. Lord is the first director, and may retain office while holding £100 shares. Registered office: 46, Barker Street, Oldham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

C.E.C., Ltd.—Debenture dated April 4th, 1921, to secure £12,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: H. E. Ellis, 38, Fairholt Road, Stoke Newington, N.

Pinkney & Forster, Ltd.—Two mortgages dated March 30th and 31st, 1921, to secure £7,000 and £1,500 respectively, charged on 5 and 7, Saville Row, Newcastle-on-Tyne. Holder: Mrs. E. Stewart, 1, Granville Road, Newcastle-on-Tyne.

Cray Installations, Ltd.—Particulars of £8,000 debentures authorised March 17th, 1921, whole amount issued, charged on company's property, present and future, including uncalled capital.

John Tinsley, Ltd.—Satisfaction to the extent of £200 on January 31st, 1921, of debentures dated June 5th, 1912, securing £500.

Muirhead & Co., Ltd.—Satisfaction in full on April 1st, 1921, of debentures dated November 16th, 1904, securing £5,500.

Adams Bros. (Longton), Ltd.—Debenture dated March 21st, 1921, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: A. P. Ford, Basford, Stoke-on-Trent.

Peerless Flash Lamp Co., Ltd.—Particulars of £18,000 debentures authorised March 23rd, 1921, present issue £12,000, charged on the company's undertaking and property, present and future, including uncallled capital.

Newcastle-upon-Tyne Electric Supply Co., Ltd.—Trust deed dated March 24th, 1921, supplemental to trust deeds dated June 30th, 1909, November 10th, 1914, May 3rd, 1915, March 14th, 1918, to secure £1,104,508 4½ per cent. consolidated first mortgage debenture stock, in addition to £1,042,000 secured by previous deeds. Property charged: Electrical undertakings of the company, freehold premises known as "Carville" and Neptune Bank, leasehold premises at Dunston, and company's other assets, present and future, except uncalled capital. Trustees: Whitehall Trust, Ltd., 2, St. Helen's Place, E.C.

Telegraph Manufacturing Co. (Colonial), Ltd. (71,854).—Return dated March 22nd, 1921. Capital, £2,000 in £1 shares. All shares taken up. £2,000 paid. Mortgages and charges: Nil.

Yorkshire (West Riding) Electric Tramways Co., Ltd. (84,167).—Return dated February 17th, 1921. Capital, £600,000 in £5 shares (70,000 preference and 50,000 ordinary), 46,261 preference and 40,977 ordinary shares taken up, £436,190 considered as paid. Mortgages and charges: £272,373.

CITY NOTES.

Cuba Submarine Telegraph Co., Ltd.

The report for 1920 shows that the receipts were £81,542 and the expenses £34,284. After providing £7,063 for income tax and adding £17,611 for difference in exchange and £21,150 brought forward, the total available is £78,957. Out of this £15,000 has been added to general reserve, £17,611 to reserve against loss on investments, and £2,500 to the pension fund. Interim dividends were paid in October at the rate of 10 per cent. per annum, less income tax, on the preference shares, and at the rate of 5 per cent. per annum, free of tax, on the ordinary shares, and the directors recommend final dividends at the same rates, and a bonus of 4s. per share on the ordinary shares, free of tax, leaving £26,646 to be carried forward, subject to E.P.D. Several sections of the cables underwent repairs during the year, while an attempt to repair the Cienfuegos-Santiago 1905 cable was unsuccessful, but it is hoped to restore this cable to working order after laying a new section from Cape Cruz to Santiago which is now being manufactured, and will be laid in the course of the next few months. The total cost of the work on the cables during the year was £24,542, and it was charged to reserve.

English Electric Co., Ltd.

In their report for the year ended December, 1920, the directors state that, after writing down stocks on a conservative basis to correspond with present day values, the balance to the credit of profit and loss account, including £45,302 brough forward, is £312,238. Deducting debenture interest and trustees' fees, £54,275; interest and discount, £84,608; dividend at the rate of 6 per cent. per annum on the preference shares, £41,914, leaves £131,441. A dividend on the ordinary shares at the rate of 8 per cent. per annum, less tax, will absorb £85,204, leaving £46,236 to carry forward. Certain dividends receivable from subsidiary companies (including the realised profit on the sale of certain assets) have been, in part, applied in writing off the entire expenses of, and discount on, the recent note issue, as well as reserving for the whole of the premium due on repayment, and in adding a further £25,000 to the capital reserve account. In view of the uncertainties of the present day position of trade throughout the world, the directors have considered it prudent to utilise these resources in the manner indicated, which is in close accord with their policy of last year. In order to replace expenditure incurred in the purchase of the Stafford Works, and stocks, and for other purposes, the company issued in November last £1,250,000 8 per cent. six year secured notes at 98 per cent. repayable at January 1st, 1927, at 103 per cent. Ten per cent. of the proceeds of this issue was received prior to December 31st, 1920, and included in the accounts for 1920. The balance of £1,100,000 has been received since that date, and will appear in next year's balance sheet. Further progress in completing the amalgamation of the various undertakings controlled by the company was made during the past year. The properties of the Coventry Ordnance Works, Ltd., and Willans & Robinson, Ltd., have been leased to the company, and arrangements are now in progress for winding up the Phœnix Dynamo Manufacturing Co., Ltd., and the United Electric Car Co., Ltd. The directors are confident that this consolidation will facilitate control, and result in effecting greater economy in administration. The engineering trade was adversely affected by a series of labour troubles throughout the year, and more particularly by the moulders' strike, which, though it ended in January, handicapped output for a considerable period thereafter. The directors sincerely regret the loss of their colleague, Mr. Walter Rutherford, who since the close of the year has retired from the board and the management of the company. During the year under review, Mr. Robert Grant, jun., joined the board. Annual meeting: April 27th.

Eastern Telegraph Co., Ltd.—The directors will convene the annual meeting as soon as the full accounts can be submitted. A final dividend for the year 1920, of 2½ per cent., free of income tax, on the ordinary stock is to be paid, making the total for the year 10 per cent., free of tax, the same rate as was paid for the previous year. The usual distribution at the rate of 3½ per cent. per annum, less income tax, on the preference stock for the first quarter of 1921 is also being made.

Norwegian Marconi Co.—The A.S. Norsk Marconi Kompani has declared a dividend at the rate of 5 per cent. for 1920, making, with the interim distribution, a total of 15 per cent. for the year. The company was formed two years ago to acquire licences for the utilisation of Marconi patents for Norway and Norwegian ships, and the shareholders are shipowners and other shipping interests.

Stock Exchange Notices.—Application has been made to the Committee to appoint a special settling day in, and the Committee has specially allowed dealings in:—

Electrical Apparatus Co.—30,423 10 per cent. "A" cumulative preference shares of £1 each, fully paid, Nos. 1 to 30,423.

And to allow the following to be officially quoted:—

Calcutta Electric Supply Corporation.—£500,000 5 per cent. first mortgage convertible debentures.

Victoria Falls & Transvaal Power Co.—£2,009,390 5 per cent. first mortgage debentures.

Yorkshire Electric Power Co.—80,306 ordinary shares of £10 each, fully paid, and £230,000 5½ per cent. redeemable debenture stock.

The Committee has ordered the undermentioned to be officially quoted:—

Hadfields.—78,118 ordinary shares of £1 each, fully paid (Nos. 1,600,001 to 1,663,118 and 1,866,667 to 1,881,666).

Johnson, Matthey & Co.—£250,000 8 per cent. seven-year notes (Nos. A1 to 2,100 (£10), B1 to 1,790 (£100), and C1 to 50 (£1,000). (Registered.)

Metropolitan Electric Supply Co.—£86,926 3½ per cent. mortgage debenture stock, redeemable.

Metropolitan-Vickers Electrical Co.—65,732 ordinary shares of £1 each, fully paid (Nos. 6,205,173 to 6,270,904).

Stewarts & Lloyds.—847,430 deferred shares of £1 each, fully paid (Nos. 1,782,501 to 2,629,930).

City Electric Light Co., Ltd. (Brisbane).—Credit balance for year ended January, 1921, £57,997, plus balance brought forward, making the total £58,427. An interim dividend was paid last September amounting with dividend duty to £25,829, and further dividends of 3 per cent. on the 6 per cent. preference shares, 3½ per cent. on the 7 per cent. preference, and 5 per cent. on the ordinary shares were recommended to the meeting in March. The payment of these dividends, together with the dividend duty and an allowance for Federal tax, absorbed £32,405, leaving £193 to be carried forward.

Indo-European Telegraph Co., Ltd.—The directors recommend a final dividend for 1920 of £1 2s. 6d. per share (making 7 per cent. for the year), free of tax; also a distribution out of equalisation of dividends fund of 15s. per share, free of tax, making a total of 10 per cent. for the year.

Electrical Utilities Corporation, Ltd.—A quarterly dividend of 1¾ per cent. on the preferred stock is announced for the quarter ended March 31st.

Kaministiquia Power Co.—Dividend at the rate of 8 per cent. per annum on the common stock for the quarter ending April 30th.

Bastian Meter Co., Ltd.—The directors report a net profit of £455 for the year, plus £589 brought forward. A dividend of 6 per cent. on the cumulative preference shares, and one of 6 per cent. on the ordinary shares are to be paid, leaving £328 to carry forward.

Eastern Extension, Australasia & China Telegraph Co., Ltd.—Final dividend on the old shares of 2½ per cent., free of tax, making a total distribution of 10 per cent., free of tax, for the year 1920, as in the previous year.

Switzerland.—La Société de la Fabrique d'Accumulateurs d'Oerlikon is declaring a dividend of 20 per cent. for last year.

Direct United States Cable Co., Ltd.—A final dividend of 4s. per share, less tax, making 4 per cent. for the year ended March 31st, is announced.

STOCKS AND SHARES.

Tuesday Evening.

Relieved from the apprehension of a general stoppage of work, the Stock Exchange markets were quick to respond to the altered conditions brought about by the refusal of the Railwaymen and Transport Workers to support the Miners' Federation. Prices improved in most departments, although it cannot be said that business increased to any noticeable extent. The position is still regarded as sufficiently unsettled for it to render buyers cautious of entering the markets except those for purely gilt-edged stocks. With the Budget to be introduced on Monday next, the domestic atmosphere is charged with financial, as well as political, uncertainty; while, abroad, the action of France with regard to the forthcoming May the First obligations of the Germans does not tend to reassure confidence.

The Home Railway market has naturally benefited from the blowing-over of the railway strike. Prices recovered in all sections of the market. The Undergrounds, which had fallen with the rest, although not to the same extent as the steam stocks, have hardened with their brothers, and Underground Electric Income Bonds are 3 better at 72½. The rise of 5 points in Central London deferred non-assented stock to 22½ has been held. Apparently somebody wanted to buy a few hundred pounds, attracted by the wide difference between the quotation of this stock and that for the assented deferred, the latter standing about 42. As might have been expected, the buyer found nobody anxious to sell the lower-priced stock at the current nominal price, which was therefore advanced as already mentioned. Metropolitans slid back to 23½, to rally to 24½. Underground £10 shares gained ⅛ at £2. Guaranteed, debenture and preference stocks are all one to two points higher.

The English Electric dividend has had a strengthening effect upon the market in manufacturing shares. English Electrics advanced to 12s. 6d. Siemens rose to a guinea and the new shares to 20s. General Electrics are better at 25s. 3d., and the preference at 18s. 6d. British Aluminium at 16s. 3d. are ex dividend. Telegraph Constructions went back a little to 20.

The only changes in the list of electricity supply companies are a rise of ⅛ in Charing Cross 4½ per cent. preference, and a decline to 17s. in City of London 6 per cent. preference. The latter came about evidently as the result of shareholders trying to sell some of these in order to apply for the company's new 8 per cent. second preferences which are being offered at 20s. The subscription lists for the latter closed on Thursday and underwriters are very curious to see whether they will be left with any of the shares. The better conditions which became manifest in the markets on Tuesday evening and which produced substantial rises amongst gilt-edged securities, resulted from rumours that a settlement of the miners' strike was expected to take place practically at once. It had a pronounced effect upon many of the markets round the Stock Exchange.

At the meeting of the Stock Exchange proprietors to-day (Tuesday) it was announced that the managers had decided to spend £12,000 upon a new installation of electric light. Up to the present about £5,000 has been expended. When finished, the installation, according to the chairman of the meeting, will be up to date in every particular. Newcastle-on-Tyne 7 per cent. preference shares are better at 19s., and in this connection it may be pointed out that there is about £2,500 stock of the company's 4½ per cent. first mortgage debenture stock on offer at 71¾. Interest is payable in January and July. The stock is redeemable in 1939 at 100, or in 1922 at 105, unless by purchase. The yield, straight out, is 6¼ per cent. on the money, but allowing for redemption this is raised to 8¼ per cent., and on the additional £2 there is, of course, no income tax to pay. The Central Electric 8 per cent. notes, over-subscribed by the public, are already quoted at a small premium.

The feature amongst Telegraphs and Telephones is a further jump to 2 7/16 in Marconi's. The preference have risen to 2⅜ and Marconi Marines to 1 7/16. Canadian Marconi's went up to 8s. 6d. Radio shares are still lagging a little behind the market in the parents. For the rise in Marconi's the only explanation is that already mentioned in these columns, namely, that the company will declare a 20 per cent. dividend next month, making 25 per cent. for the full year. In addition, there are hopes that the Government may square up before long with the Company, in the course of which it is expected that there will be a further substantial sum to come to the Marconi shareholders. Anglo-American deferred has eased off to 15¾. Cuba Submarine shares at 7 are 10s. higher, although a bargain was marked last week at 6⅝. There is little doing in the Eastern group. Globe ordinary, with a rise to 16, have come into line with the other members of their family.

Armament shares, together with those of various iron, coal and steel companies, have generally advanced. Babcock & Wilcox remain unchanged at 2 5/16. The rubber share list is a trifle harder, although the price of the produce is still no better than 11¼d. per lb.

Brazilian Tractions are better at 36, although the preferred eased off to 74½. Canadian General Electrics are 121½ after being higher. The feature in this market is the way in which Mexicans are mounting. Following upon improvements in the previous fortnight, new gains stand to the credit of the issues in the Mexican Light and Power, Mexico Tramways, and the Pachuca Light and Power companies. Vigorous rises have taken place this week in many other Mexicans. A Conference is said to have been arranged at Washington for trying to unravel the difficulties in connection with oil concessions in Mexico. If the various points of contention can be smoothed out, the way will be open for American money to flow into Mexico. Of its readiness to do so, there is no reasonable doubt, but until the diplomatic difficulties that surround the oil question are disposed of, Mexican progress can receive no assistance from American capitalists.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1919.	Dividend 1920.	Price April 19, 1921.	Rise or fall.	Yield. p.c.
Brompton Ordinary	12	12	6	—	£10 0 0
Charing Cross Ordinary	7	8	3⅞	—	10 6 6
do. do. do. 4½ Pref.	4½	4½	2⅞	+ ⅛	7 16 6
Chelsea	4	6	3	—	10 0 0
City of London	13	14	23/3	—	12 0 10
do. do. 6 per cent. Pref.	6	6	17/-	—1/-	7 1 2
County of London	8	8	7⅝	—	10 9 10
do. do. 6 per cent. Pref.	6	6	8	—	7 10 0
Kensington Ordinary	7	9	4⅛	—	10 18 2
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref	6	6	2¾	—	10 18 2
Metropolitan	6	7	3¼	—	10 15 4
do. 4½ per cent. Pref.	4½	4½	2$\frac{15}{16}$	—	7 13 2
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	6	—	2⅛	—	9 2 10
South Metropolitan Pref.	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	5⅛	—	9 15 2

Telegraphs and Telephones.

	1918	1919			
Anglo-Am. Tel. Pref.	6	6	78½xd		7 12 10
do. Def.	83/6	1½	15¾	— ⅛	9 10 6
Chile Telephone	8	6	5½	—	5 6 8
Cuba Sub. Ord.	7	7	7	+ ½	10 0 0
Eastern Extension	10	10	16	—	6 5 0
Eastern Tel. Ord.	8	10	160	—	6 5 0
Globe Tel. and T. Ord.	8	10	16	+ ½	6 5 0
do. do. Pref.	6	6	9	—	6 13 4
Great Northern Tel.	22	22	22	—	10 0 0
Indo-European	13	10	30	—	8 6 8
Marconi	25	25	2$\frac{7}{16}$	+ ¼	—
Oriental Telephone Ord.	10	12	2$\frac{3}{16}$	—	*5 9 7
United R. Plate Tel.	8	8	6⅛	—	6 10 8
West India and Panama	1/3	Nil	$\frac{9}{16}$	—	Nil.
Western Telegraph	8	10	16	—	*6 5 0

Home Rails.

	1919	1920			
Central London Ord. Assented	4	4	44⅛	—	9 0 0
Metropolitan	1½	1½	25	+ ½	6 0 0
do. District	Nil	Nil	14½	—	Nil
Underground Electric Ordinary	Nil	Nil	2	+ ⅛	Nil
do. do. "A"	Nil	Nil	6/-		Nil
do. do. Income	4	2	72½	+ 3	2 15 2

Foreign Trams, &c.

	1913	1919			
Anglo-Arg. Trams, First Pref.	Nil	6½	2⅝	—	10 9
do. do. 2nd Pref.	Nil	Nil	3	—	Nil
do. do. 5 % Deb.	5	5	59½	—	8 8 0
Brazil Tractions	Nil	Nil	36	+ 1	Nil
British Columbia Elec. Rly. Pfce.	5	5	55	—	9 1 10
do. do. Preferred	2½	5	54½	—	*8 14 0
do. do. Deferred	Nil	3	51½	—	*11 17 6
do. do. Deb.	4½	4½	57½	+ 1	7 7 10
Mexico Trams 5 per cent. Bonds.	Nil	Nil	37	+ 1	Nil
do. 6 per cent. Bonds	Nil	Nil	2½	+ 1	Nil
Mexican Light Common	Nil	Nil	11½	1	Nil
do. Pref.	Nil	Nil	18	—	Nil
do. 1st Bonds	Nil	Nil	61½	+ 2½	Nil

Manufacturing Companies.

Babcock & Wilcox	15	15	2$\frac{5}{16}$	— $\frac{1}{16}$	6 10 0
British Aluminium Ord.	10	10	16/3xd	—	12 6 2
British Insulated Ord.	12½	15	1$\frac{9}{16}$	—	9 12 0
Callenders	25	15	1$\frac{7}{16}$	—	10 18 2
" 6½ Pref.	6½	6½	17/6		7 8 7
Crompton Ord.	10	10	18/9	—	14 11 0
Edison-Swan	10	10	10/-	—	—
do. do. 5 per cent. Deb.	5	5	70	—	7 2 10
Electric Construction	10	10	15/9	—	12 14 0
English Electric	—	8	12/6	+ 1/6	12 16 0
Do. Pref.	—	6	13/-	—	9 4 8
Gen. Elec. Pref.	6½	6½	18/6	+ 6d.	7 4 5
do. Ord.	10	10	23/3	— [illegible]	*8 12 0
Henley	25	15	1$\frac{5}{16}$	—	11 8 6
do. 4½ Pref.	4½	4½	3¼		6 18 6
India Rubber	10	10	⅞		
Met.-Vickers Pref.	—	8	1¾	—	9 2 10
Siemens Ord.	10	10	1$\frac{1}{16}$	+ $\frac{1}{16}$	*9 15 2
Telegraph Con.	20	20	20	— ¼	*5 19 9

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

Tuesday, April 19th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Oxalic	per lb.	10d.	..
a	Ammoniac Sal	per ton	£75	..
a	Ammonia, Muriate (large crystal)	"	£65	..
a	Bisulphide of Carbon	"		..
a	Borax	"	£34	..
a	Copper Sulphate	"	£34	..
a	Potash, Chlorate	per lb.	6d.	½d. dec.
a	" Perchlorate	"	10d.	..
a	Shellac	per cwt.	£14	10s. dec.
a	Sulphate of Magnesia	per ton	£16	..
a	Sulphur, Sublimed Flowers	"	£19	£1 dec.
a	" Lump	"	£18	..
a	Soda, Chlorate	per lb.	5d.	¼d. inc.
a	" Crystals	per ton	£7	..
a	Sodium Bichromate, casks	per lb.	1/-	..

	METALS, &c.			
p	Babbitt's Metal Ingots	per ton	£95 to £300	..
c	Brass (rolled metal 2" to 12" basis)	per lb.	11¼d.	..
c	" Tubes (solid drawn)	"	1/1¾ to 1/2	..
c	" Wire, basis	"	11⅜d.	..
c	Copper Tubes (solid drawn)	"	1/8¾	..
c	" Bars (best selected)	per ton	£116	..
c	" Sheet	"	£116	..
c	" Rod	"	£116	..
d	" (Electrolytic) Bars	"	£74	10s. inc.
d	" " Sheets	"	£145	..
d	" " Wire Rods	"	£90	10s. inc.
d	" " H.C. Wire	per lb.	11⅛	⅛ inc.
f	Ebonite Rod	"	3/6	..
f	" Sheet	"	3/-	..
n	German Silver Wire	"	2/9	..
h	Gutta-percha, fine	"	14/- to 16/-	..
h	India-rubber, Para fine	"	10¾d.	..
l	Iron Pig (Cleveland Warrants)	per ton	Nom.	..
l	" Wire, galv. No. 8, P.O. qual.	"	£40	£5 dec.
g	Lead, English Pig	"	£22 10s.	20s. inc.
g	Mercury	per bot.	£12 10 to £12 15	..
e	Mica (in original cases) small	per lb.	4d. to 4/-	..
e	" " " medium	"	5/- to 10/-	..
e	" " " large	"	12/6 to 25/- & up	..
p	Phosphor Bronze, plain castings	"	1/4 to 1/9	..
p	" " rolled bars and rods	"	2/1 to 2/6	..
p	" " rolled strip & sheet	"	2/2 to 2/7	..
d	Silicium Bronze Wire	per lb.	1/4	..
r	Steel, Magnet, in bars	"	1/8	..
n	Tin, Block (English)	per ton	£154 to £155	£4 inc.
n	" Wire, Nos. 1 to 16	per lb.	4/-	..
p	White Anti-friction Metals	per ton	£78 to £300	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
p ———
r W. F. Dennis & Co.

Power-Factor Correction.—A careful study of motor application in an industry with a view to power-factor correction will usually produce rather startling results, said Mr. P. T. Vanderwaart, electrical engineer of the New Jersey Zinc Co., in a paper on "Power-Factor Correction and Its Relation to Plant Operation," read before the Philadelphia Section, Association of Iron and Steel Electrical Engineers. In plant No. 1, a case cited by Mr. Vanderwaart, the horse-power in motors released by such a study was 2,640, while the cost of new motors and reapplication of old ones was $1,400. Sub-station capacity to the value of $600 was also released. The power factor of the maximum demand was raised from 76·5 per cent. to 82·1 per cent. through this study. The saving in energy was not so important, as the weighted average efficiency was only raised from 87·7 per cent. to 88·3 per cent. A study of plant No. 2 produced even better results, the value of motor horse-power released being 3,400, and the cost of making changes $1,800. Sub-station capacity released was valued at $700. Mr. Vanderwaart showed how it was possible to make such surveys of a plant through the use of record systems and a liberal use of instruments. The application and economies of other power-factor correction methods were also brought out.—*Electrical World.*

A Russian Magnetic Iron-Ore Field.—The late Dr. Ernst Leyst, of the University of Moscow, after researches extending over several years, has located with the help of the magnetometer a large field of magnetic iron ore in the Government of Kursk on the Russo-Ukrainian border. The survey has been made over an area of close upon 11,000 sq. miles. There are two ore bodies running parallel to each other at a distance of about 36 miles from each other and each of them about 150 miles long, one of them being 24 miles, the other about 30 miles wide. Dr. Leyst's magnetometric survey has been examined by Dr. Petersson, Professor at the Mining High School in Stockholm, and on behalf of the Swedish Jernkontor by one of their mining engineers, Mr. Nathorst. Both Swedish experts have confirmed the Russian professor's view that a very important iron-ore deposit has been discovered. As soon as the political situation will permit, funds will be provided to make borings and complete the survey.—*Iron and Coal Trades Review.*

THE LABOUR SITUATION AS IT AFFECTS THE ELECTRICITY SUPPLY INDUSTRY.

By T. W. COLE (Joint Secretary, Home Counties Industrial Council).

(Concluded from page 458.)

In my last article I pointed out that the tendency of trade unionism in the electricity supply industry was towards industrial unionism, that is, a consolidation of all interests under one trade union organisation. This is, of course, by no means achieved at present.

It was also seen that this tendency of trade unionism fell in with the revolutionary programme of Guild Socialism. Coming to the Industrial Councils, the Whitley Scheme, of course, also falls in line (in respect of the employes' side) with the consolidation of the trade union interests. I mention this merely to indicate the momentous importance of the wise handling of the whole matter in every detail. There is no royal road out of these difficulties; indeed, the electricity supply industry is probably one of the most complex with regard to its labour troubles. Not only are there the factors which we have already enumerated, but even on the employers' side there are dissimilar and sometimes dissentient factors in so far as part of the employers are Municipal Corporations and part are private companies. With regard to the former, certain of the Municipal Corporations are largely directed by labour representatives, whose political and other views may coincide more with the employés than with those of the company employers. Then, also, there is the always impending influence of the Government in the case of disputes which threaten to come to a deadlock. The only interest of the Government is naturally that the public supply should be maintained, which means a tendency towards forcing the issue on grounds of expediency rather than of right or propriety. All this means that in coping with the situation it is finally "brains that must tell." This brings us to the last consideration, the Whitley Councils. It might be said at once that despite the occasional creaking of the machinery, the Whitley scheme provides the best hope of dealing with the whole situation satisfactorily. There is, for instance, in the first place, practically complete machinery for dealing with every question that can occur; secondly, no better scheme can be devised by which the two sides are brought into closer touch. Both parties meet, as it were, on common ground, which is a fundamental necessity of any bona-fide *rapprochement*.

The Whitley Councils were, in fact, organised just at the right time, and the present orderly state of the industry, from a labour point of view, is due, one might say, entirely to their operation. Further, in view of the evolving changes in trade unionism and their possible social consequences, as indicated in the previous article, the Whitley Councils promise to play an even more indispensable part in the future. The fact is apparent that the increasingly effective organisation and consolidation of the trade union movement, to say nothing of its possible expansion, must be met with a correspondingly powerful organisation such as the Whitley Councils. Only in this way can all the potent influences be directed towards the common good. In this connection one important fact is often lost sight of, and that is that there is no such thing as any "final settlement" of industrial problems. Industrial questions are only one aspect of a huge mass of rapidly evolving social questions. To look upon the Whitley Councils, therefore, as in any way courts of periodical arbitrations over differences, is to take a very inadequate view. Their real function is to enable capital and labour to meet, and to make the constant readjustments that are needed by this perpetual evolution.

Among all the complexities of the labour situation there is at least one step which stands out clearly, and that is to strengthen and develop the Whitley scheme to the fullest possible extent, and to ensure that the best brains of the industry are enlisted in its service. In this connection it must be remembered that the Whitley scheme is certainly still incomplete in the direction of Works Committees. The present machinery, namely, the National Council and District Councils, does not bring the employers and employés directly into touch. This is reserved for the Works Committees in each undertaking; such committees form, as it were, the lowest of the three tiers which properly compose the Whitley scheme. There is every prospect, however, that such Works Committees will shortly be formed, since the National Council at present has under consideration the constitution of such committees, and will doubtless be issuing its recommendations in the near future. When such Works Committees are established in the various undertakings, not only will the machinery of the Whitley scheme be so much nearer completion, but an opportunity will be afforded for the influence of the employers to be brought directly on the employés. By this I mean that the employers will have every chance of seeing that the employés understand their opinions on any industrial or other subject which is pressing at the moment. At present employers often have diametrically opposite views to those which are being pressed on the employé from one or another quarter, but they have no adequate opportunity of putting these forward on, as it were, neutral ground. With Works Committees, however, every question which in any way affects the industry can quite properly be included as pertinent for discussion. No one ought to ask more if the old Latin motto is right—*magna est veritas et prevalebit*. As a matter of fact, these words might be taken as the assumed basis of the whole Whitley scheme. The scheme is, in fact, nothing more than a working-out of the suggestion that employers and employed should sit down facing each other and, whatever the subject may be, talk it out. In other words, the Whitley idea is to stake everything on brains, right, or moral weight (a corollary to which is that the side which picks these qualities best should carry the day). This indirectly brings back the question of revolutionary propaganda taking place in the industry, which, in so far as it actually affects industry, is a matter of immediate concern to employers. Whatever may be any immediate practical steps that are taken, it is the general weight and soundness of opinion which tells in the long run. The strength of a great deal of revolutionary socialism lies in its carefully thought-out principles, and the general way in which it is consistently formulated. Being an entirely theoretical scheme, it has naturally in this an advantage over the present-day practical system of economics which has grown up, as it were, as an organism. The fact that capitalism is, so to speak, in possession has resulted in its supporters taking rather too much for granted. Like everything else, it is called upon nowadays to defend its title. It must justify itself on moral, social, and economic grounds, or else sooner or later it must inevitably yield place. It is far too much assumed by both sides that the position of capitalism depends upon "might being right." I mentioned Mr. Hartley Withers's book, "The Case for Capitalism," to a socialist friend one day, and he rejoined: "But it *has* no case!" Now this is the attitude which is too often unconsciously assumed even on the capitalist side, and if revolutionary socialism is not to gain ground, the capitalist supporter must not only first of all be convinced himself that capitalism has a "case," but must know exactly what that case is, and the principles on which it is based. It is obviously useless to deplore a workman being a revolutionary socialist if that is the only system which has been put to him as embodying the best, proper, economic, and moral principles. The problem, therefore, resolves itself into, first, formulating principles; and secondly, putting them forward for the adequate consideration of everybody concerned.

That there are further modifications necessary to the capitalist system as now in vogue goes without saying. That such agencies as Whitley Councils, if properly guided, may do much towards bringing about, or at least emphasising, these required changes, seems more than likely. Above all, clear, serious thinking is necessary. Finally, it must be constantly borne in mind that the test of any social organisation is its utility to the community. Applying this to capitalism, Mr. Hartley Withers's dictum might be quoted: "The test of an economic system is its success in providing us with a good world to live in." Such are the grounds on which propaganda must be based to be effective.

EXTRA-HIGH-PRESSURE CABLES AT BIRMINGHAM.

There is at present being laid in the City of Birmingham a three-core cable for the transmission of electricity at a pressure of 33,000 volts, under the Beard-Hunter system of automatic protection, the total length of the cable being about 10 miles. Two cables run through the City from the new Nechells generating station to the generating station at Summer Lane, and one cable is laid from this station to a substation at Bourneville, where the pressure will be stepped down to supply the surrounding area at 5,500 volts.

We give an illustration of the cable (fig. 1), which consists of three conductors, each of 0.2 sq. in. sectional area, paper insulated; the cable is lead sheathed and steel wire armoured, water-proofed and laid direct in the ground.

Three-core compensated pilot cables, for use with the Beard-Hunter automatic protective system, are laid in the same trenches, four pairs of telephone cores being provided in these cables for communication between the different stations.

Messrs. W. T. Henley's Telegraph Works Co., Ltd., have manufactured all the cables, and this firm is carrying out the laying and jointing. The joints are not of the usual lead-sleeve type, but are made with gun-metal sleeves plumbed direct on to the lead sheathing of the cable.

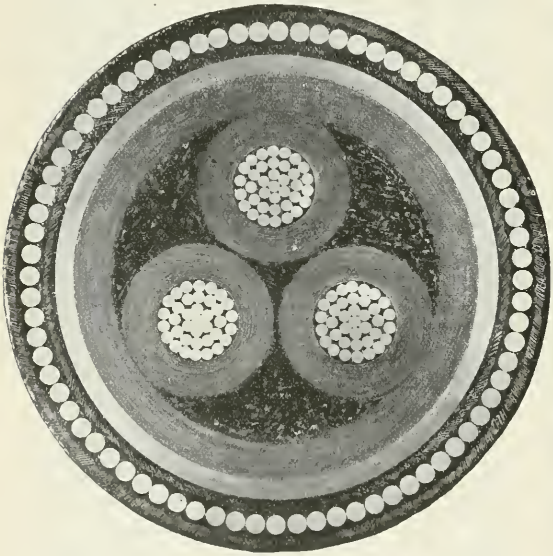


Fig. 1.—A 0.2 sq. in. 33,000-volt Cable (full-size section).

The cables are laid in the footway where possible, but where the footway is too congested, they are laid in the roadway. The extra-high-pressure, 3-core cables are laid in the trenches 18 inches apart, to counteract any possible heating effect, and the pilots and a thirty-pair telephone cable are laid between them. Fig. 2 shows the cables being laid.

After being laid, the e.h.p. cables will be tested at 90,000 volts d.c., and the portable apparatus for this test will be supplied by Messrs. Henley's. The apparatus which will be used is the "Delon," which is light in weight and of small capacity for such very high pressure.

At the time of writing the greater part of the cable has been laid, *i.e.*, between Nechells and Summer Lane, and the work has been very successfully carried out.

THERMIONIC AMPLIFIERS.

(*Abstract of Lecture delivered at* Newcastle-on-Tyne.)

Mr. J. R. Beard, chairman of the Centre, presided at a lecture on February 28th on the above subject, which was delivered to the members of the North-Eastern Centre of the Institution of Electrical Engineers by Mr. W. D. Owen, who, after briefly dealing with the basic principles of the thermionic valve, said it was important to study the characteristics of the valve in its simplest form, because the deductions drawn therefrom applied also to three- and four-electrode valves, which were revolutionising many branches of the electrical industry. By plotting plate current against plate potential a curve was obtained, half of which obeyed an exponential law, and the other half suggested the introduction of a limiting factor. From a series of such curves plotted with different filament temperatures, it became evident that the limitation of current was reached when all the electrons emitted by the filament per unit of time were attracted by the plate, in which case no further increment in plate potential could produce a greater thermionic current. Immediately the temperature of the filament was increased the emissions of electrons became more copious, and the current consequently greater. Another limiting factor operating was the space charge due to the cloud of free electrons in the immediate vicinity of the incandescent filament repelling their more recently freed neighbours back on to the filament. To overcome that space charge limitation it was necessary to increase the plate potential, and thereby accelerate the stream of electrons across the space.

It was thus evident that the successful operation of any thermionic tube depended upon the correct adjustment of both filament temperature and plate potential. Those explanations applied only to perfectly exhausted tubes in which the electrons were free to move without encountering any gas molecules, and the present day "hard" tubes were of that description. The presence of gas even in small quantities, modified the phenomena considerably, especially when the potential was high enough to move the electrons with sufficient velocity to disrupt any gaseous atoms in their path, thus liberating fresh electrons and positive ions, which moved towards the plate and the filament respectively, causing a considerable increase in plate current. The introduction of one or more auxiliary electrodes to enable the electron stream to be controlled by some independent source would seem, in retrospect, to be the next logical step in the development of the valve. Unfortunately, the valve was another of the many British inventions which had attained their consummation

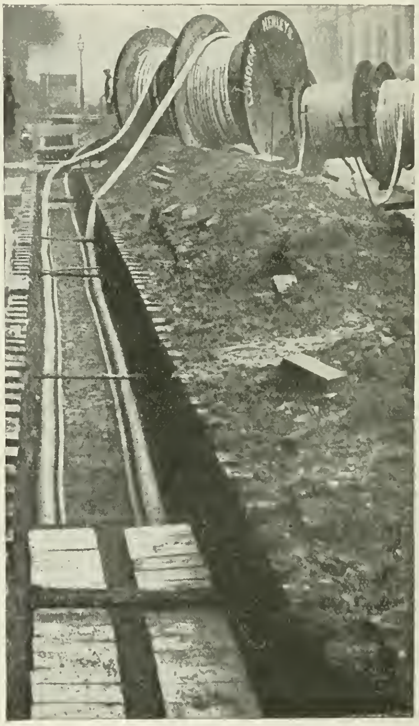


Fig. 2.—View of Cable Trench.

abroad. The speaker mentioned the simplest case of one control electrode situated either inside or outside the tube, but capable of exercising an electrostatic influence upon the electron as it left the filament. The fact of supreme importance was that a potential variation of unit value on the auxiliary electrode produced a plate-current variation such as could only be brought about by a very much greater variation in the plate potential; therein lay the secret of the tube's amplifying properties.

The lecturer referred to the amplification factor, and then spoke of the three-electrode valve, pointing out that one of its interesting applications might be described as that of a potential balance, or rather a potential lever, an arrangement for measuring high voltages. The positive pole of the supply to be measured was connected to the plate of the valve through a galvanometer or milliammeter, and the potential of the grid was varied until no current passed, then the product of the grid voltage and the amplification factor was the required voltage. Theoretically it should be possible to modify the arrangement so that h.p. a.c. could be measured on the same principle, but as the method necessitated a potential divider capable of withstanding the full potential across its extremities, it was not likely to be considered as anything but an interesting speculation. The static method of measuring the amplification factor was not so satisfactory as the dynamic method. The plate and the grid batteries were connected to the extremities of a variable resistance which, by means of a slider connected to the negative end of the filament, was divided into two sections R_1 and R_2. An alternating e.m.f. was also applied as in a Wheatstone bridge. When the filament was incandescent there would be a current flowing in the plate circuit, and that current would vary about its normal value as a result of the alternating e.m.f.'s on the grid, but the plate would be subject to simultaneous variations of the e.m.f.'s 180 deg. out of phase with those affecting the grid. By adjusting the resistances so that the drop across R_1 was equal to the drop across R_2, there would be no sound in the telephones, because there would then be no alternating component in the plate circuit.

The thermionic valve had made possible many wireless devices, to say nothing of wireless telephony, and the suggestion was made that it would be even more extensively applied if its limitations were carefully studied when its possibilities in some new directions were being tried out. The lecturer suggested that it might be supposed that the impulse to be amplified followed the sine law, and that it was desired to reproduce those sinusoidal variations faithfully in all respects other than amplitude. That could be done only within the limits of the straight portion of the curve. If the amplitude of the e.m.f. impressed upon the grid were sufficient to take the plate current beyond the upper and lower limits of that straight portion then distortion would result, and if a point on either the upper or the lower bend were chosen as the normal working point, half a cycle would be amplified and the other suppressed. That was a very valuable property in wireless telegraphy, as the valve then rectified the incoming signal for detection and amplified it at the same time. The substitution of a three-electrode valve functioning as a detector-amplifier for a two-electrode Fleming valve would sometimes transform weak unreadable signals into surprisingly loud ones.

The lecturer demonstrated the use of a three-electrode valve applied to wireless telegraphy, the messages transmitted from the Horsea station being picked up. He added that in practice it was seldom necessary or advisable to go beyond six or seven stages of amplification, because, in the first place, sufficient magnification could be obtained for all practical purposes with very few valves, and in the second place, it became more and more difficult to control successfully a multi-staged amplifier as the number of stages was increased, owing to the tendency to interoscillate and set up howling noises. Moreover, parasitic effects would all be magnified in like manner. Beyond four stages it was generally possible to use an electro-mechanical relay, by means of which any desired recording instrument could be operated. The lecturer concluded by alluding to the application of the thermionic valve to the frame aerial, and described the latter. He said that it was quite conceivable that the ubiquitous three-electrode valve might eventually be supplanted by a multi-electrode valve, in which each electrode would have some well defined function, all working together harmoniously to produce the desired effects.

THE ENGLISH ELECTRIC IMPULSE TURBINE.

For a number of reasons the impulse type of turbine has found favour in the eyes of engineers and those putting down new generating stations. This type allows ample clearance between the moving blades and all stationary parts, since the steam pressure in each of the stages is the same on each side of the disks. This feature adds to the safety and reliability of the machine, as compared with the reaction type which involves very fine clearances. Further, the only appreciable end thrust on the rotor is that due to the surface friction of the steam against the moving blades, and this can be dealt with by a thrust block of comparatively small dimensions. The impulse turbine requires fewer stages to deal with a given range of steam expansion, permitting a short and compact design.

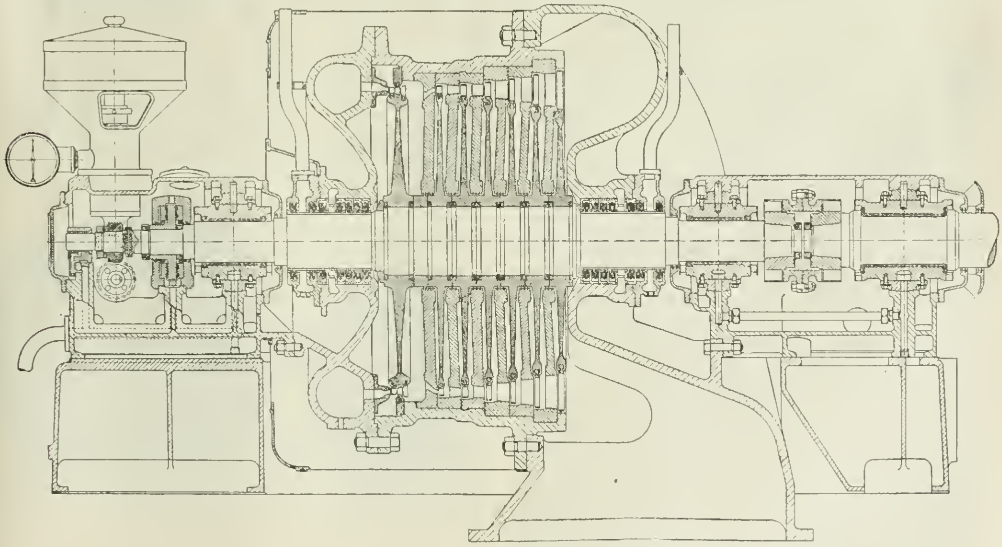


Fig. 1.—Longitudinal Section Through "English Electric" Turbine, 3,000 r.p.m. Frame.

The English Electric Co., Ltd., is now in a position to manufacture turbo-electric sets with capacities ranging from 250 kW to 30,000 kW, although none of the largest size have been produced yet. These machines are of very sound construction, and some details may prove of interest to our readers. The rotor shaft, upon which the disks carrying the impulse blading are mounted, is produced from a solid steel forging, rough turned, annealed and re-annealed between various stages of its manufacture, and finally ground to gauge. The shaft is accurately balanced before the disks are fitted. The latter are produced from solid steel forgings, and, as in the case of the shaft, are freed from internal stresses by repeated annealing. The disks are of a section to reduce to a minimum the stresses in the metal at the hubs; they are securely mounted on the shaft by means of supporting rings which are keyed into grooves in the shaft. The wheel hub does not actually touch the shaft, a feature which renders removal easy. The points of support are kept at the outer edges of the hub, thus avoiding contact at the centre of the disk where the maximum stretching due to rotation occurs. The moving blades are produced from solid nickel steel bar (fig. 2), and are machined to gauge, and finally polished to reduce frictional losses and liability to erosion. The blade roots, which are of "T" section, fit into corresponding grooves in the periphery of the disk, the blades being inserted through openings, which are securely closed by wedge-shaped locking pieces. Correct spacing is usually obtained by means of distance pieces forming an integral part of the blade (fig. 3), but in some cases these distance pieces are separate parts. The blades are shrouded with special steel strips, tangs being machined at the ends of the blades to provide a means of attachment. These tangs are inserted through slots in the shrouding, and are riveted over.

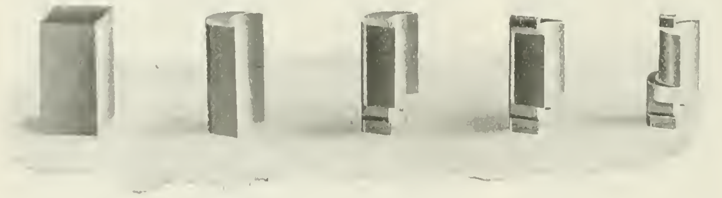


Fig. 2.—Stages in Blade Production.

The glands at both ends of the turbine are of the carbon ring type, consisting of a series of graphitic carbon rings, in three segments, held closely round the shaft by means of garter springs, a space being left between two rings inside the gland, which is supplied with sufficient steam at atmospheric pressure to form a seal. The possibility of air leakage to the condenser is thus obviated.

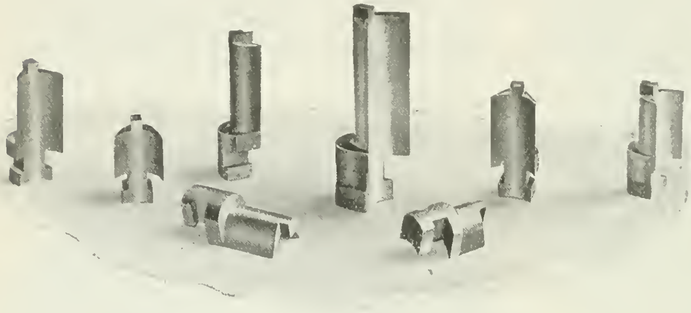


Fig. 3.—Types of Blade, Showing Distance Pieces.

The position of the rotor is maintained by a Michell type thrust block in which a single thrust sleeve, carried by and rotating with the shaft, is held in register by means of stationary elements in the form of inclined pads arranged radially in the fixed portion of the thrust block. These pads, which are supplied with a continuous stream of oil, provide a practically frictionless bearing, as there is always a film of oil between their inclined surfaces and the thrust sleeve. The thrust block is provided with means for close longitudinal adjustment, in order that the position of the rotor and the blade clearances may be fixed before the turbine is put into commission; when the adjustment has been made the block is secured in position by a special locking device.

As regards the stationary part of the turbine, the casing of the high-pressure end is of cast steel capable of withstanding the high pressures and temperatures of the steam before its expansion through the first series of nozzles. The low-pressure portion is of close-grained cast iron. The complete casing is divided on the horizontal centre line, and the top half may be lifted without breaking any pipe joints or dismantling the nozzle control and governing gear, thus giving free access for the examination or removal of the rotor. The steam end bearing pedestal, which carries also the thrust block, is connected to the turbine casing, and is designed with freedom to slide in an axial direction over a steel feather in the bedplate, and thus to follow the expansion of the casing.

The nozzles for the first expansion are carried in segmental castings which are bolted to the cast steel cover at the high-pressure end of the turbine casing. Steam passages of the predetermined form are obtained by means of shaped partitions of suitable alloy cast in the nozzle plate. The nozzles for the remaining stages are formed round the peripheries of the diaphragms in a similar manner.

The diaphragms are constructed of cast iron or steel, and are slightly dished in shape to stand rigid against the varying pressures exerted by the steam during changes of load when the turbine is in operation. For convenience in erecting and dismantling, the diaphragms are made in halves with a horizontal joint, the top halves being held in position in the cover by means of locking screws. The joints between the diaphragms are held in place and made steam-tight by the use of bronze keys which engage both halves. The sealing of the central openings in the diaphragms, through which the shaft passes, is effected by means of labyrinth packing glands formed by soft copper strips, of knife-edge section, which are caulked into parallel grooves so that the edges point outwards and practically touch the shaft. Should touching actually occur, the thin edges of the copper strips will be pressed back to a close running fit round the shaft without risk of damage to the machine.

In operation the turbine is controlled by a powerful vertical governor of the totally enclosed centrifugal type. The governor weights are freely supported on the vertical arms of bell crank levers, and are held in position by compression springs. When the turbine is operated the radial motion of the weights is directly transmitted to the governor sleeve, which communicates with a floating lever. The last in turn operates a small pilot valve controlling the admission of oil under pressure to the top or bottom of the oil relay cylinder. Thus a drop in speed is indicated at once by a downward movement of the sleeve, which, by altering the position of the pilot valve, allows oil to flow under the relay piston, and lifts the main throttle valve until the turbine speed has been brought to the correct level. The reverse action takes place if the speed rises above normal. A speed adjusting gear is fitted to the turbine by which the speed may be varied 5 per cent. on either side of the normal while the machine is running. This gear is useful for adjusting the frequency when bringing alternators into step, and may be arranged for control either from the starting platform or from the switch board.

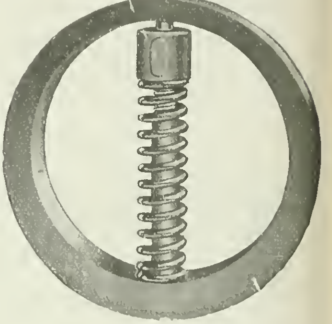


Fig. 4.—Emergency Governor Ring.

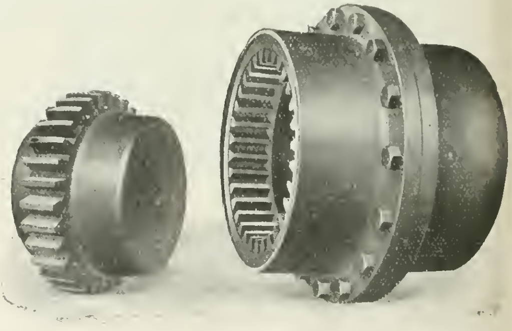


Fig 5.—Toothed Coupling

Every turbine is fitted with an emergency governor as a safeguard against the possibility of damage to the machine, should the main governor gear fail for any reason, allowing the speed to rise to a dangerous point. This governor consists of an unbalanced ring (fig. 4) mounted concentrically on the turbine shaft next to the thrust block, and held in position by means of a powerful compression spring. In the event of the turbine speed exceeding a predetermined maximum, the compression of the spring is overcome by the centrifugal force due to the unbalanced weight, and the ring takes up a limiting position eccentric to the shaft. This causes contact with a trigger which trips the valve mechanism, thus closing simultaneously the combined emergency and stop valve and the main governor valve, shutting off completely the supply of steam to the turbine. The trigger is arranged so that it may be tripped by hand, if necessary.

Oil under pressure, both for the lubrication of the bearings and for the operation of the main governor gear, is provided automatically by a small rotary pump, which is driven through worm gears from the turbine shaft.

Flexible couplings of the tooth or claw type are employed to connect the turbine and the driven shaft. The coupling is carried inside the exhaust end bearing pedestal, and consists of toothed steel sleeves (fig. 5), which fit over and are securely keyed to the ends of the two adjacent shafts, and an outer muff with corresponding internal teeth or slots which encloses the sleeves.

In addition to the standard high-pressure turbines, the English Electric Co. has developed special frames for turbines of the back-pressure, mixed-pressure, low-pressure, and reducing types. The standard frames are arranged so that they are capable of simple modification in detail to meet specially the conditions and requirements of a particular installation.

The foregoing particulars and illustrations are derived from a handsome brochure recently issued by the company.

RECENT DEVELOPMENTS IN TURBINE PRACTICE.

By K. BAUMANN.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

(*Concluded from p. 475.*)

Part IV.—Maximum Output at Given Speed.

The most important of the outlet losses are the leaving losses which it has been proposed to decrease by adding to the last row of moving blades a diffuser which converts the leaving velocity into pressure energy, but the increase in output which can thus be obtained from a given area of moving blades is very problematical, and the only effective method of reducing the leaving losses is to provide additional blade area for the last row of moving blades.

The blade area can be increased without increasing the stresses by providing blades, the cross-sectional area of which increases towards the root. The maximum increase is obtained by tapering the blade towards the root in such a way that the stress in the tapered portion is constant. For an increase of 50 per cent. in the blade area, it is necessary to increase the cross-sectional area 65 per cent. and, to double the blade area, by 172 per cent. The increase in cross-sectional area can be obtained by increasing the thickness of the blade, commencing with a thickness at the tip of the blade to be fixed mainly from considerations of strength of rivets required to hold the shrouding. The maximum thickness at the root is limited by the condition that the passage left between the blades must be such that the steam can pass without undue throttling. The blade area permissible for a given stress may be obtained either with a large mean diameter and a relatively short blade, or with a small mean diameter and a long blade. In the first case, the disk becomes relatively large and thin, and the danger of disk vibration must be faced. By adopting long blades, disks of small diameter can be made sufficiently rigid to prevent vibration, and, if the support of the blade is rigid, the possibility of blade vibration is greatly minimised. For these reasons a fairly large ratio h/D is preferable; the figure preferred by the author is $h/D = 1/3.5$.

The loss in efficiency resulting from the use of long blades is very small, and, considering that only the last few rows are affected, it is certainly not worth while running the additional risks connected with large disks, which for reasons of costs are not usually made of sufficient strength to prevent dangerous vibration. In any case, this slight difference in efficiency can be compensated for by providing a slightly larger leaving area.

To obtain the highest possible efficiency with long blades it is desirable to vary the inlet angle of the blade slightly, and there is little additional cost involved in doing so. To prevent the vibration of long blades it is good practice to provide intermediate lugs, which form a complete circle when the blades are assembled. With relatively long blades the fixing of the blade on the disk is the real limiting factor, owing to the fact that the root of the blade becomes relatively thin.

In the G.E. turbine (35,000 kW, 1,500 r.p.m.) installed at the North-West Station in Chicago, the blade area of the last row of blades is 73.3 sq. ft., and the stress in a blade of uniform cross-sectional area is 13.6 tons per sq. in. The bending stress in this blade would increase this stress by at least 20 per cent., but, owing to the increase in cross-sectional area possible with this parallel blade, the stress would be reduced in the ratio of 1.45 to 1.0, and the resulting stress is, therefore, about 11.3 tons as compared with 6.5 tons per sq. in. obtained in multi-exhaust turbines of similar capacities. The difficulties which are experienced in connection with these American machines, however, fully justify the more conservative policy which has been made possible by the use of the multi-exhaust principle.

The fact that in the American machines steel of higher physical qualities may have been used does not materially affect the position, as it is very risky to take full advantage of such properties, having in mind that these higher properties are generally accompanied by increased brittleness which may actually result in decreased safety. Heat treatment by quenching turbine disks of 8 ft. diameter to obtain an elastic limit (limit of proportionality) of 24.5 tons per sq. in. is very doubtful procedure, and it is not safe to assume that the treated disks will be free from internal shrinkage stresses.

It has become standard practice in water turbines to compare rotors on the basis of their capacity for dealing with water at a given head and speed, or, in other words, their capacity for producing power by means of what has been termed "the specific speed."

The author reverts to the original practice of introducing into his formula the volume, as this gives a more rational basis for comparing prime movers with driven machines.

His formula contains the simple relation between the specific speed and the dimension, velocity and peripheral speed ratios, and indicates to the designer all the steps he has to take to increase the speed of a machine. The established formula merely indicates to the estimator the approximate speed of a machine for given conditions, *i.e.*, for a given head and quantity. By means of his formula he compares runners of all types of turbo machines on a rational basis.

The advantages which are claimed to be possible with very high peripheral speeds for the last stage are not realised in actual practice. For this reason the author makes the comparison, so far as steam turbines are concerned, on the basis of the leaving velocity, showing that the capacity of a turbine increases as the square of the peripheral speed only for a given ratio h/D.

In 1912, the general practice was a more or less correctly-shaped exhaust casing without any attempt to guide the steam from the last row of exhaust blades to the exhaust port, which was generally of a circular shape, and the steam had to be distributed over the condenser surface by means of deflector plates. The circular exhaust port was usually kept as small as possible and was partially covered by the turbine cylinder, which overhung into the turbine exhaust. The flow of steam was thereby unduly throttled, and in some cases a drop in absolute pressure of as much as 2 in. occurred between the turbine blades and the condenser.

Even turbines quite recently constructed are incorrectly designed in this respect. For instance, if 50 per cent. of the exhaust port is covered by the turbine cylinder extending into the turbine casing, 50 per cent. of the total exhaust area is rendered ineffective, and the losses are consequently four times larger than with an exhaust properly arranged.

In figs. 6 and 7 (last issue) exhausts are shown in which the steam is directed by means of simple baffles from the last row of blades to the condenser surface in such a manner that the path of the steam is simple and short. Eddy losses are reduced to a minimum, and the steam is uniformly distributed over the whole condenser surface.

The demand for large and efficient turbines for large power stations has brought in its wake the various problems connected with the development of an efficient exhaust end for large turbines working at high vacuum, and the various solutions which have been put forward with a view to reducing the leaving losses to a minimum may be summarised as follows:—

(*a*) By designing a turbine for a lower speed (r.p.m.) any desired blade area can be obtained. Owing to the large decrease in speed usually necessary (*i.e.*, from 3,000 to 1,500 r.p.m. or from 1,500 to 1,000 r.p.m.) this solution is very costly, since it increases the cost per kilowatt of turbine capacity. Moreover, it has an adverse effect on the turbine efficiency.

(*b*) By increasing the length of the blades and the mean diameter, the increase which can be obtained to-day is 50 per cent. greater than that which was obtainable in 1912. Larger increases are difficult to obtain unless stresses are increased at the same time, and as a result of recent experience the present tendency is rather towards lower stresses and higher factors of safety.

(*c*) By adopting the double-flow exhaust principle the capacity of the machine at a given speed can be practically doubled. However, in order to meet critical speed requirements, it is necessary to adopt the two-cylinder design. It increases the cost of the turbine and the buildings out of proportion to the gain in economy due to decreased leaving losses.

The author contends that the multi-exhaust construction introduced by the Metropolitan-Vickers Electrical Co. meets the conditions, and the principle is best explained by means of fig. 17. The steam passes through the h.p. end of the turbine in the usual way until it reaches the special diaphragm D, where it is divided into two parts by the annular division ring E in the diaphragm. Passing through the outer annulus

F, the steam is expanded to condenser pressure, the shape of the diaphragm blades and that of the co-operating row of moving blades at this part being suitably proportioned. In the inner annulus G, the steam passes without appreciable expansion through suitably formed guide blades. Opposite G is the inner portion of the row of moving blades H, shaped in such a way that the stresses due to the centrifugal force are within the limits fixed by the material, the passages left between the blades being such as to pass the maximum quantity of steam with the smallest drop in pressure. The shape most suitable for this purpose is that of a blade with nearly 50 per cent. reaction, as shown in the diagram.

The steam then reaches the diaphragm J, which also has two distinct annular parts, the outer part K being suitably shaped to expand the steam to condenser pressure, and the inner part L to pass the steam on without appreciable expansion through suitably-shaped moving blades M to another diaphragm O, where the steam is expanded finally to condenser pressure over the full lengths of the blades Q. Due to the difference in pressure existing in the inner and outer annular passages, a small leakage occurs through the clearance spaces between the guide blades and the corresponding moving blades. This leakage is of quite a minor order, having regard to the large volume of steam dealt with at this part of the turbine.

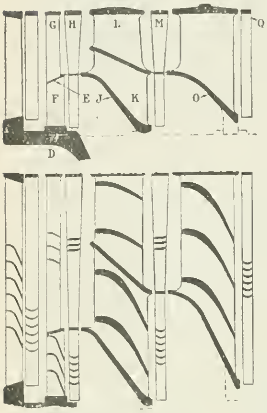
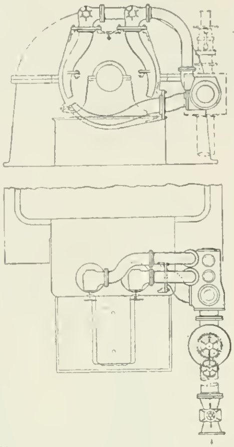


Fig. 17.—Multi-exhaust Turbine Diagram.



Figs. 18 & 19.—Arrangement of Nozzle Boxes.

With this construction it is possible to increase the leaving area of the machine in the ratio of 1 to 1.6 with one additional row of exhaust blades, in the ratio of 1 to 2.2 with two and of 1 to 2.7 with three additional rows. The output of the machine can, therefore, be increased over a considerable range without the use of the two-cylinder construction. Adding to this increase the increase possible by increasing the widths of the blade towards the root, we find that if 5,000 kW is the maximum output for a single-flow 3,000-r.p.m. turbine designed for a vacuum of 29 in. and having parallel blades and a given leaving loss, the corresponding output obtainable from a modern multi-exhaust type turbine having the same leaving loss and factor of safety is 20,000 kW.

In the multi-exhaust turbine the steam is divided into two separate flows only when it has become impossible to deal with the whole of it in a single row of blades. This is not the case in the ordinary types of double-flow turbines. On account of the fact that in a multi-exhaust turbine the steam quantity flowing through the high-pressure stages is much larger than usual, the efficiency of these stages is considerably higher than those of the corresponding stages of previous turbine designs, because the leakage, disk friction and gland losses, &c., are inversely proportional to the output. With the increased outputs possible with the multi-exhaust turbine, it is possible with Rateau turbines to adopt full admission, even for the first row of blades, and special nozzle boxes have been designed to this end.

Turbines built in two separate portions consisting of high- and l.p. elements, the former running at a higher speed than the latter, increase the cost and complicate the running of the plant. In the manufacture of the multi-exhaust type of turbine it is possible to derive considerable advantages which are not obtainable with other designs. It is possible to construct different multi-exhaust turbine frames for relative exhaust capacities of 1, 1.6, 2.2, and 2.7 on the same mean diameter and with the same length and type of blades. It is also possible to use the same set of patterns for moulding the turbine cylinders on all four frames. Thus, for instance, it was possible to build the turbines illustrated in figs. 6 and 7, pp. 473 and 474, on the same set of patterns, a distance piece having an axial length of 2 ft. being necessary to obtain the pattern for the latter frame from that of the former.

During the period under review, the floor space for turbines per 1,000 kW economical capacity has been reduced from roughly 40 to below 20 sq. ft., and the weight from 14 to below 7 tons. For large sets consisting of turbine and alternator the floor space per 1,000 kW economical capacity has been reduced from over 60 to below 40 sq. ft., and the weight from over 20 to below 15 tons. The total height of a turbine of 25,000-kW economical capacity with a condenser of 40,000 sq. ft. can be made less than 35 ft. by bolting the condenser directly to the turbine. It is practicable to make the higher-speed turbine with a smaller weight per kW capacity than the larger turbine. Present practice would indicate that the weight of the smaller machine would be about 10 per cent. smaller per kW capacity than that of the larger turbine. On the other hand, the manufacturing costs are about 20 per cent. higher per ton on the smaller machine and, consequently, the cost per kilowatt of the smaller machine would be about 10 per cent. higher than that of the larger low-speed turbine. This difference is, however, very small considering that the output must be increased four times to obtain a decrease in the cost per kilowatt of 10 per cent. On the whole there would be very little difference between the two cases as regards efficiency. Actually, however, the clearances are slightly larger in proportion on the high-speed machine and, consequently, the efficiency of this machine is reduced. As a rough guide, this difference in efficiency may be taken as being 2 per cent. As far as the efficiency is concerned, a turbine of 10,000-kW capacity running at 3,000 r.p.m. would be equivalent to a turbine of 20,000-kW capacity running at 1,500 r.p.m.

Part V.—Governing.

The use of oil relays for the operation of the governor valves is now universal for all large turbines. The principal disadvantage of throttle governing as compared with nozzle cut-out governing is due, not so much to the fact that at light loads the former is less efficient than the latter, but to the necessity in the case of throttle governing of bypassing h.p. steam to an intermediate stage in order to obtain loads greater than the economical load. Intermediate stages to which h.p. steam is occasionally admitted must be designed to stand the high pressures and temperatures as if they were h.p. stages.

The conditions under which these intermediate stages have to operate are in reality much more severe than those to which the initial h.p. stages are subjected.

The drop in temperature in the initial and in the by-pass stages for normal and maximum loads is much easier where nozzle governing is employed, and the variations of temperature with load in the first and second stages, besides being smaller in magnitude, are less sudden than those which take place with throttle governing. Owing to the practice for steam conditions tending towards higher pressures and temperatures these facts become of great importance, no matter whether the admission and overload valves are automatically or hand-operated. It is interesting to note that the practice adopted by the General Electric Co. during the period under review is exactly opposed to that which would follow from a consideration of the phenomena described above.

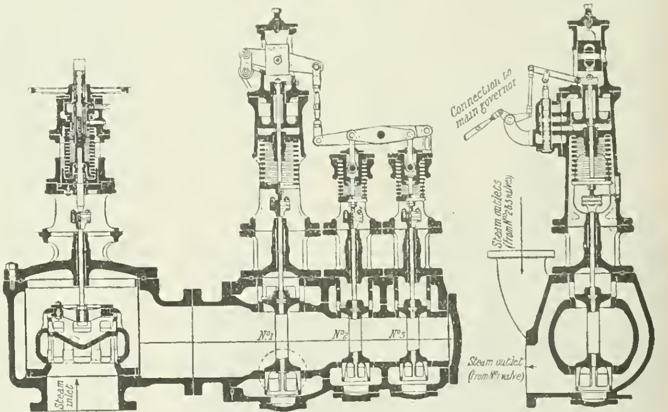

Connection to main governor
Steam outlets (from Nos 2 & 3 valves)
No 1
No 2
No 3
Steam outlet (from No 1 valve)
Steam inlet

Fig. 20.—Steam Chest and Governor Gear.

Most large turbines are required to give loads beyond the economical load automatically, and, in the author's opinion, all commercial needs can satisfactorily be met by the use of three automatic valves, with the addition of probably one or two hand valves to be used for emergency conditions.

Figs. 18 and 19 show an arrangement of nozzles and steam valves and the allocation of loads to each valve and nozzle group. The only parts which are subjected to full steam pressure and temperature are the steam chests and the nozzle boxes. The steam chest and the governor gear are shown in fig. 20. The body of the steam chest consists of an inner and an outer pipe. The inner pipe to which steam is supplied from the main stop valve is provided with three valves, which admit the steam to three compartments formed within the steam belt between the inner and the outer pipes. Each of the compartments in turn communicates with a group of nozzles. The three governor valves are actuated by means of oil pressure under the control of relay mechanism fitted to governor valve No. 1. As the load exceeds that which valve No. 1 is designed to carry when fully opened, the spindle of this valve continues to move upwards, carrying with it a lever pivoted at one end and attached at the other end by means of a short vertical adjustable link to one end of a second lever, the other end of which is pivoted at a fixed point above governor valve No. 3. This lever moves in the same plane as the lever situated above valve No. 1, and carries with it a floating lever, which is connected at its extremities to governor valves Nos. 2 and 3. The springs which close valves Nos. 2 and 3 are so adjusted that, for an increasing load, valve No. 3 remains closed until valve No. 2 is fully opened, and for a decreasing load valve No. 2 does not begin to close before valve No. 3 is fully closed. In like manner valve No. 1 does not begin to close on a decrease in load until valve No. 2 is fully closed.

Part VI.—Recent Steam Consumption Guarantees and Test Results.

In order to assess the economic value of various turbines it is necessary to reduce their thermodynamic efficiencies to a common basis by applying appropriate corrections in respect of certain controlling features which enable us, for comparison purposes, to reduce the thermodynamic efficiencies of turbines to a common standard basis in respect of steam and vacuum conditions. In order to obtain a comparison on a wider basis, *i.e.*, on the basis of the economic value of turbines, it is necessary to take into consideration corrections in respect of the output-speed characteristic and price, and in order to illustrate the application of the above-mentioned correction factors for reducing a turbine to a standard basis for purposes of comparison, the author works out an example on the basis of the published test results of a cross-compound steam turbine installed at the 74th Street Station at New York by the Westinghouse Electric & Manufacturing Co., Ltd. The maximum continuous rating of the machine is 30,000 kW and its economical rating 25,000 kW, the speed of the h.p. turbine being 1,500 r.p.m. and that of the l.p. turbine 750 r.p.m. The author shows that the economic value of this turbine is equivalent to that of a single-cylinder machine of a capacity of 20,000 kW and a speed of 1,500 r.p.m., the efficiency of which when designed for standard conditions would be 74.06 per cent. In order to illustrate the use of the corrections outlined, certain published steam-consumption guarantees have been analysed and corrected in the manner proposed, and it is to be regretted that only one test result on a large turbine has been published during the period under review with the necessary details to enable the actual performance to be judged.

Part VII.—Operation Experience.

The trend of development towards larger capacities at a given speed necessitated, in the case of single-flow turbines, an increase in the peripheral speed of the last wheels with a consequent increase in stresses. The difficulties which have been experienced, however, were generally not directly due to this increase in stresses, but to the increased tendency of the various parts to vibrate. These difficulties have become of the greatest importance owing to the great losses which have been incurred as a result of the various accidents which have taken place. It is the author's considered opinion that turbine development has arrived at the most critical stage in the history of the steam turbine, and a review of the difficulties experienced, together with a full and frank discussion between turbine users and manufacturers, of the means whereby these difficulties may be overcome, will be in the interest of all, and will facilitate further turbine development generally. The principal difficulties which have been experienced are reported in detail by the author, who says that considerable difficulties have been experienced due to distortion of the rotor and stator causing excessive rubbing. Unless large turbines are carefully warmed up so as to ensure a uniform temperature all round the cylinder and rotor, distortion is likely to cause rubbing. The uniform heating up of large low-speed turbines is much more difficult than that of small high-speed turbines, and to facilitate uniform heating up the rotor should, during the warming-up operation, be kept turning round at a low speed—say, 10 per cent. of the normal speed.

The difficulties can be minimised considerably by arranging the parts likely to rub independent of the shaft itself, so that the heat will take some time before reaching the shaft and, when it does so, will be more uniformly distributed all round the shaft. Thin sleeves fitting on the shaft are beneficial, but to be effective a space should be arranged or the sleeve should be of such thickness that it will distribute the heat uniformly all round the shaft. Another solution introduced by the General Electric Co. is dummy strips on the rotor, the strips being thin and relatively high. In case of rubbing, the heat will be generated on the tips of the strips, and as the cooling surface of the strips is relatively large, the heat will be absorbed by the surrounding steam before it is transmitted to the shaft through the thin strips. It is reported that these strips work quite satisfactorily, but they have the disadvantage that they cannot be replaced without taking the rotor disks off the shaft.

Trouble has occurred, particularly in connection with reaction turbines, directly due to the distortion of the turbine casing caused by the stresses resulting from the expansion and contraction of the steam piping, and difficulties have been experienced from the relatively weak support provided for the turbine bearing at the exhaust end. When the turbine was put under vacuum, the bearing support dropped considerably, thus throwing the rotor out of line.

The deflection of diaphragms may be due to two different causes:—

(*a*) The difference in pressure in front of and behind the diaphragm. In this case the deflection increases with the load on the machine, and may become larger than the axial clearance between the diaphragm and the turbine wheel, causing violent rubbing. The complete wrecking of the 35,000-kW turbine at Boston, U.S.A., was due to this cause. The accident took place when, due to a breakdown of another machine on the system, the large unit was called upon to supply the additional load, to which the governor promptly responded by causing the opening of the by-pass valve. The rubbing between the diaphragm and the disk was so intense that it caused the welding of the diaphragm to the disk. The diaphragm consequently started revolving with the rotor until the two halves were thrown off, bursting the turbine casing.

The actual deflection of a diaphragm composed of two portions, viz., the stationary blade portion and the remainder of the diaphragm, is the resultant of the deflection of each portion, and is very difficult to determine by calculation, and past experience has shown that the diaphragms which have been used were in many cases much too weak.

(*b*) The diaphragm usually fits into a groove in the turbine cylinder with a given radial clearance. At no load, or when the turbine is running non-condensing, the temperature of the steam flowing through the last rows of blades is considerably higher than when the turbine is running under load. If the load is decreased suddenly, or if the turbine changes over to atmosphere, the last diaphragms will heat up much more quickly than the more massive exhaust casing. The diaphragms will consequently expand at a greater rate than the casing and, if the clearances are not sufficient, the diaphragms may distort in an axial direction under the pressure exerted by the casing in a radial direction. This will cause rubbing between diaphragm and rotor, with disastrous consequences unless the turbine is immediately shut down.

Considerable difficulties have been experienced during the last eight years due to the cracking of turbine disks, and it has been possible to avoid serious accidents by inspecting the machine carefully as soon as increased vibration became evident and removing the faulty disk before an actual burst occurred. In another case, however, the turbine disk actually burst, primarily due to fatigue fracture which generally takes considerable time to develop. This fatigue fracture is caused by the vibration of the turbine disk giving rise to considerable vibratory stresses being superimposed on the static stresses due to centrifugal force and uneven distribution of temperature. With reasonably sound material, excessive static stresses would simply cause an elongation of the material without causing a fracture. High local static stresses, however, such as those which occur at balance holes, keyways with sharp corners, sharp edges or rough machining work in any part of the disk, or owing to faults in the material, are contributory causes. The vibration may be of the umbrella-shape, or the segmental type with two or more nodal diameters. The former is likely to be set up by some axial disturbance of the shaft such as may result from an inaccuracy of the thrust bearing or flexible coupling. The latter may be caused by the uneven distribution of the admission of the steam over the periphery of the turbine wheel, such as may occur with partial admission, or even with small inaccuracies in the stationary blades such as usually exist near the horizontal joint of the diaphragm. In such a case the nodal diameters rotate at the same speed as the disk, but in a direction opposed to the direction of rotation of the disk. They are, therefore, stationary in space, and the disk assumes a deformed shape stationary in space. There is evidence, however, that dangerous vibrations also occur in cases where the nodal diameters do not rotate relatively to the disk, or only at a speed lower than the running speed. Such vibrations may be set up by a slight vibration of the machine resulting from a badly balanced rotor. These various types of vibrations may exist at the same time, and greatly complicate the problem of predetermining the natural frequency of vibration by calculation, and a good deal of research work will be necessary to clear up the situation.

Owing to the difficulties which have been experienced, due directly or indirectly to the use of high peripheral speeds, the tendency towards the employment of such high peripheral speeds has received a definite check. During the war the difficulties were not primarily due to faulty material; if vibration had not existed, the fault in the material would not have resulted in the fracture of the disk. It is proved, however, that in some instances the faulty material did accelerate the fracture. The disk may easily pass an over-speed test of short duration, even if it is faulty; moreover, it is quite probable that the test itself may cause further local weakening. A good indication of correct rigidity can be obtained by supporting one end of the stationary rotor on a part of another machine which can be rotated at various speeds up to the maximum running speed for which the supported rotor is designed. If any parts of the stationary rotor vibrate in synchronism with the running machine, there is a possibility of similar vibration occurring when the rotor is run.

In impulse turbines the disk is heated or cooled by the steam leaking past the diaphragm glands, and it is thus kept at a fairly uniform temperature except for the lag occurring in the heating of the more massive hub as compared with the time required to heat the relatively thinner rim. This lag may be considerable with large disks, but will be much smaller with disks at the exhaust end such as are shown in figs. 6 and 7 (last issue). This point is of considerable importance for the l.p. disks, where the largest temperature changes occur, because at very light loads the steam at the exhaust end may become superheated owing to the windage losses due to the long l.p. blades, and also because when changing over to atmosphere the temperature may suddenly be raised from 100 to considerably over 200 deg. F.

In some types of reaction turbines disks are used for the l.p. end. The spaces between such disks are filled with stagnant steam, and when changes of load occur the difference between the temperatures at the rim and the hub may cause warping or vibration of the disks unless the spaces between the disks are ventilated by steam at approximately the same temperature as the steam flowing through the blades.

There have been difficulties due to blades being stressed too highly, and blades which are fixed to the turbine disks by means of a T-root have been particularly vulnerable, owing to the very high local stresses caused by the sharp corners which are associated with this type of fastening. The principal difficulties here are again due to the possibility of vibration, which may be set up by synchronous vibration of the turbine disk, or by excessive vibration of the machine due to unsatisfactory dynamic balance of the rotor, or to unsatisfactory working of the thrust bearing or coupling, or finally to a synchronous vibration of the blades themselves. The cure of the disease depends on its cause.

If the feed water is kept reasonably free from corrosive matter, particularly from CO_2 and oxygen, and if the turbine is kept free from moisture when standing, corrosion can be practically eliminated. The feed water should not be exposed to atmosphere at any part of its cycle. To ensure the turbine being in dry condition when standing, the air pump should be kept running for some time after shutting down, and the steam space should be open to atmosphere to lead away any steam which may leak past the stop valve. It has been found beneficial to inject a small quantity of kerosene into the steam entering the turbine, which forms a coating on the blades and affords protection against corrosion.

Erosion can be diminished considerably by draining the water from every stage so that it does not come into contact with the moving blades. It is also essential to prevent the accumulation of water in pockets and bends in the steam piping, valves and turbine casing.

During the period under review, bearing speeds have increased from 60 to over 120 ft. per second, and bearing pressures from 60 to over 120 lb. per sq. in.

The temperature of the oil should not exceed 160 deg. F. in any part of the system. There is no necessity for water cooling, and this additional complication should be abolished even with large high-speed bearings.

The success of large turbines depends to a great extent on their proper treatment during operation. The principal object in starting up must be to obtain temperature conditions as close as possible to those existing when the turbine is running under load, *i.e.*, the h.p. end must be heated up whilst the warming-up of the exhaust end should not be started until a considerable vacuum has been obtained, say, 20 in. (Hg). When a vacuum of 25 in. has been reached, the turbine should be started by passing a puff of steam through the governor valve, and should be kept running at about 10 per cent. of the normal speed for about 15 minutes, after which the speed may be increased to full at the rate of not more than 10 per cent., of the full-load speed in one minute. When the turbine is brought to full speed, in order to effect a gradual stabilisation in temperature, the load should be increased slowly at the rate of not more than 10 per cent. of full load in one minute.

The above particulars apply to large 1,500-r.p.m. turbines. For 3,000-r.p.m. machines, the time allowed for warming-up can be considerably reduced.

If vibration occurs during starting up, reduce the speed at once until vibration disappears, and keep running at the reduced speed for some time, after which the speed may again be increased. Keep the turbine and the generator in good running balance; if vibration increases for no apparent reason, shut the turbine down and examine the rotors.

Electrical Imports of Siam.—The imports of electrical goods and apparatus into Siam reached a value in 1919-20 of £121 790, as compared with only £86,563 in 1918-19.

NOTES FROM CANADA.

(From Our Special Correspondent.)

In the Canadian House of Commons recently there was a debate on the subject of the canalisation of the St. Lawrence river, and it is reported that there was little opposition to the scheme except on grounds of probable cost. This matter has been the subject of exhaustive inquiry by the International Joint Commission during the past year. This Commission has held numerous sittings in very many cities and towns in Canada and the United States, and has heard many witnesses for and against the project; as has been mentioned before in these notes, most of the opposition comes from New York State (chiefly on account of the existence of the Erie Barge Canal and the large expenditures which have been made on it), from the railway companies, and from Montreal.

To assist the International Joint Commission in its labours Canada and the United States each appointed an engineer to jointly investigate the whole scheme, and to report to the Commission; these engineers are supposed to have their report ready in the very near future, and probably within a short time afterwards the report of the Commission itself will be issued.

This report will be of very great interest to many sections of the community, as the scheme is one of far-reaching importance, and if carried out and successful will profoundly affect Canada and the Western States of the Union.

Primarily, the St. Lawrence canalisation scheme is one effecting navigation, for it is intended to enable ocean-going vessels to go right from the Atlantic to the western end of Lake Superior. The picture opened up to the imagination by such a project is one of possible tremendous expansion of Canadian trade, of the growth of towns and villages in the far interior of the country, of the creation of new lake ports, and the increased prosperity of existing ones, and of the rapid extension of the already vast grain-growing areas of the western Provinces.

The opponents of the scheme, of course, take a lugubrious view, and foresee vast sums of money expended on something which they are convinced will never bring in any return, hence, instead of increasing prosperity, they prophesy a burden of debt under which the country will languish for years.

The above is somewhat of a diversion, so to return it may be pointed out that those who favour the proposal to make Canada's greatest river a canal claim that the water power which could, by suitable engineering works, be developed would pay by far the greater portion, if not the whole, of the cost of the entire scheme, and doubtless, if the cost were not too heavy, so that power might be made available at reasonable rates, there would be much truth in this claim. The furnishing of approximately 4,000,000 h.p. to a region abounding in natural resources of all kinds—agriculture, mines, forests, fisheries, game, &c., should, if rates were competitive with those in other parts of the world, result in wonderful development throughout the territory served in Canada and the United States (it must be remembered that of the 4,000,000 h.p. mentioned about one-quarter would belong to the United States), especially when combined with navigational facilities communicating with a very large part of both countries as well as the outside world.

REVIEWS.

Motor and Dynamo Control. By W. S. Ibbetson, B.Sc., A.M.I.E.E. Pp. viii+476; 174 figs. London: E. & F. N. Spon, Ltd. Price 21s. net.

This book has been specially written for engineers who are engaged in the operation and control of all types of electrical machinery.

It covers a wide range of subjects; the first chapter is on "General Principles," while the last one deals with "Lubricating Oils and Mechanical Hints." The reviewer has searched in vain for any point with the slightest claim to freshness or originality.

In the so-called theoretical portions of the work extremely elementary applications of Ohm's law and the relations between mechanical and electrical units are given. The formulæ are given in every possible way, the author evidently being of the opinion that his readers will be incapable of carrying out the simplest algebraic transformation. The practical hints are on the same level as the theoretical work. In some cases the hints given are misleading. For example, when dealing with the drying-out of machines, the author recommends that "Immediately any smoke is seen, or excessive smell of charred insulation . . . is observed, open the main switch . . ." (p. 197.) This seems rather like locking the stable door after the horse has been stolen. The author might with advantage have recommended the use of thermometers. The instructions regarding paralleling d.c. dynamos (pp. 209 and 273) are inadequate, as the danger of a machine having wrong polarity is not mentioned.

The author seems to think that supermen are required for paralleling alternators (p. 274). The operation is really very simple, and could be performed by anyone of normal faculties after a few minutes' tuition.

Catalogue information is freely used, the notes on motor converters being a specially glaring example. All the matter and figures on this subject can be found in Messrs. Bruce Peebles's pamphlet, which is itself a reprint of a paper by Mr. Saaler.

In his chapter on "Alternate-current Motors," the author seems to imply that for power purposes 25-cycle supply is better than 60-cycle supply. This view will not be supported by engineers afflicted with 25-cycle systems.

The figures consist of simple line diagrams, and the inevitable manufacturers' stock illustrations. The diagrams are not particularly well executed, and figs. 59 and 60 are poor. The winding diagram given in fig. 17 has a remarkable similarity to that given in Barr's "Direct Current Engineering" (fig. 144).

The English style in the book is hardly what one would expect from an honours graduate. The author seems to have very little use for verbs. One of his sentences(?) is "Easy adjustment of brush rocker, yet secure fixing in any position by bolts easily accessible" (p. 224). This savours of Walt Whitman. On the same page he starts another priceless effort which runs to 87 words; the reviewer was keenly disappointed that the century was not reached. Under "Fault Localisation" there are weary lists of troubles which ought to be self-evident to the merest apprentice. These are also tabulated in the manner of the august American poet.

The book may be useful to the great army of untrained practical men, who are averse to thinking for themselves, but even to them it cannot be of much permanent benefit.

The reviewer has no hesitation in candidly expressing his opinion that any ordinary electrical pocket book is a far better investment than the work under review.—C. W. M.

The Year Book of Wireless Telegraphy and Telephony, 1921. Pp. 1,355, illustrated. London: Wireless Press, Ltd. Price 21s. net.

This, the ninth, edition has been increased to the extent of two hundred pages. Apart from additions to the articles which form, perhaps, the most attractive feature of the work, the standard features have been amplified and extended to bring them into line with recent developments. An addition which is likely to prove of service is a nine-page list of schools and colleges at which wireless telegraph courses are given. The information contained in this list includes details of fees, hours of attendance, and duration of course for schools in many parts of the world.

In the Special Articles Section, the "National Résumés" now include notes on the progress in 1920 in Canada, China and Spain. The Canadian notes are contributed by Prof. A. S. Eve, and it is stated that the most important radio-telephonic event of the year was associated with the visit of the Imperial Press Delegation to Canada, when communication was established with the s.s. *Victorian*, which carried the delegates, at a distance of one thousand miles. Mr. F. E. Robinson deals with Chinese progress, which has been very rapid. The Wireless Telephone Signal Corps, officered by Chinese military officers, proved a valuable unit during the 1920 disturbances, when the telegraph and telephone wires were cut. Three 25-kW stations are in course of erection, and in addition to these a factory is being built by the Chinese National Wireless Telegraph Company at Shanghai for the output of wireless apparatus. The remainder of the *résumés* are written by eminent men in their respective national fields and taken together form a valuable record of the forward steps made during the year.

There are four special articles in the present issue; that on "Valve Amplifiers for Shipboard Use" has been re-written by its author, Mr. F. P. Swann. The article which appeared in the last edition discussed the factors which governed the design of the three-valve amplifier; the four electrode valve was then in the embryo state, and it was recognised that the design put forward at that time was only a temporary measure. Since then, however, a great advance has been made, and the description of a four-electrode valve and its circuits is dealt with very fully. The details of the valve are reached through a description of the three-electrode valve and its development, and, by means of the diagrams given, the designs and circuits are not difficult to follow.

Mr. Philip R. Coursey, B.Sc., A.M.I.E.E., in an interesting and useful article, describes "Some Outstanding Problems of Radio Reception, with Particular Reference to Interference." The author details the methods employed to eliminate or minimise tuned and untuned interference from other stations and from natural electrical disturbances or atmospherics. Dealing briefly with alteration of wave-length, not a very practical solution, the author passes on to directive reception and its advantages in connection with the elimination of interference by other stations. The prevention of interruptions by natural phenomena—a much more difficult matter—is discussed, and the means of combating their effects are treated of, including the omission of tuning of the aerial circuits to the signals to be received, so that the natural oscillations set up by the atmospherics will thus be given a different frequency from that of the signal it is desired to receive. The incoming signals, if their decrement is very small, will be able to force an oscillation of their own frequency in the aerial circuit, and thus affect the tuned secondary circuit coupled to the aerial. This coupling must be a weak one, or the atmospherics will impulse the secondary directly. Thus at least a partial separation of signals from the atmospherics is possible. Variations of this arrangement are dealt with, and these are followed by descriptions of limiters as opposed to "eliminators" of the effects of atmospherics. The "Kallirotron" limiter, devised by L. B. Turner, is detailed and illustrated diagrammatically. Several other devices are briefly mentioned, and the whole forms a valuable guide to the solution of interference problems.

"The Radio Compass" is very fully described by Mr. Stuart Ballantine. Commencing with the theory of operation of an ideal compass, the author passes to the modified theory of the compass in its practical form. This is a thoroughly technical article which takes into account an enormous number of factors. The remaining article is a survey, by Prof. G. W. O. Howe, D.Sc., of the "Historical Landmarks in Wireless Invention." Commencing with the experiments of Hertz in 1887, progress is traced step by step, through the inventions of Lodge, Marconi, and many others, to the state of the science and art at the present time.

It is impossible, within any reasonable space, to deal adequately with a work of this nature, but perhaps enough has been said to indicate its worth to all in that ever-widening field which was first opened up such a short time ago.

The Theory of Direct-Current Dynamos and Motors. By John Case, M.A. Pp. xiii+196; 122 figs. Cambridge: W. Heffer & Sons, Ltd. Price 15s. net.

This book, the author states in his preface, is intended to cover the gap usually existing between the work commonly dealt with in specialised books on the design of electrical machines and the work met with in text books on general electrical engineering. The hope is expressed that it will, in particular, be useful to men reading for an honours degree in universities.

The treatment of the subject is essentially from a theoretical point of view, no attempt being made to include an account of constructional details. While agreeing in general with the author, that such information can best be obtained by practical experience, we feel that an ideal book should contain a due proportion both of theory and of practice. Many useful lessons can be taught from work of a more practical character, the interest of the student is more likely to be secured, and an appeal is made to a wider circle of readers.

The greater part of the book is concerned with the theory of the operation of dynamos and motors, special attention being devoted to the consideration of losses and efficiency and to motors for traction. The section dealing with losses and efficiency, which includes a full account of the appropriate methods of testing, may be well commended.

Numerous examples, many of which are taken from university examination papers, are included in the book, some of which are fully worker out and others left as exercises for the reader. Those dealing with characteristic curves of motors and dynamos strike us as being particularly useful and interesting. In a few of the worked examples we find numerical errors, and in others the data might perhaps be improved, but these are matters which will doubtless be set right when the time arrives for a second edition. A list of answers to the unworked examples might, with advantage, be added at the same time.

The book is well printed and the figures are clear, though in a few cases the lettering on them is not quite in line with the text.

Lehrgang der Schaltungsschemata elektrischer Starkstrom-Anlagen. By Dr. J. Teichmüller. Vol. I; Schaltungsschemata für Gleichstromanlagen. Pp. vii+131; 27 plates, 9 figs. Second edition. Munich: R. Oldenbourg. Price 68 M.

The main feature of this publication is the set of lithographic plates, giving diagrams of connections of a wide range of electrical apparatus and installations; these are very clearly printed and easy to trace, although sometimes as many as 20 diagrams appear on one plate. The subjects vary in complexity from the simplest two-wire circuit to very elaborate power-station switchboards, with batteries and boosters, &c.—all for direct current in this volume. Three-wire balancing generator windings of various types are illustrated, the Thury system of transmission finds a place, and examples are given of connections to fulfil special requirements. The last plate is devoted to a pictorial index to the symbols employed in the diagrams.

The text for the most part is directly related to the diagrams, explaining the purpose of these and pointing out possible modifications. A few paragraphs are of a more general nature. The plates are detached from the bound volume, so that they can be studied alongside of the explanatory text without turning pages. The work is certainly useful and, so far as we have tested it, reliable.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

9,844. "Variable speed squirrel cage induction motors and generators." J. C. B. Ingleby. April 4th.

9,857. "Mechanical and electrical railway fog-signalling apparatus." G. A. Farmer, L. J. Coussmaker, and E. A. Campbell. April 4th.

9,858. "Apparatus for indicating approach of trains." E. A. Campbell, L. J. Coussmaker, and G. A. Farmer. April 4th.

9,862. "Continuous flow apparatus for manufacture in solution of pure alkali, &c., by electrolysis." C. G. Vernon. April 4th.

9,874. "Switch and fuse contacts." Callender's Cable & Construction Co., Ltd., and A. E. Wilson. April 4th.

9,877. "Electric burglar alarms." G. Kirk. April 4th.

9,881. "Mounting for trolley poles." V. Spagnuola and M. Urbinati. April 4th.

9,882. "Wind-driven electric generating sets." G. Lambert. April 4th.

9,888. "Sparking plug." M. Prat. April 4th.

9,904. "Adjustable telephone bracket." T. W. Arney. April 4th.

9,909. "Electrically-heated muffle furnaces." Akt.-Ges. Brown, Boveri et Cie. April 4th.

9,910. "Apparatus for suppressing upper harmonic currents in metal vapour rectifiers." Akt.-Ges. Brown, Boveri et Cie. April 4th. (Switzerland, April 10th, 1920.)

9,911. "Apparatus for suppressing upper waves in the direct-current circuit of metal vapour rectifiers." Akt.-Ges. Brown, Boveri et Cie. April 4th. (Switzerland, May 15th, 1920.)

9,913. "Installatinn apparatus for wireless telegraphy." C. S. F. Mellor. April 4th.

9,919. "Electron discharging device." British Thomson-Houston Co., Ltd. April 4th. (United States, October 22nd, 1920.)

9,920. "High-resistance conductors." British Thomson-Houston Co., Ltd., and H. W. Taylor. April 4th.

9,921. "Current collecting devices for electrically propelled vehicles." British Thomson-Houston Co., Ltd., and C. McCready. April 4th.

9,926. "Decorative electric devices." H. H. Berry and C. A. Painton. April 4th.

9,933. "Galvanic batteries." G. Oldham and J. Oldham. April 4th.

9,934. "Pocket electric lamps." G. Oldham and J. Oldham. April 4th.

9,951. "Cut-outs." Metallurgique Electrique. April 4th. (France, September 6th, 1920.)

9,952. "Automatic circuit breakers." Metallurgique Electrique. April 4th. (France, September 6th, 1920.)

9,958. "Electro-mechanical lamps." P. Blot-Garnier and G. Chevalier. April 4th.

9,959. "Ships' telegraphs, &c." W. Clark (C. P. Clark). April 4th.

9,984. "Railway signalling devices." Ateliers de Constructions Electriques de Charleroi Soc. Anon. April 5th. (Belgium, January 3rd.)

10,005. "Sparking plugs." L. S. Clarke. April 5th.

10,038. "High-frequency duplex signalling system." Western Electric Co., Ltd. (Western Electric Co., Inc.). April 5th.

10,051. "Plug connections for electric circuits." J. Hall & Co. and G. F. Ostins. April 5th.

10,057. "Liquid electric controller." R. F. Baerlocher. April 5th.

10,058. "Drum type controller." R. F. Baerlocher. April 5th.

10,065. "Electric relays." E. A. Sperry. April 5th. (United States, November 13th, 1914.)

10,081. "Injection devices for internal combustion engines." J. Romeyn. April 6th.

10,098. "Electric lamp for motor cars and cycles." L. E. H. Hill. April 6th.

10,119. "Short-circuiting electrical devices." C. F. Killar. April 5th.

10,133. "Attachment for automobile dynamos for combining the action of lighting and starting." S. Gussin. April 6th.

10,140. "Apparatus for magnetising steel for permanent magnets." A. T. Scorey. April 6th.

10,141. "Electrical switchboards." Metropolitan-Vickers Electrical Co., Ltd. April 6th. (United States, April 23rd, 1920.)

10,168. "Electro-refining glass furnace." W. G. Clark and L. N. Bruner. April 6th. (United States, April 6th, 1920.)

10,172. "Illumination control systems." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). April 6th.

10,178. "Means for cooling dynamo machines." R. F. Baerlocher. April 6th.

10,179. "Apparatus for registering telephone calls." E. H. Kinnard. April 6th.

10,181. "High-frequency telephone systems." Ges. fur Drahtlose Telegraphie. April 6th. (Germany, April 9th, 1920.)

10,183. "Insulated conductors." British Thomson-Houston Co., Ltd. (General Electric Co.). April 6th.

10,178. "Means for cooling dynamo electric machines." R. F. Baerlocher. April 6th.

10,199. "Device for testing sparking plugs." G. Burchell. April 6th.

10,213. "Device for automatically making and breaking an electric circuit with commencement and ceasing of speaking currents, &c." Telegraphon Ges. April 6th. (Germany, August 24th, 1920.)

10,217. "Regulation of high-tension cable systems." A. M. Taylor. April 6th.

10,239. "Sparking plugs." S. P. Shaw. April 7th.

10,241. "Sparking plugs." J. S. Borrington, W. H. Lowth, and Lowth & Smith, Ltd. April 7th.

10,249. "Spring contact members for electric circuits on motor vehicles." E. G. Mottershead. April 7th.

10,261. "Variable rheostats, &c." L. A. Gow. April 7th.

10,265. "Machine for undercutting commutator micas of dynamo-electric machines." G. Flower. April 7th.

10,274. "Telephones." E. A. Laidlaw and Siemens Bros. & Co., Ltd. April 7th.

10,281. "Counting mechanism for telephones." H. J. Carter. April 7th.

10,285. "Teletype machines." E. C. R. Marks (Morkrum Co.). April 7th.

10,324. "Wireless telegraph and telephone systems." H. J. Round. April 7th.

10,326. "Reception of radio signals." Marconi's Wireless Telegraph Co., Ltd. April 7th. (United States, April 14th, 1920.)

10,332. "Electrolytic apparatus." J. T. Niblett. April 8th.

10,341. "Holders for electric lamps, plugs, &c." H. J. Dean-Osgood. April 8th.

10,365. "Electric tumbler switches." G. H. Webb and W. H. Wood. April 8th.

10,372. "Electric and automatic device for egg testing." H. E. Keogh. April 8th.

10,394. "Control of alternating current electric motors." Metropolitan-Vickers Electrical Co., Ltd. April 8th. (United States, June 17th, 1920.)

10,396. "Electro-magnetic machines." G. de Holden-Stone. April 8th.

10,398. "Ignition devices for internal combustion engines." A. E. Lamkin. April 8th.

10,399. "Apparatus for regulating phase compensation for asynchronous electric machines." E. C. R. Marks (Siemens-Schuckertwerke). April 8th.

10,403. "Lamps, searchlights, &c." J. G. Smith. April 8th.

10,404. "Commutators." J. E. Calverly and W. E. Highfield. April 8th.

10,416. "Electro-magnetic switches." British Thomson-Houston Co., Ltd. (General Electric Co.). April 8th.

10,417. "Lighting fixtures." British Thomson-Houston Co., Ltd., and F. M. Cocksedge. April 8th.

10,418. "Electron discharge devices." British Thomson-Houston Co., Ltd. and R. C. Clinker. April 8th.

10,433. "Dynamo electric machinery." H. E. Joel, April 9th.

10,434. "Combined safety coupling and buffer for colliery trams, &c." R. J. Haddon. April 9th.

10,441. "Electric switches." J. B. Tucker. April 9th.

10,442. "Electric switches." J. B. Tucker. April 9th.

10,462. "Electrical machines." S. B. Morgan. April 9th.

10,472. "Electric lighting systems." F. W. Highfield. April 9th.

10,473. "Vent plugs for electrical accumulators, &c." C. Saunders and Saunders Electrical Co., Ltd. April 9th.

10,478. "Electric voltage regulators." E. C. Wilkins. April 9th.

10,487. "Dynamo electric machines." E. C. Hatcher and T. Rooke. April 9th.

10,498. "Electric conductors." S. G. Frost and J. Erskine-Murray. April 9th.

10,506. "Cattons for storage, &c., of electric lamp bulbs, &c." A. H. Rippon. April 9th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

20,399. "Wireless direction finders." H. J. Round. August 19th, 1919. (160,475.)

22,114. "Pulleys for use with trolley poles of electric tramcars, and for other purposes." G. A. Bishop and R. A. Chadwick. September 9th, 1919. (Cognate application, 9,303/20.) (160,478.)

25,950. "Electric heat radiators." A. F. Berry. October 22nd, 1919. (160,486.)

28,315. "Electrical seam-welding machines." E. Schroder. June 8th, 1918. (Addition to 133/700.) (135,212.)

28,478. "Electrical seam welding machines." E. Schroder. June 12th, 1918. (135,482.)

29,033. "Electric switches." H. F. Westney and British Ever Ready Co., Ltd. November 21st, 1919. (160,497.)

29,296. "Wireless receiving apparatus." C. K. Chandler. November 24th, 1919. (Cognate application, 14,683/20.) (160,502.)

31,617. "Electric welding." O. A. Kenyon. December 17th, 1919. (160,518.)

31,788. "Combined electrical and mechanical drive for a vehicle equipped with steam turbines, polyphase generators, and asynchronous motors." Maschinfabrik Oerlikon. October 30th, 1919. (153,270.)

31,899. "Electric furnaces." British Thomson-Houston Co., Ltd., H. C. Hastings, and N. Laycock. December 19th, 1919. (160,529.)

31,920. "Electric switchboards." A. H. Midgley and C. A. Vandervell and Co., Ltd. December 19th, 1919. (160,531.)

31,948. "Ignition devices for internal combustion engines." F. A. Smith. December 19th, 1919. (Addition to 142,197.) (160,535.)

32,066. "Automatically operated electric switches for controlling electric motors." J. A. Hirst and P. S. Brook. December 22nd, 1919. (160,547.)

32,132. "Manufacture of plates or sheets by electro-deposition." S. O. Cowper-Coles. December 22nd, 1919. (160,554.)

32,371. "Electric arc lamps." F. R. Boardman, R. V. Boardman, and F. Boardman. December 24th, 1919. (160,569.)

32,372. "Reflectors for electric arc and other lamps." F. R. Boardman, R. V. Boardman, and F. Boardman. December 24th, 1919. (160,570.)

32,375. "Electric arc lamps." F. R. Boardman, R. V. Boardman, and F. Boardman. December 24th, 1919. (160,571.)

32,879. "Electric cigar lighters and similar devices." Quain Electric Co., Ltd., and J. R. Spink. December 31st, 1919. (160,582.)

1920.

209. "Alternating current track circuits for railway signalling." Automatic Telephone Manufacturing Co., Ltd., and P. N. Roseby. January 3rd, 1920. (160,589.)

467. "Electric accumulators." J. H. Green. January 6th, 1920. (160,595.)

707. "Electrical switchgear." W. A. Coates, G. E. Gittins, D. R. Davies, and Metropolitan-Vickers Electric Co., Ltd. January 8th, 1920. (160,603.)

1,415. "Means for facilitating the timing of electric ignition apparatus of internal combustion engines." F. C. Ewart. January 16th, 1920. (160,609.)

1,591. "Electric condensers." British Thomson-Houston Co., Ltd., A. P. Young, and H. L. Durrant. January 17th, 1920. (160,611.)

1,660. "Elastic fluid turbines." British Thomson-Houston Co., Ltd. (General Electric Co.). January 19th, 1920. (160,616.)

4,012. "Electric lamp." G. A. Fennimore. February 10th, 1920. (160,637.)

4,592. "Flame proof boxes for switches, fuses, and similar electrical fittings." W. T. Henley's Telegraph Works Co., Ltd., and G. Gregoire. February 14th, 1920. (160,641.)

5,432. "Electrically heated utensil." E. C. R. Marks (Landers, Frary and Clark). February 23rd, 1920. (160,645.)

7,799. "Railway electric track-circuits." W. R. Sykes Interlocking Signal Co., Ltd., and R. W. Tarrant. March 16th, 1920. (160,663.)

8,244. "Electric motors for starting internal combustion engines." R. Bosch Akt.-Ges. May 5th, 1919. (142,795.)

9,822. "Flexible pendant electric light fittings." W. Broadbent. April 8th, 1920. (160,086.)

10,612. "Spark plugs." R. R. Hill. April 5th, 1916. (141,740.)

11,150. "Terminal electrical connections suitable for the sparking plugs of internal combustion engines." M. L. Williams. December 10th, 1919. (Divided application No. 151,349.) (160,375.)

11,624. "Spark plug." J. M. McHernan. April 27th, 1920. (160,093.)

12,506. "Telephone exchange systems." Western Electric Co., Ltd. August 17th, 1916. (142,851.)

12,943. "Electrical connectors." Western Electric Co. August 16th, 1918. (143,220.)

14,721. "Electric fuses." G. Austin. May 31st, 1920. (160,383.)

16,399. "Snap-action switches for electric lighting circuits." R. Alkan. August 19th, 1919. (149,940.)

16,680. "Electric contact makers and circuits connected therewith for railways and the like." N. P. Roe. June 21st, 1920. (Patent of addition not granted.) (160,388.)

17,348. "Electrolysers." R. Pechkranz. June 27th, 1919. (146,184.)

19,104. "Pneumatically operated electric switches." W. J. Thorrowgood and F. Bushrod. December 30th, 1919. (Divided application on 150,778.) (160,113.)

19,108. "Brush holders of electric dynamos." F. Munz. April 5th, 1919. (147,089.)

20,593. "Controlling system for simultaneously firing a number of guns from a central station." Siemens & Halske Akt.-Ges. April 13th, 1916. (148,771.)

21,389. "Electric induction regulators cooled by forced draught." Akt.-Ges. Brown, Boveri et Cie. July 15th, 1919. (149,284.)

21,628. "Conduit fittings for electric conductors." H. March and W. Newey. July 19th, 1920. (160,711.)

21,855. "Electromagnets." Soc. Anon. Des Etablissements L. Bleriot. July 31st, 1919. (149,342.)

23,375. "Electric motor for driving phonographic and other machines." H. Wade (H. S. Mills). October 22nd, 1919. (Divided application on 154,411.) (160,715.)

23,750. "Pouring channels for electric and other furnaces." D. De Luca. September 2nd, 1919. (Divided application on 150,532.) (159,803.)

28,081. "Apparatus for separating or sorting fragmentary materials by electric conductivity." H. L. A. Schweitzer. October 3rd, 1919. (151,990.)

26,901. "High-frequency electric signalling." Western Electric Co., Ltd. September 29th, 1919. (Addition to 102,503.) (151,928.)

31,516. "Electrical transformers." Metropolitan-Vickers Electrical Co., Ltd. December 10th, 1919. (155,237.)

THE

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INDUSTRY AND WAGES.

IT seems that the Government has had under consideration a suggestion for a systematic inquiry to be made regarding industrial unrest. There was such an inquiry held during the war, as our readers will well remember. The country was divided up into districts, lightning investigations of causes of disaffection were made, the pulse of the industrial community was felt, and the Government found out many things that it wanted to know at a time when it was imperative for all our industrial resources to be employed in bringing the war to a successful issue. We observe that the Premier thinks that there *may be* a good deal to be said for repeating that experiment, and he hints that employers and employed might unite in making the investigation, thereby, as on the former occasion, assisting the Government in finding out really what is happening in the industrial world. We observe that one member of Parliament would like to include within the compass of such an inquiry the question of an equitable rate of wages, not only for one trade, but for the whole trade of the country. We are not surprised, however, to find that the Premier deprecates so wide an inquiry, and detects therein a source of great danger. Profiting, we suppose, by the experience of the Government in its unfortunate bungling of wage questions when it was controlling the production of munitions of war, he adds that questions of wages are much better settled between employers and workmen.

With regard to the proposed new inquiry, we fear that little good can be expected to result from it. It can hardly be said that the Government is in need of information as to the causes of industrial unrest, though it may be that the members of the community who have to vote at election times would be better able to judge what influences are really at work amongst us if the whole of the facts could be suitably reviewed. There is a dangerous element working for revolutionary ends, and recent utterances of a delegate of the Electrical Trades Union (London) cannot be overlooked; but we believe that the great mass of the people of the United Kingdom want to carry on their industrial and family life free from such disturbing elements. Yet they are most of them concerned about wages and probable reductions therein. They care little about inquiries respecting the causes of industrial unrest, and through their organisations they are strong enough to negotiate respecting wages. It is, as the Premier says, far better for employers and workmen to settle such matters between them. What we are waiting for is the growth of a sincere spirit of inquiry and compromise between employers and employed in each separate trade. Surely it has become plain to nearly everybody by now that if wages do not go down or, alternatively, production increase, we shall lose more and more of our trade, because our prices will continue to be non-competitive. At present, in some trades, increased production cannot be secured because there is not the demand; many selling prices have got to fall before the demand will return; yet unless we are to do business on uneconomic terms, selling costs can only fall as costs of manufacture, including wages, go down. Organised workmen may struggle to defeat their employers, and may succeed in wrecking the industries out of which they have hitherto gained their livelihood; but there will always be the economic force to fight when the employer is done with. Both sides have to reckon with it—it is always there, imperative in its laws and inevitable in its consequences. To kick against the pricks is to court discomfort, and to run one's head against a wall is not to damage the latter.

Mr. J. Annan Bryce, the chairman of the Metropolitan-Vickers Electrical Co., in the course of the speech which is reported in our "City Notes" to-day, referred to the growing human sympathy of the employers and a desire among them to maintain the improved standard of living promoted during the war, but he also showed that unless Britain could reduce its costs by an increase in output and greater efficiency and economy in every direction, the outlook for exports, upon which hitherto the prosperity of the country had principally depended, was dark. He showed also that the prophecy that when the working day was shortened the output would be maintained or increased, had not been fulfilled; in fact the output per man fell immensely and the cost increased.

How can we deal with so serious and so complex a situation? Is there no alternative to fighting things out? Must we repeat in other industries the process of ruination that is proceeding in connection with the coal trade? Maintain high wages and an industry may perish in consequence. Indulge in a struggle, shut down the works, suffer privation to secure a few shillings a week less reduction when work is resumed, but drop a few thousand more workmen into the sea of unemployment in the process—does such a course commend itself to anybody having the best interests of the community at heart?

Conferences are being held this week with regard to wages in the engineering trade, and we trust that conciliatory influences will get to work on both sides. The wage reduction proposals in this great department of industry are, it is said, being strongly opposed. It seems that the employers have suggested a reduction of 6s. per week on time rates and 15 per cent. on piece-work rates and the abolition of certain bonuses. During the past five or six years when labour in this and many other trades has put forward its demands for advances it has often asked double what it expected to get. Negotiation, strained relations, general discontent and poor output, and finally compromise—these were the different stages of the proceedings. It will be deplorable, now that reductions are being required in order that our industries may survive, if we are going to repeat the same irritating and nerve-wracking procedure. Why not short-circuit the whole business? Mr. W. O. Smith, chairman of the B.E.A.M.A., in the speech that we recently reported, referred to suggestions for wage reductions which originated from the employés' side as one of the most promising signs of the moment. The trade danger signals have not been ignored or misread. If this attitude were to develop in the interest of the community as a whole, and if employers were to agree not to ask for too sweeping reductions all at once, there would be an approach to the spirit of goodwill in which such matters ought to be settled.

We want no battles with victory to one side or the other, leaving smarts which will revive the struggles at a later stage. We want a spirit of comradeship and co-operation which will recognise that both sides are human—the war has not developed a new divinity in either.

The Electricity Districts.

The announcement made in our last issue with regard to the constitution of the Mersey and West Lancashire Electricity District, together with that which we publish to-day regarding the North Wales and Chester Electricity District, shows that the Electricity Commissioners have lost no time in arriving at their conclusions, and they are to be congratulated not only on their promptitude—which, for a Government department, is unexampled—but also on their firm grasp of the situation and their courageous decision, especially in the latter case, to follow the course which unquestionably serves the public interests most efficiently.

Their solution of the problem presented by the cleavage of opinion of the local authorities on either side of the Mersey is decidedly ingenious; a Joint Electricity Authority will be formed for the whole district, but the Wirral Peninsula will be temporarily partitioned off under the control of a separate Committee, thus becoming an "area" within a "district." What degree of authority will attach to the Wirral Committee remains to be seen; the local authorities concerned have gained their end—separation from the main scheme—and it will be for them to demonstrate the wisdom of that course by their subsequent procedure. Doubtless they will act as an Advisory Committee whose advice will be followed by the Joint Authority, in which alone, we take it, will be vested executive powers. The Mersey Power Company also receives a valuable concession, in that it will be (or, as the Commissioners put it, "may be") empowered to extend its operations into neighbouring districts. Both the Wirral Committee and the Power Company will be separately represented on the Joint Electricity Authority. This fact indicates that the Wirral Committee will not be one of the "committees of the authority" to which, under Section 6 (2) of the 1919 Act, the authority may delegate its powers or duties; it will be a body specially created to meet the position. It will be observed that the Commissioners intend to confer financial powers on the Committee, if the passing of the new Bill enables them to do so; and that a further inquiry is necessary before the order can be put into force.

Turning to the North Wales and Chester scheme, we find that the Commissioners have here made a clean cut; the interesting proposals put forward by the Chester Corporation have been swept away *en bloc*, for both technical and financial reasons, and the Commissioners have accepted those of the North Wales Power Company in their entirety. The fact that the municipal scheme failed to secure adequate public support bears out what we have said on previous occasions with regard to the financing of such projects. The local authorities are willing to formulate engineering schemes—through the medium of their engineers—and to support them with lip-service; but when the hat goes round they look the other way. As we have pointed out, if they wish to own and control the supply and distribution of electricity, they must be prepared to foot the bill. This point was strongly emphasised at the I.M.E.A. Convention last year. If they cannot do this, the matter must necessarily be left to private enterprise—for the supply must be provided by someone; and private enterprise will not come in unless it is assured of an adequate reward.

In the case under consideration, the Commissioners have realised that by entrusting the Power Company with the whole undertaking, on the lines advanced at the inquiry, they will secure the development of the water-power resources of North Wales on an economic basis, thus reducing the consumption of coal, and providing an ample supply of electricity for the whole area, and will at the same time solve the financial problem completely. A Joint Electricity Authority will be formed to exercise general supervision over the district, encourage the development of electricity supply, and advise the Commissioners. This is precisely the system which we have advocated; it may not be palatable to the local authorities, but we are convinced that it is by far the wisest solution of the problem, and the one which is most directly conducive to the welfare of the district. Further statutory powers will have to be obtained by the Company, but will involve no charge on the public purse, and being supported by the Electricity Commissioners, should be readily obtainable.

Now as to Yorkshire—but the inquiry has not yet been held; we will wait and see.

The E.T.B.I.

The meeting of the Electrical Trades' Benevolent Institution on Monday disclosed a heavy decrease in subscriptions and donations, except those received in connection with the annual festival—the total being only £656, as compared with £1,679. It is well known that retrenchment is apt to commence with the cessation of subscriptions to charitable institutions, but it is not right that this should happen; it is just when the times press retrenchment on the notice of the well-to-do that their poorer brethren stand most in need of help, and the stream of benevolence ought to flow in spate. It does not say much for our brotherly love that the comparatively small sums devoted to its service are readily cut off, whilst the vastly larger outlay on personal luxuries, amusements, &c., is maintained to the last moment. Can we not realise that it is a duty, as it should be a pleasure, to take care of our less fortunate comrades?

If we will not do so in our life-time, at any rate let us make some provision to that end out of the material possessions which we cannot take away with us. A kindred institution in one year received more by way of legacies than the total amount of the invested funds of the E.T.B.I. A form of bequest will be found on the back of the annual report of the Institution. Use it!

Financial Problems of Small Companies.

We have many times referred to the serious financial post-war position in which the majority of small electricity supply companies find themselves. Whereas before the war small companies, by very careful management, could be made to pay satisfactorily, post-war conditions have conspired to press them into a very awkward corner. The present restricted prices of supply, even though these be 10d. or 1s., will often not bring in sufficient revenue to meet adequately the increasing costs of supply; and this entails the obvious consequence that investors fight shy of putting in more capital. The case of the small companies was very clearly, not to say eloquently, pleaded by Mr. P. D. Tuckett last week when speaking at the annual meeting of the Urban Company, which includes a large number of typical cases of small undertakings. By an especial irony, many of these undertakings, as Mr. Tuckett pointed out, are precluded from enjoying a general increase in maximum charge under Section 32, and have to content themselves with relief under the Statutory Increase of Charges Act, which confessedly is inadequate and cannot properly meet the cases at all. The Joint Electricity Authority schemes give very scant promise of any benefit. In the first place, the majority of small undertakings are more or less out of the run of big towns, and in many cases in positions where a bulk supply cannot reach them for many a year to come. Moreover, the fact that undertakings in a District would have to subscribe to the administrative expenses of the Joint Authority, and, if they took a bulk supply, be responsible for making up deficits, makes poor, small companies feel chilly at the prospect. Again, there is the possibility that the Joint Authority itself might pick up any plum on the fringe or compete in some such way. Altogether there is no doubt that small companies must be treated as a case by themselves. The most pressing need under the existing conditions, as Mr. Tuckett pointed out, is for a wide latitude to be allowed over prices. The legal disabilities of companies which cannot apply under Section 32 must be removed, and the period of revision of prices must be much reduced from the present term of five years. Some clauses towards this end are embodied in the Electricity Supply Bill now before the House of Commons. But the strong opposition evoked by the Joint Authority finance part of the Bill makes its passage anything but a certainty. In case of its rejection, the best course would be for all the small companies labouring under these disabilities jointly to promote a Bill solely dealing with this point, which, as it would be a measure simply to regularise anomalous cases, should practically be sure of the support of the Electricity Commissioners. This would help to some extent, and in other ways the Commissioners might relax, as far as lies in their power (and there is a new legislative latitude in the 1919 Act), restrictions which might in one or another case stand in the way of development; in particular, an extension of tenure is almost indispensable if fresh capital is to be attracted into the business. Curiously, in respect of price, these statutory companies suddenly find themselves at a great disadvantage in comparison with the non-statutory ones, which are unrestricted as to price. There certainly ought not to be a premium upon being unauthorised. Again, in determining increased charges, the financial advisers of the Commissioners might well regard small companies as being on a special footing.

The mere fact that they may for the moment be paying a dividend of 5 or 6 or 7 per cent. ought not to weigh as in the case of big companies. The absolute revenue of a small company is so little in total that it only requires a breakdown or an all-round rise in wages and salaries for the dividend to be wiped out altogether. The prices allowed by the Commissioners should be fixed not only with regard to the profit at the moment, but also with due consideration of the precarious state of the financial side of the undertaking. As things are, a small company cannot raise further capital until it pays a satisfactory dividend—but if it does so, then down comes the possible increase in maximum price. In a word, small companies must be assisted to pay a good dividend, otherwise the public will suffer sooner or later—to say nothing about justice to the original shareholders. If there is one case more than another where the Electricity Commissioners should regard themselves as acting *in loco parentis* it is the case of small companies. If only these and similar anomalies can be put right there is no reason why small companies should not get on their feet again and achieve general success.

Canadian Trade.

Elsewhere we print an account of the mode of procedure of the Approval Laboratory of the Hydro-Electric Power Commission of Ontario in respect of the testing and approval of electrical installation materials and apparatus. Those of our readers who were our readers before the war will remember that in those far-off days we did our best to induce British manufacturers to take an interest in the great market open to them in the Dominion, and that this question of approval was one of the most pressing problems awaiting solution. At that time the Underwriters' Laboratories, Inc., of Chicago, carried out the tests, and the National Board of Fire Underwriters laid down the law for the whole of North America; to meet the needs of British firms, in 1913 Messrs. Heap and Digby were appointed engineers in Great Britain to the Underwriters' Laboratories, but that arrangement has lapsed. Evidently the Hydro-Electric Commission felt the urgent necessity of setting up a testing department of its own, of which we are now able to give an account. We commend the matter to the notice of British manufacturers who wish to sell electrical accessories in the Province of Ontario.

But while this arrangement liberates our manufacturers to some extent from the control of an alien institution (against which we have not a word to say, but whose autocratic control was always somewhat distasteful to us), it does not really meet our needs. The only way to do that is to set up a British National Proving House, whose label shall be a guarantee of the quality of British goods throughout the world. The case for the Proving House has been debated in our columns, at the Institution of Electrical Engineers, at the Councils of the B.E.A.M.A., and elsewhere; the Board of Trade supports it, the National Physical Laboratory will co-operate with it—in fact, it is unanimously called for—yet nothing tangible has been done. Only a few weeks ago, at the annual dinner of the I.E.E., Sir Frank Heath, secretary of the Department of Scientific and Industrial Research, stated that we should soon have a National Proving House. It is to be regretted that the veil of silence is so persistently drawn over the progress of the scheme. It is high time that the industry, which has waited so long for a most necessary aid to its functions, should at least be told how much longer it will have to curb its impatience.

MONTHLY GENERATING STATION COSTS.

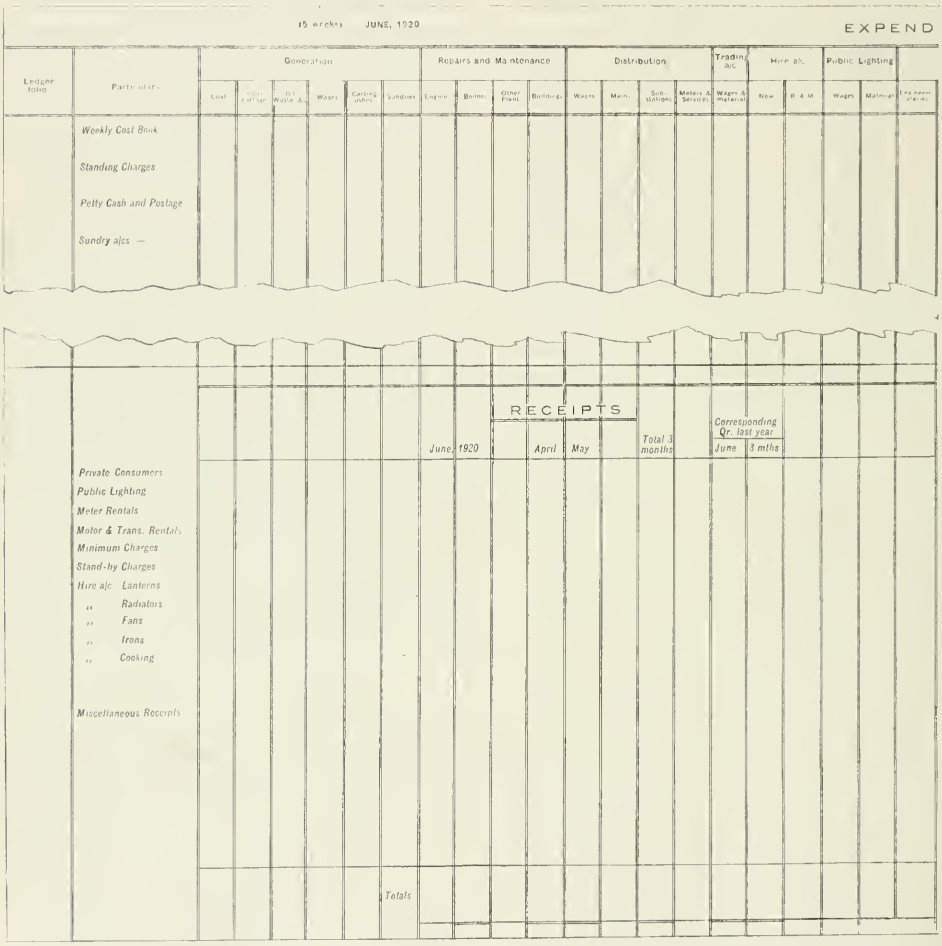
By "INTERESTED."

In recording accurate costs, municipal electricity supply stations have many difficulties to overcome, not the least of which is payment made direct by the accountant's department and not actually passing through the books at the works. A proper system arranges for every account to bear the initials or signature of the engineer before being passed for payment. But, even with the best intentions in that direction, mistakes do occur when accounts are presented to the Council for payment without cognisance of the works clerical staff, the first intimation being the appearance of such amounts in the Council agenda. This refers equally to capital as well as revenue accounts. Particularly when extensions are in progress, the borough surveyor may put forward certain certificates for payment from the funds of the electricity department, and a common practice in some districts is for rates and taxes to be passed by a Committee other than the Electricity Committee.

During the times of ever-increasing charges, it is imperative that complete detailed costs be presented at least monthly, and an essential point is that no item which has been paid direct in the above-mentioned manner should be omitted. Herewith is an illustrative description of a method of recording supply-station costs each month which has satisfactorily passed a three months' trial in a station where most of the actual financial work is undertaken from the town hall.

The illustration shows a deep pattern book ruled with a number of cash columns. Headings are written in as required. This shows a fair saving in the cost when ordering the book, and the writing does not occupy much time at the end of each month. Also this method allows for alterations being made from time to time when necessary in the arrangement of headings.

Of the side headings the first is works costs. Figures are transferred from the weekly cost book, a description of which was recently published in the columns of the Electrical Review. The second is standing charges. These are proportioned from the sums shown in annual estimates or from the previous year's accounts, and include such items as rent, rates, taxes, insurance, engineers', and proportion of Town Hall legal and financial staffs' salaries, which are usually charged to the electricity department, likewise certain printing and stationery used at the Town Hall and charged against the department. Any adjustment, such as the unlikely reduction in rates and taxes, is made in the last month of the year, but for all practical



(5 weeks) JUNE, 1920 EXPEND

Ledger folio	Particulars	Generation						Repairs and Maintenance				Distribution				Trading a/c	Hire a/c		Public Lighting		
		Coal	[illegible] carriage	Oil Waste &c.	Wages	Carting ashes	Sundries	Engines	Boilers	Other Plant	Buildings	Wages	Mains	Sub-stations	Meters & Services	Wages & material	New	R & M	Wages	Material	[illegible]
	Weekly Cost Book																				
	Standing Charges																				
	Petty Cash and Postage																				
	Sundry a/cs —																				

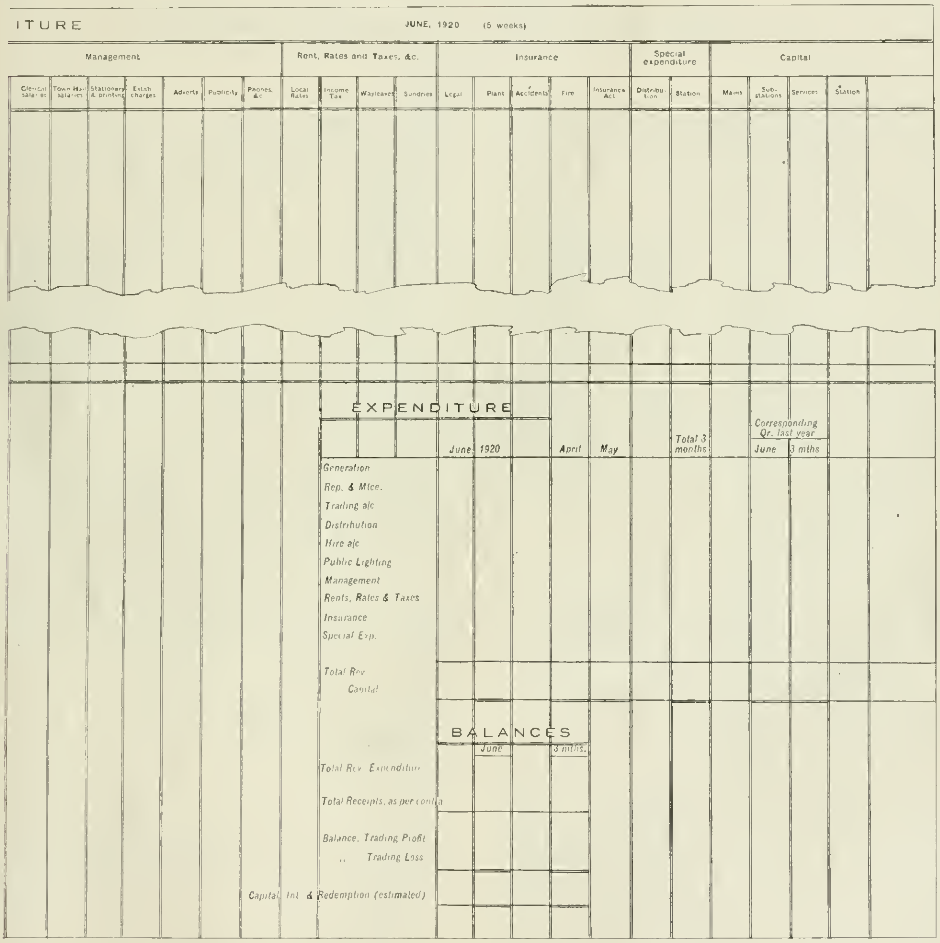
	RECEIPTS				Corresponding Qr. last year	
	June 1920	April	May	Total 3 months	June	3 mths
Private Consumers						
Public Lighting						
Meter Rentals						
Motor & Trans. Rentals						
Minimum Charges						
Stand-by Charges						
Hire a/c Lanterns						
,, Radiators						
,, Fans						
,, Irons						
,, Cooking						
Miscellaneous Receipts						
Totals						

purposes the sums thus proportioned from previous years' accounts and current year's estimates are as accurate as it is possible to obtain the figures under the circumstances. In dealing with most of these items it is sufficient to take one-twelfth of each sum for the month, but in a few cases a better plan is to proportion the monthly sums nearer to the relative figure received for the sale of energy, which, of course, varies from month to month. However, that is a matter for individual opinions—which sometimes differ.

The third of the side headings represents petty cash and postage duly apportioned to the various sections. The remaining space of the top half of the book is utilised for sundry accounts such as coal cartage, repairs to plant, buildings, advertisements, &c. These entries are made at the time accounts are passed for payment, and the space allows for additions at any time for those accounts mentioned above, which are sometimes paid direct by the accountant without first being presented to the engineer for passing.

The lower half of the pattern is reserved for an estimate of revenue received during the month, and for a comparative summary of both income and expenditure. By making proportional adjustments in the previous year's figures for revenue received compared with present increase or decrease of units output to mains, it is possible to arrive at a fairly close estimate of the actual revenue due for the month for inclusion in the statement just mentioned.

Figures presented in this form illustrate clearly during which months of the year profit is made, and are useful as arguments in favour of quoting low prices for long-hour consumers.



ITURE JUNE, 1920 (5 weeks)

Management							Rent, Rates and Taxes, &c.				Insurance					Special expenditure		Capital				
Clerical salaries	Town Hall salaries	Stationery & printing	Estab. charges	Adverts	Publicity	Phones, &c.	Local Rates	Income Tax	Wayleaves	Sundries	Legal	Plant	Accidents	Fire	Insurance Act	Distribution	Station	Mains	Sub-stations	Services	Station	

EXPENDITURE

	June	1920		April	May		Total 3 months		Corresponding Qr. last year June	Corresponding Qr. last year 3 mths
Generation										
Rep. & Mtce.										
Trading a/c										
Distribution										
Hire a/c										
Public Lighting										
Management										
Rents, Rates & Taxes										
Insurance										
Special Exp.										
Total Rev.										
Capital										

BALANCES

		June		3 mths.
Total Rev. Expenditure				
Total Receipts, as per contra				
Balance, Trading Profit				
,, Trading Loss				
Capital, Int. & Redemption (estimated)				

ON REVIVING EXHAUSTED DRY BATTERIES.

By "VOLTMAN."

It has always seemed to the writer that the discarding of the average dry cell when "dead" is an outstanding piece of wasteful practice. On the other hand, the wet Leclanché cell, with its renewable zinc rod and almost inexhaustible porous pot, is a much more economical proposition. Out of a dry cell one may get back only 25 per cent. of the capital value represented in it, whereas from a wet cell as much as 75 per cent. is probably obtainable. In the former case one has to scrap a large piece of sheet zinc, a sound carbon rod, and a lot of chemical material which, as experiments prove, is not so worthless as it may appear. The idea of a rechargeable dry cell is an old one—that is, rechargeable on the accumulator principle, though no one appears to have made it commercially practicable; nevertheless the writer has found that some cells, notably the Hellesen and Siemens, take quite a good and useful recharge if connected up through one or two lamps passing from .5 to .75 amp. for a period of from eight to ten hours. The carbon pole of the cell should be connected to the positive of the circuit. The effect is curious and interesting as, up to a point, the dry cell behaves like a lead accumulator. Immediately after charging, each cell will show a super-voltage up to 1.75 V per cell. This is probably due to the presence of nascent oxygen and hydrogen in the cell, and when these gases combine the extra voltage disappears, but the voltage will still remain somewhere about normal for a new cell, and the internal resistance is beneficially reduced. Furthermore, the active material, depolariser, &c., in the cell would appear to be restored by electrolytic action in a way that renders it capable of doing more work. Certainly, the results seem to show that it would pay to give large cells a reviving "charge-up" at intervals of a month or six weeks.

Apart from passing a current through the cells, experiments on "doping" them with an oxidising reagent have given by no means negligible results. Trials were made with some very old cells, a hole first being bored through the pitch sealing to introduce the "dope." The best results were obtained with strong solutions respectively of permanganate of potash and hydrogen peroxide, and at the same time injecting some sal-ammoniac solution. In all cases the results were beneficial, and the cells were capable of giving a useful output for many months.

The writer has in use now an example of a "doped" dry cell at least ten years old, vigorously working a house bell. Until treated it was stone dead. The cardboard cover was stripped off the zinc, and a couple of dozen holes were bored with a gimlet through the shell—a very easy matter. It was then placed in a household jam jar along with the doping solution, and some sal-ammoniac. It now forms as efficient a "wet" cell as one could wish for.

[It has been said that the "charging" of Leclanché cells is a dangerous process, owing to the possibility of the formation of highly explosive compounds. The opinions of chemical experts on this point would be welcome; it would be interesting to know whether such action had actually been observed.—Eds.]

THE RIBADELAGO HYDRO-ELECTRIC SCHEME.

By E. SCOTT RIVETT.

In view of the growing interest evinced by British engineers and manufacturers in hydro-electric developments, I think I am justified in asking for more publicity for the following figures than they received in their Spanish form. Further, at the present time there is a lack of available data referring to the capital costs of water-power plant, and while I do not suggest that 10,000-kW hydraulic schemes are likely to be common objects of the English countryside—the seaside is another matter—I am hopeful that British engineers in Indian and Colonial fields will find this rough translation of Senor Oliver's report of more than passing interest and of some usefulness.

Senor B. Oliver y Román, a Spanish civil engineer, has recently published a report and estimate on a hydro-electric project on the river Tera in the Province of Zamora, in N.W. Spain. He takes us very fully into his confidence in the preparation of the estimate, and I have therefore given that part in some detail, but I have omitted a good deal of his description of the surrounding country which is depicted at great length and with true patriotic zeal.

The demand for electricity comes from the district of Valladolid, which at the present time is inadequately supplied. Also, the district of Ponferrada is crying aloud for power for the transportation of its coal and iron, and for use in smelters. There is also a likelihood of electrochemical industries being established. In view of this demand, Senor Oliver was commissioned to report on the utilisation of the Ribadelago Falls on the river Tera, among the mountains known as the Sierra Cabrera and Sierra Segundera.

At the commencement of his labours Senor Oliver met with difficulties. "The determination of the flow of the river Tera cannot be based upon direct readings, because none have been taken. This is not surprising, for the district in question lies at a very high elevation, suffers very severe winters, and is absolutely uninhabited." He began to have readings taken without delay, but as an immediate basis for his calculations he applied the results obtained in gauging stations situated in other river valleys under analogous conditions. He arrived at the following conclusions:—

1. The annual average flow of the river Tera at the point chosen is equivalent to 50 litres per second per kilometre of the valley.

2. The variations of this flow during the year are insignificant, and can be neutralised, if desired, by making use of some small lakes in the neighbourhood as storage pools.

The rainfall figures taken for many years past in an adjacent valley gave an equivalent of 45 litres per second, and as the catchment area of the Tera valley is 50 sq. kilometres, Senor Oliver felt himself justified in asking the Government for a concession of 2,000 litres per second. This has been granted. The working head at the power house was calculated at 575 metres (1,887 feet), which, with a flow of 2,000 litres per second (70.62 cusecs), will develop 12,700 h.p.

Headworks.—The only headworks necessary consist of some slight clearing of the channel and a small dam, to be placed at a point just below the confluence of the Tera with a small stream called the Lacillo, at an altitude of 1,650 metres (5,410 ft.) above sea level. The maximum height of this dam will be 10 ft. and its length 90 ft. The cost of the headworks is estimated at 27,010 pesetas (£1,080, at par), use being made of the granite which abounds on the site.

Canal and Tunnel.—The site of the power house is about four miles from the headworks, and the water will be conveyed by a canal having an inclination of 1 in 2,000, and opening out into a storage bay at the power house end. Owing to the extremely rough nature of the ground, only about 530 metres of the canal will be open to the sky, the remainder (5,850 metres) being in tunnel. On this point Senor Oliver naively remarks, "The difficulties of boring a tunnel through this granite mass are simply due to the hardness and compactness of the rock." The open canal has to be roofed in places as a precaution against rock-falls. The estimate for the open canal is as follows:—

	Pesetas	£
1,000 metres cube of excavation in hard rock at 5 pesetas per metre cube	5,000	200
150 metres cube hydraulic concrete at 40 pesetas per metre cube	6,000	240
Roofing, &c.	2,000	80
Pesetas	13,000	£520

The cost of boring the tunnel and facing with hydraulic concrete is estimated at 150 pesetas (£6) per linear metre, giving a total of 5.850 × £6 = £35,100 for the tunnel alone.

Pipe-line.—With regard to the pipe line Senor Oliver studied three methods:—

1. Two steel pipes each conveying 1,000 litres per second.

2. One steel pipe only, carrying 2,000 litres per second.

3. One circular tunnel of 1 metre diameter, bored through hard granite rock.

He decides on the tunnel method because of the higher cost of steel pipe, and on account of the ruggedness of the ground. (Personally, I think Senor Oliver's profession of civil engineer influenced his decision.)

This tunnel pipe line will be first bored at a diameter of 1.6 metres and then faced with hydraulic cement to give a diameter of 1 metre. The cost is estimated at 125 pesetas (£5) per linear metre (£2 10s. for boring, and £2 10s. for facing).

	Pesetas	£
2,400 linear metres of tunnel at 125 pesetas per metre	300,000	12,000
Auxiliaries and accessories	60,000	2,400
Steel-plate pipe for distribution of water within the power-house	40,000	1,600
Pesetas	400,000	£16,000

Power House Building.—The site of the power house has been chosen on the north shore of lake Sanabria, where there is a suitable foundation. The altitude is such that the turbine shafts will be 1,030 metres (3,380 feet) above sea level. In estimating the cost of the power house building Senor Oliver says: "As we are here concerned with a simple and easily constructed building, and as, further, there is abundance of good stone close at hand, we are justified in adopting the figure of 15 pesetas per kW installed, including in this the cost of an overhead crane, and also the tail race channel, the last being a very insignificant item." As the plant will consist of three sets of 4,700 kW each (one set always to be held in reserve), the estimate for the power house building will be 4,700 × 3 × 15 = 211,500 pesetas = £8,460.

Turbines, &c.—Each of the three turbines installed will be of 6,350 h.p. Figures furnished by "one of the principal manufacturers of water turbines in Europe" (Senor Oliver does not give the name of this firm, which is evidently not Spanish), form the basis of the following estimate:—

	Pesetas	£
One turbine	115,000	4,600
One "Universal" governor	18,000	720
One speed-regulator	1,500	60
Shafting	1,500	60
One main valve	23,000	920
Anchoring-gear for pipes, &c.	3,000	120
Pressure gauge and speed indicator	1,000	40
Foundation-plates, &c.	5,000	200
Packing cases	1,500	60
Freight charge to port of entry and Customs dues	10,000	400
Rail and road charges in Spain (30 tons) ...	10,000	400
Erection and testing	10,000	400
Pesetas	199,500	£7,980

For the three prime movers, installed and ready to run, 3 × £8,000 = £24,000.

Electrical Plant.—Senor Oliver decided upon the following characteristics of the alternators and step-up transformers, but does not give the reasons for his decision.

Alternators.		Transformers.	
Capacity	4,700 kW.	Capacity	4,700 kW.
Speed	500 r.p.m.	Voltage ratio	6,000/65,000
Frequency	50 cycles		
Voltage	6,000 volts		

In estimating for this plant he says: "At the present time it is very difficult to form an estimate for this class of plant, as everyone knows. I have, therefore, adopted the following figures, furnished me by well-known electrical engineers, as a basis for the price per kW in which all costs are included":—

	Pesetas	£
Alternators, complete with auxiliary apparatus	60	2.4
Step-up transformers (in oil)	25	1.0
Measuring and protective apparatus	10	.4
Auxiliary services	3	.12
Freight charges	5	.2
Testing	5	.2
Various	5	.2

As each set is of 4,700 kW, and one is to be held in reserve, the estimate for the electrical plant installed within the power house is as follows:—

	Pesetas	£
Three alternators of 4,700 kW. each ...	846,000	33,840
Three step-up transformers	352,500	14,100
Measuring and protective apparatus ...	94,000	3,760
Auxiliary services	28,200	1,128
Freight	70,500	2,820
Testing	70,500	2,820
Various	70,500	2,820
Pesetas	1,532,200	£61,288

Transmission Lines.—The energy generated will be transmitted a distance of 130 kilometres (81 miles), and the same lines carrying the 9,000 kW developed at Ribadelago must also transmit a further 10,000 kW developed at Cobreros Falls, a plant to be situated in the Sierra Segundera. The line voltage will be 65,000, and power will be distributed from four sub-stations by secondary networks at a voltage of 8,000 to 10,000 V. The following figures form the basis for the e.h.p. section of the estimate:—

	Pesetas	£
Steel lattice-work poles, each	1,500	60
Copper, per kilogramme	4	0.16
Insulators, each	50	2
Earth wire, per kilometre	400	16
Telephone lines, per kilometre	750	30
700 steel lattice-work poles at 1,500 ptas	1,050,000	42,000
200 tons (metric) copper at 4,000 ptas...	800,000	32,000
5,000 insulators at 50 ptas	250,000	10,000
Earth wire	50,000	2,000
Telephone lines	100,000	4,000
Switch and protective gear	50,000	2,000
Erection and testing	50,000	2,000
Special poles	50,000	2,000
Pesetas	2,400,000	£96,000

Sub-stations.—Senor Oliver places the cost of the four sub-stations at 405,000 pesetas (£16,200), based on an over-all cost of 45 pesetas (£1 16s.) per kW installed.

General Estimate.

I. *Headworks, dam and canal*—	Pesetas.	£	Pesetas.	£
Headworks and dam on River Tera ...	27,010	1,080	—	—
Gate valves, screens, &c.	15,000	600	—	—
House for two families	10,000	400	—	—
Open canal... ...	13,000	520	—	—
Canal in tunnel ...	877,500	35,100	—	—
Forebay and accessories	25,000	1,000	—	—
House for two families	10,000	400	—	—
Cost of land, &c. ...	20,000	800	—	—
			997,510	39,900
II. *Pipe line*	—	—	400,000	16,000
III. *Power-house building*	—	—	211,500	8,460
IV. *Water turbines* ...	—	—	600,000	24,000
V. *Electrical plant*—				
Generators and transformers ...	1,532,200	61,288	—	—
High-pressure transmission line ...	2,400,000	96,000	—	—
Sub-stations ...	405,000	16,200	—	—
Secondary transmission lines ...	400,000	16,000	—	—
			4,737,200	189,488
Total Pesetas ...			6,946,210	£277,848

Final Estimate.

	Pesetas.	£
General estimate, as above	7,000,000	280,000
Cost of drawing up scheme	100,000	4,000
Administration, taxes, &c.	150 000	6,000
Contingencies	500,000	20,000
Grand total	7,750,000	£310,000

Ribadelago Falls Scheme.

Cost of Power at Various Points of the System.

	h.p.	kW.	Cost in £.	
			Per b.p.	Per kW.
Power at turbine shaft	12,700	—	6·92	—
" alternator terminals ...	11,940	8,800	12·06	16·52
" beginning of h.p. line..	11,580	8,500	13·76	18·68
" end " "	10,770	7,900	22·04	29·92
" bus-bars in sub-stations	10,450	7,700	25·28	34·40

Note.—In working out the above figures of cost of power, Senor Oliver has evidently taken into consideration the fact that the transmission line is common to both the Ribadelago and Cobreros schemes.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Aqua" Water Heater.

A device for delivering hot or cold water by a simple movement of a tap is made by the Aqua Electric Heater Co., for which Messrs. Copus & Green, 22, Clapham Road, S.W.9, are sole agents in the London area. The construction of this appliance (fig. 1) is as follows:—

The heating element has a porcelain body through which pass 22 vertical tubes connected progressively at top and bottom to form a continuous passage over nine feet long. A coil of special non-corrosive resistance wire passes through this passage, and is connected to a switch. The switch and the hot and cold water valves are operated by a shaft. A gear on the rear end of the shaft snaps in the switch when the tap handle is turned to the right. A cam opens a valve simultaneously, and water is permitted to flow round the heating passage and out through the tap. When the handle is restored to its upright position the switch is cut out, and the cam allows a spring to reseat the inlet valve, stopping the flow of water. If the handle is turned to the left the actuating gear slides out of mesh, and does not operate the switch, but another cam opens a valve and permits cold water to flow straight through to the tap. The temperature of the hot water can be varied by altering the water inlet; this is effected by an adjustment screw. The capacity of the heating element is about 6.6 kW.

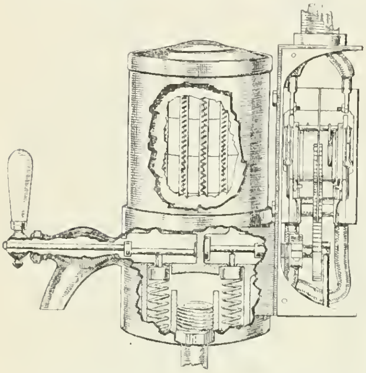


Fig. 1.—The "Aqua" Water Heater.

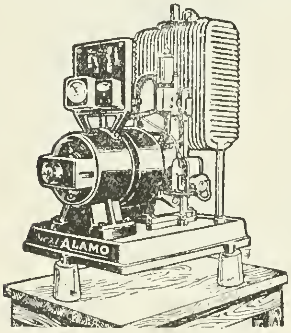


Fig. 2.—The "Silent Alamo" Generating Set.

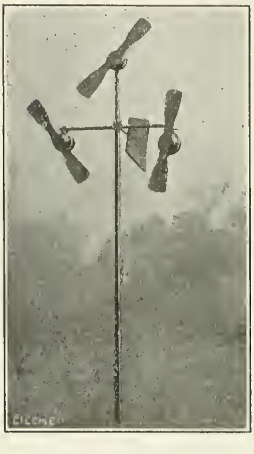


Fig. 3.—Triplex Wind Dynamos.

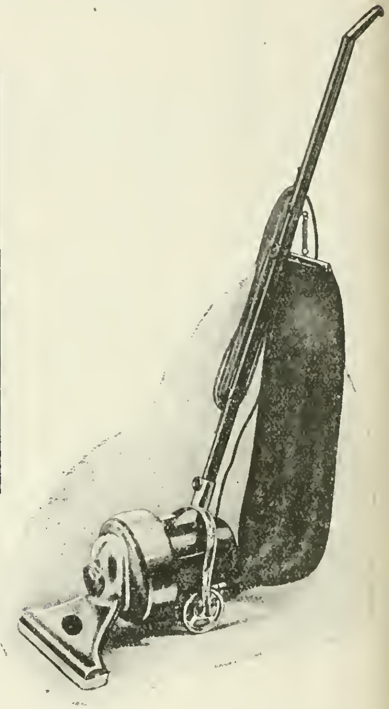


Fig. 4.—The "Little Glutton" Vacuum Cleaner.

The "Silent Alamo" Lighting Set.

The feature of the generating set which has been put on the market by Messrs. Alamo Electric, Ltd., of 36, Grosvenor Gardens, S.W. 1, is its balancing and freedom from vibration; we recently saw one of these sets running under load and on light load, perched on three tumblers, with no holding-down bolts (fig. 2), and found we could balance a penny on edge on it. The engine has a rotating sleeve-valve surrounding the piston, which enables the construction to be simplified and cuts out many of the troubles met with in engines with poppet-valves. The engine and dynamo are designed as one machine, together with the radiator and controlling gear, forming a completely self-contained set, which is used in conjunction with a 100-Ah, 32-V battery, and is started and stopped by push-buttons. The output of the set is 1 kW, and it is provided with automatic devices which shut it down if the cooling water or the oil gets low, and when the battery is fully charged, whilst if the engine stops the battery is automatically disconnected.

With a set of this size, practically the whole of the lighting and small power requirements of a country house or farm could readily be met.

An "All-British" Vacuum Cleaner.

The introduction of another "All-British" electric vacuum cleaner is a step in the right direction, and the "Little Glutton" vacuum cleaner (fig. 4), which is being placed on the market by The Edison Swan Electric Co., Ltd., certainly qualifies for the "All-British" title, as it is made throughout at the Ponders End works of this company.

An outstanding feature of the cleaner is the motor, which is most rigidly built, and is of a far heavier pattern than is usually found in cleaning machines. The carcass is built up from laminated field stampings of "Stalloy" with die-cast aluminium end brackets. This carcass also carries a special automatic switch. The armature is constructed on novel lines, in that two cores are mounted on the spindle, leaving a central space one-third of its length, so that between the cores the armature windings are directly open to the surrounding air, thus providing a novel and very effective self-cooling arrangement. The armature is wound in double silk-covered copper wire, and is fitted with a commutator of 24 drawn copper bars. The spindle runs in ball bearings which are enclosed in machined housings of the same diameter as the core, and the armature can thus be inserted from either end of the carcass. The brush gear and armature can be removed from the machine without disturbing any of the connections. This motor is "universal," running equally as well on direct as on alternating current. It is made for all circuits from 25 to 100 cycles, and from 50 to 250 volts. The normal loading is 200 watts. The fan is six-bladed, and is constructed from high tensile die-cast aluminium alloy. It is of exceptional strength, and is designed to give the maximum air displacement.

The dust bag is made in the form of a valve in which the dust is thrown up a central passage, and is then thrown to right and left and is deposited in pockets. There is, therefore, no possibility of dust falling back into the machine, and a clear passage is maintained when working the cleaner. The automatic switch, which is patented, is operated by the main handle of the cleaner. The normal "at rest" position of this handle is a vertical one, and is spring locked. To use the cleaner this handle is released, and is brought into the most convenient position; this automatically starts the motor. Upon returning the handle to the vertical position the motor is automatically stopped.

The machine is provided with a very complete range of accessories, including a hose length with steel extension tubes of ample diameter, and a variety of nozzles for every class of cleaning. The total weight of the cleaner is 23 lb.

Triplex Wind Dynamos.

There are undoubtedly many owners of private and small electrical installations who, though possessing the usual oil engine, dynamo, and battery, would welcome an auxiliary method of generating electrical energy provided the first cost was low and the running costs and attention required were practically nil. Large low-speed windmills have, in a few instances, been employed for driving dynamos, but their cost of installation and inability to take full advantage of the power to be derived from a gale, together with the loss of energy absorbed by the gearing necessary to run the dynamo at a high speed, are some of the reasons that have militated against their more general use. Messrs. F. A. Wilkinson & Partners, Ltd., of Hatfield, Herts., have placed on the market a system of high-speed wind dynamos for battery-charging purposes, and fig. 3, p. 544, shows one of their "Triplex" type of installation, from which it will be seen that three totally-enclosed dynamos driven by direct-coupled impellers are mounted upon a crossbar fitted with a vane and a swivel head, and are supported by a vertical tube sunk in the ground. The output from a single installation with a strong breeze is 60 watts, or 600 watt-hours for a run of 10 hours, which is about the average daily consumption of a small electric lighting installation. The output can, of course, be increased by the provision of more than one installation of wind dynamos. The apparatus is entirely automatic in its action, and has given satisfaction in actual operation.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession*

The Direction of Rotation of A.C. Motors.

In reply to the questions of "Inquirer" in your issue of March 25th, if the motor under consideration is near the alternator the direction of rotation is not a difficult job to ascertain, but if the power supply is received from a supply company, the large amount of "tracing out" engendered seldom admits of the following method being attempted. It is usually much simpler to remove the belt or, if conditions permit, to take the motor off the bedplate in the case of gear and direct drives.

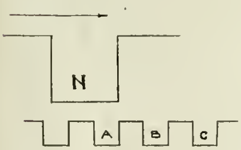


FIG. 1.

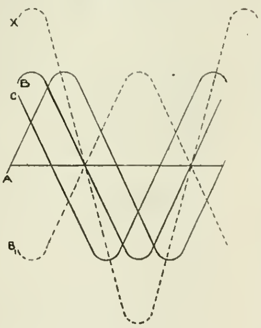


FIG. 2.

It is necessary, in finding the direction of rotation of an induction motor, to know which phase, at the motor, attains its maximum value first, which second, and which third. If we assume this to be in the order A, B, and C at the alternator, phase A, in slot A (fig. 1) first comes under the influence of the north pole, and therefore is the leading phase, followed by B and C phases, and since B phase is reversed, in both alternator and motor, the wave form in the motor is represented by A, B, C, in fig. 2. The wave form in the line is represented by A, B_1, C; X is the resultant of the waves A, B, C, and represents the magnetising wave.

If, in the motor, we represent the slots A, B, C (fig. 3) as three norths, and A_1, B_1, C_1, as three souths, since A phase is the first to reach the maximum value it will be the first to reverse its polarity, and will move the pole forward one pole phase, in this case one slot as shown in fig. 4. So that when all the phases have reversed twice and completed one period, the field will have advanced one pair of poles in the direction of the arrow (fig. 5).

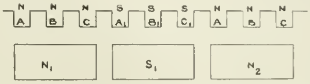


FIG. 3.

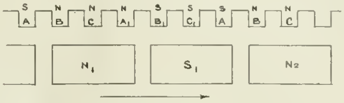


FIG. 4.

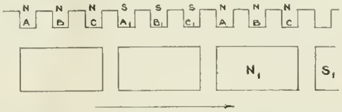


FIG. 5.

Reversing an alternator would alter the sequence of phases from A, B, C, to C, B, A, and would be similar in effect to reversing the phases A and C, and would reverse the direction of rotation.

S. S. Pilgram.

Runcorn.
April, 1921.

Gold for Notes.

In your article "Currency and Banking," in your current issue, you imply that Mr. Williams was wrong in stating that one may present a note at the Bank (of England) and demand gold. Mr. Williams, in my opinion, was quite right, for the Act of Parliament says that a Treasury note may be presented to the Bank of England, which must pay in gold on demand. Of course, what this Act gave with the right hand it took away with the left, for another clause said that gold must not be exported or melted down, thus annulling any advantage to be derived from having gold in one's possession instead of Treasury notes.

D. V. Onslow.

London.
April 21st, 1921.

[Technically, our correspondent is quite correct; as he admits, however, the free exchange of notes for gold is not now practicable.—Eds. Elec. Rev.]

Rotary Converter in Parallel with Steam Sets.

I should be pleased to hear the views of other engineers on the following.

At our generating station we have a rotary converter which runs in parallel with steam plant, generating direct current, the rotary, of course, running a.c. to d.c. On several occasions when I have taken the rotary off load (as a rule I trip her out while she is doing about 40 kW), I have noticed the steam practically fly up, this with the steam sets taking the extra load which the rotary has dropped. It does not always happen. I should be pleased to know if anyone else has experienced a like thing.

Super Tension.

April 22nd, 1921.

Wiring Ferro-concrete Factories.

If Mr. Purday were entrusted with the wiring of a ferro-concrete factory, according to his ideals heavy gauge weldless screwed tubing would be installed—that is, if there were any risk of fire. Suppose there was a fire; does he mean to say his screwed tube would emerge unscathed? I also work in an industry with considerable fire risk; I have experienced a fire, and after the fire my weldless tube and V.I.R. wire were, alas! no more. So why burn costly screwed tube and V.I.R. wire, when C.T.S. burns just as well, but costs considerably less?

I contend that C.T.S. is one of the cheapest systems of wiring, and is a sound lasting job if properly installed.

Mr. Harry Rogers will no doubt accept my statement that C.T.S. was not intended for underground work, owing to its not being mechanically protected. "Inquirer," in the first instance, stated that he thought C.T.S. "rather too unprotected." The Hurlingham Electric Co. can vouch for it in water, steam, heat, and intense cold, so now there only remains the case of someone attacking it with a hammer and chisel; C.T.S. will not stand that, neither will screwed tube.

As the Editors remark that the question under discussion is the best method of wiring ferro-concrete factories, I plump for C.T.S.; if properly used, it ranks as a good, cheap, neat, reliable job.

Of course, lots of persons are prejudiced against C.T.S., because they have never had any experience with it. If Mr. Purday has not had any, or not much, experience with C.T.S., he is not giving it the fair play, of which he appears quite enamoured.

April 18th, 1921. **Two-Phase.**

The Training of Kinema Operators.

With reference to "Electrician Operator's" letter in your publication this week, I should be greatly obliged if he could give me the name of the trade journal which, he states, runs tests and offers certificates to operators.

I quite agree with his letter, as I myself have come across two or three operators in this town who could not even wire a two-way switch and light. I may add that in a large town like this it was impossible to obtain any book on operating, but I eventually obtained one through the agency of the Caxton Publishing Co., *i.e.*, "Motion Picture Operation," and I find it a thoroughly reliable book, giving the theory and the practical side of operating; although not an operator myself, I should advise all operators to obtain one.

Bristol. **L. H. Edwards.**
April 23rd, 1921.

The Building Trades' Exhibition.

I am glad to see that you take serious notice of the unbusinesslike apathy of the electrical fraternity. It would be well if you could devote the same amount of space every week to this subject, if only for the purpose of "rubbing it in." The attitude of the Institution and the Trade Association in this matter seems to me to be unaccountable, except for the fact that knowing the electrical fraternity as I do, one can hardly be surprised at anything in this direction. Some time ago a feeble effort was made in the direction you name. I believe that an Association of the Supply Companies did start some sort of system of making a combined exhibit from various manufacturers, with a surprisingly good result. After going on for a short time, I presume the thing collapsed from sheer ennui, for I have never heard any more about it.

I can quite understand that separate exhibits, especially on the scale that is necessary, would be at present too great a strain on the financial resources of many of us to warrant continual individual exhibits, but the idea of a collective electrical exhibit is so splendid, and so simple, that it seems a great pity that the effort which was begun, and which was so successful, should have been allowed to lapse. A combined exhibit offers so many advantages. In the first place, the cost and trouble to the exhibitor is reduced to a minimum, whereas the interest to the public is enhanced many times. After all, the public that goes to an exhibition cannot or will not be bothered to go into the details of each stand or exhibit, but if a collective group of some hundreds of interesting electrical goods and appliances of every variety are brought together in one spot, then the public will be interested in the exhibit as a whole.

It is possible that the collective exhibit idea was dropped because the expense was too much for the Association that promoted it, for, if I remember rightly, no charge was made to the exhibitors—but why not make a charge? An exhibitor would be only too pleased to pay a nominal amount, and many of these amounts together would undoubtedly pay the whole expense of the exhibit. If you can do anything to "ginger up" the Association, which appears to be hibernating at the present time, you will have done a service to us all, and not least to—

London. **Gassed.**
April 25th, 1921.

[We are inclined to think that the British electrical industry wants shaking up with regard to exhibitions. Some years ago certain firms objected to exhibiting at various shows, because the profits would find their way into the pockets of private parties. Nowadays we neither organise exhibitions keeping a hold on the profits, nor do we heartily support other people's propositions; and the industry loses the benefit of the magnificent publicity that exhibitions afford. We have repeatedly advocated the holding of local electrical exhibitions; of central co-operative displays where the public can make their own choice of electrical domestic appliances; and of big exhibitions representative of the majority of the industry. Remembering many local and large-scale successes of the past, and having seen the interest evinced by the public in many trade exhibitions during the last year or so, we cannot help feeling that, in some electrical centre or other there is an inexcusable apathy which blocks the way. As announced a fortnight ago in our pages, manufacturers have not of late been prohibited from taking part in exhibitions by their B.E.A.M.A. understandings; but unhappily the lifting of the embargo does not appear to have released a flood of exhibition enterprise on the part of members, nor is there any great courting of such publicity on the part of non-members. Granted that times are trying—that uncertainty handicaps us all; but trying times increase the fertility of the soil in which electrical habits, and therefore electrical developments, grow; and however uncertain we may feel about some things, there is no doubt about the vast progress that electrical applications must make if we blow the trumpet loud and long enough. Eds. Elec. Rev.]

Water-tube Boilers.

With reference to Mr. Cauthery's article in the Review dated April 1st, he gives a remedy for excessive density, namely, "Keep down density by sufficient blowing down." With a water-tube boiler this would be very bad practice, because the water blown out has already deposited its scale, and extra feed water has to be pumped in which contains scale-forming salts. The proper method is to allow the density to rise to the maximum of 2/32nds, and then empty the boiler completely. *Re* Mr. Porter's letter in the Review dated the 15th inst., I do not agree that the limit of 2/32nds is excessive, for the reason stated above, and with a leaky condenser, it would be highly dangerous to keep as low a density as one-quarter of 1/32nd, because of the amount of scale which would be deposited on the bottom rows of tubes. My experience of boiler insurance companies is that they cannot lay much stress on "densities," otherwise they would see that every boiler was fitted with a salinometer cock on the lowest part of the boiler, or as near the bottom row of tubes as possible. The usual method of obtaining a sample of water is through the drain cock of the water gauge mountings, at the risk of getting one's eye knocked out by the gauge glass bursting, and then not getting a correct density reading, because the density is always less in the top drum than in the bottom row of tubes. Of course "density" always indicates abnormal conditions, and in an up-to-date power station with a good water-softening plant the cause can quickly be found.

Glasgow. **A. Murray.**
April 24th, 1921.

Telephone Cables for Power Schemes.

The writer of the article on "Telephone Cables for use in Power Schemes," in your issue of April 18th, has hardly given a fair comparison between the three types of cable. Although a cable with solid impregnated paper insulation costs more than a dry-core cable, the additional cost is only about 30 per cent. greater, and not two or three times as great, as stated by the writer. Although the cable is a miniature power cable, it need not have more than half the thickness of insulation specified by the British Engineering Standards Association for low-pressure cables, and with this value will still have a higher factor of safety than cables of types (1) and (2). The transmission distances also are somewhat understated; for dry-core cable good commercial speech is possible over the following distances, even when instruments and terminal losses are allowed for.

	Dry core.	Solid impregnated.
10 lb. Conductors.	12.5 Miles.	7 Miles.
20 lb. ,,	18 ,,	10 ,,
40 lb. ,,	26 ,,	15 ,,
70 lb. ,,	37 ,,	21 ,,
100 lb. ,,	45 ,,	25 ,,

T. N. Riley, M.Sc., A.M.I.E.E.,
Cable Engineering Department,
London. *Western Electric Co., Ltd.*
April 25th, 1921.

A Peculiar Phenomenon.

I have been interested in the recent correspondence regarding electrostatic phenomena, and the following experiments which I carried out some years ago may help to form the basis of a theory.

During my apprenticeship, much of my spare time was utilised in making electrical apparatus, among them a Wimshurst machine, and I found when grasping an electric lamp in my hand by the lower or pip end, that the lamp absorbed a charge of electricity when the cap was presented to the discharging rods of the machine. This continued until I received a sharp shock through a spark jumping from the cap to my thumb, and I immediately concluded that the component parts of a Leyden jar were present, and later I theorised it as follows:—

The glass of the bulb formed the insulating medium between two conductors, and my hand formed the outer coating. It is well known that electricity will pass through a vacuum, and I concluded that the charge passed into the bulb through the connecting wires to the filament, thence the particles of electricity passed through the vacuum and were distributed over the inner surface of the glass according to the position of my hand. Thus if the cap had been held near the positive electrode of the Wimshurst machine, a positive charge would pass into the inner surface of the glass, and be held there by the induced negative electricity under my hand. This would continue until the potential was great enough for the charge to jump the space between the cap and the outer coating. This happened sometimes with as much as two inches between my hand and the cap. This, of course, would only happen where there was within the bulb a vacuum or some gas which conducted electricity, and it would be immaterial whether the filament was broken or not.

It is also well known that certain rays are emitted when electricity passes through a vacuum, notably in the X-ray tube, where green rays are given off at the same time as the X-rays. If this experiment were carried out in daylight probably these green rays would appear to be grey, as mentioned by one of your correspondents. While charging both carbon and metal-filament lamps, I observed these rays coming from various parts within the bulb, and when it was away from the machine and the bulb turned over and over in the hand the charge was released from various parts of the inner surface of the glass, again passing through the vacuum and giving off green rays, thence it passed through the connecting wires to the cap and diffused into the atmosphere. I have often heard of machine belts becoming electrified, probably due to the slight slip on the pulley. This electricity could easily be collected into a vacuum lamp through the projecting pins on the side of the cap or even through the contact pieces on the top.

Aberdeen. **Jas. C. Lang.**
April 23rd, 1921.

LEGAL.

Sevenoaks and District Electricity Co., Ltd. Reduction of Capital.

In the Chancery Division on April 19th, Mr. Justice Russell had before him the petition of this company for sanction to reduce its capital.

Mr. Gurdon, for the company, said his capital was £40,000, divided into the same number of £1 shares, only half of which had been issued. The scheme was to reduce the shares that had been issued from £1 to 10s. each. The petition was before Mr. Justice Sargant, he said, on the previous Tuesday, and he expressed his approval of it except on one point. This related to 15 shares held by three persons who were in arrears with their calls. That difficulty had now been got over by the directors having forfeited the shares, and having sold them to a purchaser for the remaining money required to make them fully paid up.

His Lordship asked counsel to mention the matter to Mr. Justice Sargant.

This Mr. Gurdon did, and his Lordship gave his sanction as asked.

Hampton & Sons, Ltd., v. Munroe.

In the Official Referee's Court, on April 23rd, Mr. Edward Pollock continued the hearing of an action which had occupied several days, in which Messrs. Hampton & Sons, Ltd., decorators, builders, and electrical engineers, of Pall Mall, sought to recover from Mr. G. H. Munroe and his wife the balance of an account of £7,000 for repairing, decorating, and electrically fitting their house, "Chessington Place," Chessington, near Luton. The work, it was said, included electrical fittings of an expensive character, including an electric bath.

Mr. Colam, K.C., appearing for the plaintiffs, said that the house upon which the plaintiffs had done the work was the property of Mrs. Munroe, and she called in August at plaintiffs' place in Pall Mall and said she wanted a lot of work done at her house at Chessington. The outcome of the conversation was that one or two of plaintiffs' staff visited the house with her, and estimates were from time to time subsequently prepared. There were altogether about 80 estimates, and the gross amount involved in those estimates was something over £7,000. But the whole of the work was not done because the defendants did not comply with the terms of the contract under which they undertook to pay 80 per cent. of the cost as the work proceeded. This they neglected to do, and the plaintiffs discontinued the work and claimed the full amount of the contract, less the cost of the work which had been left undone. One of the main questions to be decided, said counsel, was whether the husband or the wife was responsible. The husband was anxious to take the responsibility, asserting that he ordered the things. Then in their defence they said there was a contract for a lump sum, and that as plaintiffs had discharged themselves they could not claim anything. But there was in the contract a special note that the estimates were given subject to labour fluctuations and another to the effect that 80 per cent. of the charges should be paid as the work proceeded, and that defendants had failed to pay. If those defences failed the question would resolve itself into a matter of detail which would occupy a considerable amount of time. The plaintiffs had received £1,000 on account, but promises made of further payments had been without result. Plaintiffs were entitled to charge the increase in the amount of wages paid which came to £105. They also claimed £732 for extra work done and £132 for things which defendants would not allow them to take away from the job—materials and appliances for the work. Plaintiffs further said they were entitled to loss of profit on the items commenced but which they were not allowed to finish. The first estimate was accepted on August 12th, and men were sent down to start the work at once; but it turned out that defendants had not proper legal possession, and the men, in consequence, had to be taken away again. As a matter of fact plaintiffs did not get defendants' order to do the work until October. As to who was liable, counsel said that the estimates were prepared for Mrs. Munroe, although her husband occasionally gave directions, and although discussions took place from time to time, it was never suggested that Mrs. Munroe was not responsible.

A great deal of evidence, occupying several days, was taken, largely in relation to the ownership of the house, and the directions given by the husband or the wife for the work required.

Mr. Herbert Symons, electrical engineer employed by the plaintiff firm, gave evidence as to the electrical installation, explaining in detail all that had been done at the house. He said that the total amount of the estimate for the whole of the installation was £1,096, which included generating plant, engine, and fittings, and of that sum £149 was for the accumulator. The whole of the electrical work was not completed, and allowance had been made in the account for work which was left undone, amounting to £180 8s. The switchboard was supplied, but not connected up.

The hearing was adjourned for a fortnight in order that the Official Referee might himself take the evidence of an absent witness.

Unsuccessful Prosecution at Cape Town.

The Cape Town municipality has lately prosecuted two ratepayers (one being a town councillor) for fraudulently using electrical energy. The facts in each case were identical—the premises had been wired, but as no notice of completion had been given to the Electric Light Department the meters had not been fixed. The consumers' leads had, however, been connected to the municipality's wires without the knowledge of the department, and light had been used. In each case the magistrate decided that the municipality had not proved "fraud," and decided in favour of the defendants.

Workmen's Compensation Claim.

In the Mayor's and City of London Court, on April 18th, the case of Portugal *v.* Grayson was mentioned under the Workmen's Compensation Act in which a claim was made by Mrs. Sarah Portugal, 111, Cazenove Road, Clapton, against H. & C. Grayson, Ltd., ship repairers, 37, Gracechurch Street, E.C., to recover compensation for the death of Harry Isaac Portugal, electrician in the defendant company's service, who met his death as the result of an accident on June 22nd, 1918, at Liverpool, when he fell down the hold of the ship on which he was working. His wages had been £4 10s. a week, and he did private work as well. The claim was for £300.

Mr. Dale, counsel for the applicant, said he appeared for the mother and daughter of the deceased. The employers had paid £150 in settlement which the applicants were willing to accept. The widow was not a dependant, she having been divorced according to Jewish law, and now living in America. She had formally renounced any claim she might have had.

Judge Jackson approved of the settlement.

Hackney Borough Council Summoned.

The case referred to on p. 513 of our issue of April 22nd, came on at the North London Police Court on Tuesday. The Council, it will be remembered, failed to give supply to certain premises because the installation had been carried out by a small master man, who did the work himself and was not a member of the Trade Union. Mr. Forbes Lancaster said he would consider his judgment.

Restricted Lighting.

At Leeds Police Court, last week, Charles Landey and William Hall, shopkeepers, were charged with committing a breach of the Emergency Powers Act by using lights for display or advertisement during the period of lighting restriction consequent on the coal stoppage. In the case of Landey it was stated by the police that he had three electric lights in use and had been warned an hour before, when he had put the lights out. His defence was that he put them on again to let a customer see an article in the window. He was fined 40s., or 14 days' imprisonment. In the case of Hall, it was stated that his lights had been extinguished by order of a policeman, and that he turned them on again when the policeman had walked 50 yards away. Hall sent an assistant to the Court, but the magistrates sent him back with the message that Hall himself must appear.

Manchester Contractor Fined.

At Manchester City Police Court, Henry Hayhurst, electrical contractor, 413, Bury New Road, Higher Broughton, was fined £2 for unlawfully connecting an installation to the Corporation supply in contravention of their regulations. An inspector from the electricity department found the wires connected to the service-boxes when visiting the premises to inspect and test the installation.—*Manchester Guardian.*

BUSINESS NOTES.

Bankruptcy Proceedings.—John Jones & John Richard Jones, trading as J. Jones & Son, 7, Chapel Street, Penzance, Cornwall, electrical engineers.—The adjourned public examination of these debtors was held recently at the Town Hall, Truro. The elder partner stated that he came to Penzance about 16 years ago, and commenced business on his own two years ago. His capital then amounted to £1,900. According to the statement of affairs, the liabilities were returned at £1,040, while the assets were estimated to realise £776, leaving a deficiency of £264. The debtors attributed their failure to the illness of the senior partner, his wife and daughter, pressure by creditors, and depreciation of stock. After the junior partner had been questioned regarding the business, the examination was closed.

H. Doyle (Accessories Supply Co.), factor in electrical accessories, 56, Hardman Street, Deansgate, Manchester.—Receiving order made April 18th, on debtor's own petition.

W. Hedgecox, electrical engineer, 33, North Road, and 121, Salop Street, Wolverhampton.—Receiving order made April 20th, on debtor's own petition.

Ernest Albert Goodings, trading as Goodings & Son, The Grove, Watlington Street, Reading, motor and electrical engineer.—The public examination of this debtor was held recently at the Assize Courts, Reading. According to the statement of affairs, the gross liabilities amounted to £290, of which £289 was expected to rank for dividend, against assets £4 16s. 2d., or a deficiency of £284. Debtor stated that he commenced business without capital at "The Paddock," Staines, in 1911. The examination was adjourned.

Company Liquidations.—The Semaphore Engineering Co., Ltd., Advance Works, Jews Road, Wandsworth, London, S.W.—A meeting of the creditors of the above was held recently at the Institute of Chartered Accountants, Moorgate Street, E.C., when it was reported that the company had gone into voluntary liquidation, and Mr. H. W. McLaren had been appointed to act as the liquidator. According to the statement of affairs submitted, the liabilities amounted to £5,103. The assets were estimated to realise £4,316, from which had to be deducted £559 for preferential claims, leaving net assets of £3,758, or a deficiency of £1,345. The assets were as follows:—Cash in hand and at bank, £98; bills receivable, £88; book debts, £917, estimated to realise £430; stock at cost, £936, expected to produce £300; plant and machinery at cost, £4,484, valued at £1,200; motor van at cost, £502, expected to produce £250; and lease of premises, £2,000. The company was formed at the end of 1915 with a nominal capital of £6,000, and was engaged for a time on munition work for the Government, and made satisfactory profits. Subsequently experimental work was carried out, and there was a loss. Finally the company turned its attention to the production of all kinds of electrical goods, which necessitated the installation of special machinery. The liabilities included about £2,900 due to the directors of the company. The premises at Wandsworth were large and well equipped, and an offer of £6,000 had been received for the premises and lease. There was a contingent liability in respect of income-tax, but it was pointed out that it would probably be the subject of a set-off against a claim for the repayment of Excess Profits Duty.

A suggestion was made for the appointment of a joint liquidator, but this was not agreed to, and eventually it was decided to confirm the voluntary liquidation, with the liquidator appointed by the company.

Record Engineering Co., Ltd.—We are informed by this company, of Tutbury, Burton-on-Trent, that owing to the large demand for "Silent Record" engines, "Record" steam traps, and other goods that they manufacture, they have gone into voluntary liquidation with a view to reconstructing as a much larger company to enable them to meet their demands. We are also informed that the whole of the additional share capital is taken up by the present holders and their associates.

Dissolutions of Partnership.—Pendlebury, Sugden and Co., electrical engineers, General Street, Blackpool.—Messrs. S. Pendlebury, S. Sugden, and W. Northrop have dissolved partnership. Debts will be attended to by Messrs. Sugden and Pendlebury, who will continue the business.

Wager & Coller, electrical engineers, 108, St. Benedicts Road, Small Heath, Birmingham.—Messrs. A. J. Wager and E. W. Coller have dissolved partnership. Debts will be attended to by Mr. Wager, who will continue the business.

Trade Announcements.—The electrical engineering and contracting business, formerly carried on under the name of Guy V. Laycock, Cloth Hall Street, Huddersfield, is now incorporated as a private limited company, under the title of Guy V. Laycock, Ltd., at the same address. The business is now under the management of Mr. H. P. Ripley, who for the last 15½ years has been chief of the electrical department of Messrs. Thos. Broadbent and Sons, Ltd., of Huddersfield.

Mr. M. T. Pickstone, who was for many years connected with Messrs. Bruce Peebles & Co., Edinburgh, and who has since been engaged in pneumatic engineering, has now joined the Progressive Engineering Co., Ltd., of Leicester, with a view to taking over the development of the fan side of their business.

Mr. Edward P. Prior has removed from King Street to Gibson's Buildings, Mill Street, Belfast.

The Government having given up possession of their premises at Millbank House, Messrs. I. A. Timmis & Son re-occupied these as from Monday last. Communications should therefore be addressed as follows in future:—Millbank House (2, Wood Street), Westminster Abbey, London, S.W. 1.

Catalogues and Lists.—Messrs. Ward & Goldstone, Ltd., Frederick Road, Pendleton, Manchester.—An illustrated and priced pamphlet dealing with the "Dimla" switch for reducing the intensity of automobile headlights.

Messrs. Hindle, Son & Co., Union Engineering Works, Haslingden, Lancs.—An illustrated pamphlet describing patent electric baling presses.

Messrs. Marconi's Wireless Telegraph Co., Ltd., Marconi House, Strand, W.C. 2.—Six well-illustrated descriptive pamphlets:—L. 111/3, Aircraft wireless telephone transmitter, type A.D. 1; L. 126/3, Combined aircraft transmitter and receiver, type A.D. 2; L. 135/3, Aircraft receiver, type A.D. 3; L. 170, 1½-kW continuous-wave transmitter sets, types M.C. 1 and M.C.; L. 173, 3-kW continuous wave set for telegraphy; and L. 175, Marconi 6-kW continuous-wave transmitter set for telegraphy.

The General Electric Co., Ltd., Magnet House, Kingsway, W.C. 2.—Installation Leaflet No. P. 2,463. This publication gives a number of illustrations, and an exhaustive description of a gas engine generating set installed in a large country residence.

Metropolitan-Vickers Electrical Co., Ltd., 20, Brazennose Street, Manchester.—Instruction Book 5,370/1, giving very full and illustrated details of the installation, working and care of power transformers.

Messrs. Herbert Morris, Ltd., Loughborough, Leicestershire.—An illustrated folder dealing with elevating trucks and showing various applications.

Callender's Cable and Construction Co., Ltd., Hamilton House, Victoria Embankment, E.C. 4.—Illustrated descriptive booklets describing the use of screened pilot cable for the Merz-Price feeder protective system, and "Kalecore" cable for automatic protective gear.

The Swift Electrical, Ltd., 6, Cork Street, Old Bond Street, W. 1.—Three postcards giving illustrations and prices of "Z" type ironclad switch and fuse-gear.

Messrs. Austin Walters & Son, Gaythorne Electric Works, Manchester.—An illustrated circular dealing with tandem resistances, dimmers, and other types of resistances, &c.

The Cambridge and Paul Instrument Co., Ltd., 45, Grosvenor Place, S.W. 1.—List No. 160—"Cambridge Unipivot Instruments for Direct Current," giving very full details and illustrations of various types of instruments, standard shunts, &c. List No. 164—"Cambridge Testing Sets," illustrating and describing portable sets, fault localisers, capacity test sets, rail band testing sets, &c.

Private Meeting.—Samuel Horace Dougherty, trading as the Mersey Electric Co., 106, Kensington, Liverpool, and 53, Warren Road, Southport.—A meeting of the creditors of the above was held last week, when a statement of affairs was presented which had been prepared by Messrs. T. Theodore Rogers, Bowler and Co., chartered accountants, 30, North John Street, Liverpool. The liabilities amounted to £1,135, while the assets were estimated to realise £633. After allowing £73 for preferential claims, the assets were estimated to realise £559, or a deficiency of £576. The assets comprised stock at cost £565; book debts, £41; estimated to produce £35; fixtures, fittings and utensils, £30; and surplus from fully-secured creditors, £3. In a circular which they have issued, the accountants state that "the two principal trade creditors were present at the meeting. These were the General Electric Co., Ltd., £226, and the General Engineering Co., Ltd., £185. . . . The preferential creditors include £60 for wages, and £13 for rent. . . . At the meeting it was found that the General Electric Co.'s claim was £48 more than was given to us by the debtor, and the liabilities therefore want increasing by this amount. . . . After full discussion at the meeting, the two principal creditors stated that they would prefer the matter dealt with in bankruptcy. We have, however, had a further interview with the debtor to-day, and he is very anxious if possible to continue the business, and is writing up to some solicitor friend in Glasgow to-night with full particulars to ask if he can come to his assistance in order that he may make an offer to his creditors. We endeavoured to get the petitioning creditors to hold their hand while this communication was going forward, but their solicitor was of opinion the petition had better go on the file at once, and that if we were able to show them that there was a prospect of an offer, then the petition should be adjourned to enable us to formulate the offer to the creditors, and if accepted, the petition could be withdrawn. We think you will agree it is in the interests of the creditors that all efforts should be made to get a fair offer, as if the case goes into bankruptcy, it can only result in a very small dividend."

Patent Application.—Mr. J. Carpentier has made application for restoration of Patent No. 19,102, of 1910, for an "Improved transmitter for transmitting telegrams composed in perforations on a band by the Baudot system."

Inquiries.—The maker's name and address are asked for in respect of the following items:—"Type H N 300" d.c. 30-kW generator, 110 volts; an electric egg tester; "Pluton" insulating material; "Perry" (or "Parry") electric pump.

Social Events.—Messrs. Rawlings Bros., Ltd., of South Kensington, held their first annual social after the war at the Kensington Town Hall on April 19th, between 300 and 400 employés and their friends were present. Mr. W. R. Rawlings, one of the joint managing directors, said that he and his brother, John Joseph, started in business in Kensington 35 years ago as general engineers, following immediately with the electrical business, and they were practically the first to start electrical contracting in Kensington. With the advent of the motor car, they started many garages in London. In 1900, in order to meet the expansion of the business, they became a limited company, and added further new departments. Two years ago they took over premises in Gloucester Road, where the head offices are now situated. The Rawlplug, which was invented by Mr. J. J. Rawlings, is manufactured by a separate company with a factory at Lewisham. Mr. W. R. Rawlings mentioned there were 23 employés now with the company who had been with them upwards of 20 years, some going back beyond 30 years. The directors marked their appreciation by presenting to each a gold compass pendant. A number of employés have invested loans amounting to £1,000, for which the company pays 7½ per cent. interest, and it is expected that the rate will be increased to 10 per cent. It was announced that Messrs. J. J. and W. R. Rawlings personally desired to commemorate the occasion by giving 700 fully-paid ordinary shares of £1 each in Rawlings Bros., Ltd., to the old employés, £100 each to the three oldest employés, and £100 each to four other employés, who were selected by ballot. A fine programme of music and song, recitals and ventriloquial vagaries contributed to the success of the gathering.

Japanese Electrical Dumping in Australia.—We quote the following interesting note from the *Melbourne Age* for February 28th :—

"The report published in these columns a few days ago indicating that an organised effort was being made by Japanese manufacturers to 'dump' goods on the Australian markets is supported by vendors of electrical fittings. It is alleged that the dumping scheme has been particularly successful in regard to electric lamp-holders, and a claim is made by Australian manufacturers of these articles that the duty should be increased from the present rate of 40 per cent. in order to defeat the move. A favourite plan adopted by the Japanese, it is stated, is to duplicate the orders for fittings, and so flood the market. As a result the holders of local manufacture, which are acknowledged to be superior to the Japanese goods, are practically unsaleable, and an industry promising employment to several hundreds of Australians may have to be abandoned, unless effective protection be afforded it. It is contended that, while Australian manufacturers have to pay 16s. a day wages, and the Japanese only 4s., the 40 per cent. duty is not an adequate protection against Oriental competition. Instances of this character have been reported frequently in the last few months, and it will be necessary for the Minister and his officers to keep a watchful eye on trade developments if the acknowledged evil of 'dumping' is to be suppressed."

South African Electrical Supplies.—The *S. A. Mining and Engineering Journal*, in its issue for April 2nd, says that trading is quite good in electrical wares, fair orders coming in from the country districts in addition to the local requirements. Prices remain unchanged. The demand for half-watt lamps continues, but stocks of these are very slow in arriving ; otherwise materials are coming to hand satisfactorily.

The Budget.—In concluding his speech on behalf of the Chancellor of the Exchequer (Sir R. Horne), Mr. Austin Chamberlain reviewed the achievements of the past two years in connection with the restoration of credit, in the following terms :—

"We have re-established Treasury control, necessarily abandoned during the war. We have ceased to borrow, we have begun to repay debt, the deficit of the first year has been converted into a surplus, and the foundations have been laid for a steady recovery when industrial disputes are laid to rest and trade can begin a new revival. Finally, we have wiped off a large part of our foreign debt, we have restored our international credit, and we have made it clear to those who doubted our capacity or our will that we can hold, and shall hold, for this country and this City their proud position as the premier financial centre of the world."

Electric Company's Offices Raided.—An official Dublin Castle report states that the offices of the Kerry Electric Supply Co., Killarney, were raided by armed men, who held up the staff and carried off three miles of electric wire, three testing instruments, a mile of flexible cord, and tools and insulating tape.

Metropolitan-Vickers in Belgium.—The Metropolitan-Vickers, Société Anonyme, with a capital of 1,000,000 fr., has been established at Brussels (54, Rue des Colonies), for the carrying out of all operations relating to the trade and industry of electrical material and machinery.

Industrial Councils.—The District Council (No. 2) for the electricity supply industry at its monthly meeting at Leeds, on April 13th, decided that the two representatives from each electricity undertaking and Trade Union in the area should be invited to the annual meeting to be held at Leeds on May 11th, when the election of the Council will take place. There are 18 candidates for the 12 seats on the employers' side of the Council.

Book Notices.—The *Journal* of the American Institute of Electrical Engineers, Vol. XL, No. 4, April, 1921. New York : The Institute.—In addition to reports of proceedings at meetings of the Institute and kindred societies, a number of valuable papers are embodied in this issue. Among these are a description of the Duquesne Light Co.'s 300,000-kW Colfax power station ; "The Frequency Problem in the Steel Industry" ; "Longitudinal and Transverse Heat Flow in Slot-wound Armature Coils," &c.

"Management." By J. Lee. Pp. viii + 126. London : Sir I. Pitman & Sons, Ltd. Price 5s. net.

"Elements of Illuminating Engineering." By A. P. Trotter. Pp. xii + 104, 63 figs. London : Sir I. Pitman & Sons, Ltd. Price 2s. 6d. net.

"The Henley Telegraph." Vol. I, No. 5 March, 1921. (32 pp.) —This number of Messrs. Henley's house organ contains the usual interesting notes, articles and verse. Mr. H. R. Kempe contributes some recollection of the founder of the firm, and Mr. J. Hall gives some information regarding deep-sea soundings for cable laying.

"Dynamo and Motor Attendants and their Machines." By Frank Broadbent, M.I.E.E. (Tenth edition.) Pp. 214 ; 107 figs. London : S. Rentell & Co., Ltd. Price 4s. 6d. net.—The preface to this edition of a well-known manual states that the chief revisions are in connection with the permissible temperature limits of dynamos and motors and the method of reversing induction motors. As a popular handbook for the use of the readers named in the title, this work would be hard to beat : it is a mine of practical information regarding the principles and operation of the machines, their applications, their weaknesses, the troubles that arise and their remedies. It deals also with accessories such as motor starters, regulators, belts and gearing, and accumulators.

We have received from Messrs. H. K. Lewis & Co., Ltd., 136, Gower Street, and 24, Gower Place, W.C. 1, two supplementary catalogues (price 1s.) of medical and scientific works in their circulating library. The price of each book is given, and the lists cover a very wide field in the many branches of science.

Copper and Lead Prices.—Messrs. F. Smith & Co. report, April 26th :—"Copper (electrolytic) bars, sheets, wire and rods and h.c. wire, no change."

Messrs. James & Shakespeare report, April 27th :—"Copper bars (best selected), sheet, rod, no change. English pig lead £22 5s. ; 5s. decrease."

Lead.—Messrs. James Forster & Co., reporting on April 23rd, stated :—"With trade anything like normal, the question of supplies would be serious, as, with Australian production on a very low scale, Mexican mines reported shutting down and Germany out of the running with the 50 per cent. tax, we are left with Spain as our only reliable source of supply. On the other hand, consumption in this country is anything but good. We understand that for March the sheet and pipe lead figures are just over 5,000 tons (in October last they were 50 per cent. more), and the electrical trade demand has fallen off to a similar extent."

Scottish Electrical Trades Dispute.—The Electrical Contractors' Association of Scotland states, with reference to reports to the effect that 41 firms in the Clyde area have agreed not to reduce wages, and that many of these firms belong to the Employers' Association, that no member of the Association in the Clyde area is acting contrary to the recommendations of the Association. In the Edinburgh district, it states, only three federated firms have not accepted the recommendation, and it is incorrect to state, with reference to federated firms, that nine firms in Edinburgh have signed agreements to pay the old standard rate of 2s. 3d. Several firms are fully staffed at the new rate, and, as a matter of fact, are passing applicants for work on to other firms. The number of employés working is now considerable. In Dundee and Aberdare all federated firms are conforming to the recommendations of the Association. In Dundee the employés of three firms have returned to work at the new rate of 2s. per hour, and throughout Scotland there is a distinct tendency for men to return to work at the new rate, and a considerable amount of labour has recently been obtained. On the whole throughout Scotland, it is stated, the majority of apprentices have not struck work in support of the journeymen's demands.

New French Companies.—There has been formed at Lille (70, Rue Gantois), the Société Anonyme des Accumulateurs du Nord, with a capital of 1,600,000 fr., for the manufacture and sale of accumulators and electric lamps for the mines.

The Aciéries et Usines Hydro-Electriques de la Sioule (Albert Wehrlé et Cie.), has been formed at Bellenaue Department of Allier, with a capital of 4,000,000 fr.

Under the style of Stourm et Cie., there has been established at Paris (19 bis Rue de Boulainvilliers), a company, with a capital of 275,000 fr., to carry out electrical, water, gas, and heating installations.

A Dundee Exhibition.—An interesting exhibition and demonstration of electrical labour-saving devices attracted attention last week at the premises of Messrs. Ponsford and MacHardy, Ltd., when Messrs. Simplex Conduits, Ltd., demonstrated their "Plexsim Royal" vacuum cleaner, which is up-to-date from every standpoint. Other popular exhibits were the "Thor" washing machine, the "Western Electric" sewing machine, and the domestic motor.

Australian Electrical Manufacturing: The Question of Preference.—Following upon the reference to the Sydney transformer contract in our last issue, we give below a copy of a letter written to the Sydney *Morning Herald* of February 24th by the Lord Mayor of Sydney and the chairman of the Electric Supply Committee:—

We shall be glad if you will publish the following figures, which give in detail the tender prices for electrical transformers as called for by the City Council specifications 626 and 635:—

The English Electric Co. of Australia, Ltd. (local manufacture)	£17,082
Edison Swan Electric Co. (imported)	£20,753
British General Electric Co. (imported)	£22,104
Alternative (ditto)	£21,258
Metropolitan-Vickers Electrical Co., Ltd. (imported)	£22,392
Ditto, ditto (imported)	£20,070
Alternative (imported)	£19,584
Johnson & Phillips, Ltd. (imported)	£23,813
Alternative (ditto)	£22,622
Australian General Electric Co., Ltd. (imported) ...	£24,255
Alternative (imported)	£18,390
Noyes Bros., Ltd. (imported)	£25,866
Ditto (ditto)	£25,866

The following tenders were received on January 17th, 1921, for transformers, to specification No. 635:—

General Trading Co. (local manufacture), (afterwards withdrawn)	£10,400
Noyes Bros., Ltd. (imported)	£11,440
Australian General Electric Co. (imported)	£12,372
British Electrical Engineering Co. (imported) .	£12,997
Metropolitan-Vickers Electrical Co., Ltd. (imported)	£13,540
Alternative (imported)	£12,500
English Electric Co. of Australia, Ltd. (local manufacture)	£13,700
Johnson & Phillips, Ltd. (imported)	£13,800
Alternative (imported)	£13,100

It will be observed that in the first case the local manufacturers' price was lowest, but when a second lot of transformers were called for the importing firms lowered their prices in line with the local manufacturers' price and even below it. The lowest tender for imported machinery was sent in by the firm whose previous tender was actually highest.

There is little need to comment upon these figures. They show that the infant industry in Australia will require a little shepherding to prevent it from being crushed by concerns which think they have vested interests in the supply of such goods.

The City Council wants to buy in the cheapest market, other things being equal. But it is primarily concerned with the well-being of its citizens, and we consider that it is better to give mechanics the opportunity of earning good wages than to save even 20 per cent. on a tender and spend the money saved among the people of Australia. Our policy is to patronise and encourage Australian industry, if reasonable conditions are offering.

We are, &c.,
WM. H. LAMBERT, *Lord Mayor.*
W. HOLDSWORTH.
Chairman,
Electricity Supply Committee.

The Coal Miners' Strike.—It is reported from Rome that owing to the British miners' strike the Italian Government has curtailed the supply of coal to private manufacturers. Gas and electricity undertakings were ordered to reduce lighting last week, and the train services were to be reduced on Tuesday last.

Fines.—A number of miners were on trial at Cupar, Fife, last week, on charges connected with recent disturbances at the electric pumping station at Milton of Balgonie, when the boiler fires were drawn, and those working the pumps ordered to withdraw. The mine manager stated in evidence that the immediate damage by the stopping of the pumps was that 12 motors and machines were "drowned," and the cost averaged £350 each. It would be more than a couple of months before they got a full start. Sentences ranging from two months' to fourteen days' imprisonment were passed on the men.

At Birmingham, on the 22nd inst., Messrs. Charles Alder, Ltd., coal merchants, were fined £25 and costs for selling coal in greater quantities than one hundredweight.

Glasgow.—In common with the rest of the country, industrial establishments in the West of Scotland are hard pressed for the want of fuel. Messrs. Wm. Beardmore & Co., who employ over 3,000 men at the Parkhead Forge, state officially that they have no intention of closing down. The establishment may be compelled to slow down should the miners' strike be prolonged, but as a large portion of the works is operated by electricity supplied by the Corporation, they hope to carry on for a considerable time. Other large establishments using electricity are in the same fortunate position. Street lighting has been reduced.

North-East Coast.—From Berwick-on-Tweed to the Tees the continuance of the strike is having serious effects upon local industry. The cut in the electricity supply by 50 per cent. has meant that several of the shipyards and engineering works have had to be closed down temporarily, and a system of long week-ends has been adopted, the works shutting down on the Thursday of one week to the Tuesday of the next. The Sunderland Corporation has restricted the supply to three days a week, and the Newcastle Electric Supply Co., which serves Newcastle-on-Tyne, is also having to limit its services to its customers. The tramway services in the district have been curtailed, and at Newcastle the reduction amounts to 35 per cent. of the normal cars in use. This drastic reduction commenced on April 25th.

Lancashire.—The tramway services in many towns, including Oldham, Stalybridge, and Blackpool, are being suspended on Sundays. At Burnley cars are being run on Mondays and Saturdays only, and the Oldham Electricity Committee has circularised its consumers asking them to economise in the use of electricity.

Halifax.—The Tramway Committee cut down the tramway service practically immediately the coal shortage began in order to conserve fuel from the first. The Sunday service was suspended after the first week of the strike, and last week the Tramway Committee decided that from April 25th the week-day service should commence an hour later in the morning and cease half an hour earlier at night.

Doncaster.—It was announced last week that if the coal stoppage continued the electricity supply would probably not be maintained for more than a further three weeks, as the fuel supply would then be exhausted, which would mean the cessation of both tramway and general electricity supply. The Sunday tramway service was suspended on April 24th.

Nottingham.—The tramway service is to cease at 7.30 p.m. daily and the Sunday service has been cancelled.

Bradford.—Both electricity and gas departments can carry on for a few weeks for both power and lighting purposes.

Bolton.—The Corporation gas and electricity undertakings could probably keep going for another six weeks; electricity is chiefly used for power purposes in the engineering trade.

Huddersfield.—The public services of gas and electricity have coal stocks to serve for some time.

Wolverhampton.—The motor, electrical, and hollow-ware trades are amongst those hit severely.

London.—Drastic curtailments in electric tramway-car services are asked for by the Secretary of Mines in a letter to local authorities impressing on them the necessity of observing strictly the 50 per cent. restriction in the use of coal. Electric power for tramway-car services, it is stated, should forthwith be reduced by at least 25 per cent., and it is suggested that services should be suspended wholly or in part during the comparatively slack hours of the day. The restriction of the use of gas and electricity in hotels is being taken up with the Hotel Proprietors' Associations in London and the provinces. Considerable movements of coal took place on the 22nd inst., in order that works of vital national importance could be kept supplied. The Secretary of Mines also states that in the public interest strict observance of the fuel and lighting regulations is necessary. In a letter addressed to proprietors of hotels and boarding houses, the Secretary for Mines asks that immediate instructions be given that illumination shall be reduced to a minimum, a proportion of the bulbs being removed in the case of electricity, and that every other measure which will tend to conserve the consumption of fuel directly or indirectly shall be taken. The letter adds that it is not anticipated that further supplies of coal will be available until a considerable time after the termination of the emergency, and that gas and electricity undertakings will shortly have much difficulty in supplying their customers unless demands are materially reduced.

The successive reductions of train and boat services are seriously interfering with the ordinary course of post, state the Postmaster-General.

The London & South-Western Railway put into force on the 22nd inst. several rearrangements in services, and those on the suburban electrically-operated lines are being reduced. The London "tube" and underground railways are being opened later in the morning and closed earlier at night than usual.

Street and Public Lighting.—Mr Bridgeman, the Secretary for Mines, has issued a further direction under the Emergency Regulations, 1921, dealing with the restriction of street and other public lighting. The coal emergency directions issued at the commencement of the present emergency required local authorities to restrict such lighting as much as possible, but as this has not led to the curtailment which is considered necessary the new direction requires that, subject to police requirements, the consumption of gas and electricity for street and other public lighting shall not exceed 50 per cent. of the quantity supplied and consumed on the corresponding date last year.

West Ham.—At the Town Council meeting on Tuesday night it was reported that owing to the shortage of coal the Electricity Committee had put all consumers on half supply.

New Belgian Company.—At Antwerp has been embodied a company, the Ateliers Marckx, with a capital of 800,000 fr., for the construction and working of shipbuilding and repairing yards, and all kinds of electrical undertakings. Offices, 36, Quai Sainte Aldegonde.

The N.E.L.A. Convention.—The forty-fourth Annual Convention of the United States National Electric Light Association is to be held in Chicago from May 31st to June 3rd. The Convention headquarters is to be the Drake Hotel, and further information can be obtained from the Committee at that address.

Applications for British Trade Marks.—Appended is a summary of the recent applications for British trade marks in respect of goods and productions connected with the electrical trades and industries:—

Miller. No. 403,776. Class 6.—Dynamos for use in electric lighting sets for motor vehicles. No. 403,777. Class 8.—Fitted electric switchboards and batteries all for use in connection with the electric lighting of motor vehicles. No. 403,778. Class 13.—Metal goods including lamps for vehicles, electric fittings used in connection with the electric lighting of, and with starting sets for motor vehicles, &c. H. Miller & Co., Ltd., Monarch Works, Miller Street, Birmingham. May 5th, 1920.

Triangle and circle design. No. 412,723. Class 8.—Electric apparatus. Delta Star Electric Co., 2433, Fulton Street, Chicago, U.S.A. February 2nd, 1921.

Kingsway. No. 404,945. Class 14.—Electro-plated goods. Suckling, Ltd., Kingsway House, Albion Street, Birmingham. June 8th, 1920.

Majestic. No. 408,555. Class 18.—Electric heating radiators. Majestic Electric Development Co., 656, Howard Street, San Francisco, U.S.A. October 1st, 1920.

Eisemann Magneto Corporation (lettering and design). No. 412,419. Class 6.—Machinery of all kinds. Eisemann Magneto Corporation, 32-33rd Street, Brooklyn, N.Y., U.S.A. February 2nd, 1921.

Hotpoint. No. 376,582. Class 13.—Electric appliances for heating, cooking, ironing, and cleaning purposes. Hotpoint Electric Heating Co., Lemon Street, Ontario, Cal., U.S.A. January 23rd, 1917.

Metrovick. No. 401,999. Class 50.—Electric insulators, insulating materials, and preparations. Metropolitan-Vickers Electrical Co., Ltd., 4, Central Buildings, Westminster, S.W. March 17th, 1920.

M.V. & M.V.E.C. (lettering and design). No. 403,546. Class 50.—Electric insulators, insulating materials, and preparations. Metropolitan-Vickers Electrical Co., Ltd., 4, Central Buildings, Westminster, S.W. April 29th, 1920.

Electric Carbons: Meeting of Importers.—We read in the *Chamber of Commerce Journal* that an emergency meeting of the carbon importing members of the Electrical Importers' and Traders' Association was held recently at the Association's offices (London Chamber of Commerce) to consider what action should be taken in reference to the Government's proposal to impose a 33⅓ per cent. duty for five years on imported arc lamp carbons (under the Key Industries Schedule). A special committee was formed under the chairmanship of Mr. Charles Leven, M.I.E.E. (Electrical Engineering & Equipment Co., Ltd.), and a guarantee fund established to combat the inclusion of arc lamp carbons in the schedule referred to. A communication was reported from the Kinematograph Exhibitors' Association of Great Britain and Ireland, intimating its opposition to the Government's policy and its willingness to co-operate with the E.I.T.A. in the matter. It was resolved to develop active opposition along three lines, viz.:—

1. A deputation to the Board of Trade in conjunction with representative consumers of the goods in question.
2. Mobilisation of Parliamentary opposition.
3. Press propaganda, showing the effect which the proposed duty would have upon prices to the home consumer and the dangers attending the consequent virtual monopoly which would be conferred on a single British manufacturing group.

The secretary was instructed immediately to take all necessary steps to give effect to this policy.

Engineering Wages: Conference.—*The Times* reports that a conference between representatives of the Amalgamated Engineering Union and kindred organisations and the Engineering and National Employers' Federation was held at Broadway House, Westminster, on April 21st, Sir Allan Smith, M.P., presiding, to discuss the employers' proposals for reduction of wages. The men's case against the proposals was stated, and an adjournment for a week was agreed to. The proposals include a reduction of 6s. a week on time rates and 15 per cent. on piece-work rates, together with the abolition of the bonuses of 12½ per cent. on the earnings of time workers and 7½ per cent. on the pay of piece workers. According to our contemporary, the conference was a private one, but it is understood that it was represented on behalf of the men that the proposed reductions were not warranted, having regard to the rate of wages paid to workers in other trades which did not require equal or higher skill. It was further claimed that the rate of remuneration paid to the skilled engineers was not commensurate with the value of the engineering products to industry generally. The employers promised to take into consideration the arguments advanced for the men, and the conference was adjourned until Thursday (yesterday).

"Mr. J. T. Brownlie, chairman of the Council of the Amalgamated Engineering Union, interviewed at the close of the conference, said that the average rate of pay for skilled engineers was £4 9s. 1d., which was equivalent in money wages in 1914 to £1 18s. 3d. The effect of the employers' demands was to reduce the present average wage to £3 13s. 3d., or 21.4 per cent. below 1914."

A conference of 900 delegates of the A.E.U. was held at the Memorial Hall on Tuesday, at which the employers' proposals were considered. It is stated that there was strong opposition, firm action and resistance being advocated by some speakers. The conference was adjourned until Wednesday.

The Times further reports the holding of a conference of engineering union representatives numbering 120, at Caxton Hall, on 22nd inst. Resolutions were passed to the effect that the representatives of the organisations do not commit themselves to a joint recommendation with the employers to reduce wages, and that a further meeting be held to consider the matter. Referring to the "attack made on women's wages by the Engineering and National Employers' Federations," a resolution was passed requesting the male members of the Trade Unions to render practical help and sympathy to the women on the grounds that if the reductions were insisted upon they would reduce the position of women employed in the industry to sweating conditions, which would be a shame to our social life.

Fires.—According to the *Daily Chronicle*, damage estimated at £15,000 was done by fire on 21st inst., at the electrical works of Messrs. J. Dennis & Son, Knowle, North Devon.

Damage estimated at £5,000 was caused by an outbreak of fire at the electrical engineering works, Strabane, Co. Tyrone. The contents of the works were completely destroyed.

LIGHTING AND POWER NOTES

Australia.—Sydney. — The Chief Justice has been requested to nominate a Judge to hear the application of the City Council for power to increase the charges for electricity. It was expected that the application would be heard early in March. Mr. Forbes Mackay, general manager of the electricity department, in his last quarterly report, shows that the apparent loss on the trading for the quarter ended December 31st, 1920, was £28,043, and for the previous three quarters, £15,709, making the total loss for the year £43,752. In submitting his estimates for 1921, Mr. Mackay points out that as the City Council has undertaken the legal responsibility of supplying electricity in certain areas it must do so, irrespective of what it costs to produce, so that the revenue and expenditure are practically beyond the control of the City Council or its officers. On the basis of the past year's working he estimates a loss of £38,000 during the current year.—*Sydney Morning Herald.*

Ayrshire. — Street Lighting. — The Irvine Town Council has decided next lighting season to light the main streets of the town with electricity and to fit the gas lamps in the side streets with wave pressure mechanism.

Bognor.—New Diesel Plant.—The Electricity Commissioners have granted permission for the Bognor Gas-Light and Coke Co. to replace an old 30-kW Diesel engine by a new 90-kW set, the output of the station having been practically doubled during the last 18 months.

Continental.—Spain.—Application has recently been made to the Spanish Government for a concession to establish a plant to utilise the water power of the River Nalon, near Laviana, to generate electricity.

Belgium.—La Société Intercommunale Belge d'Electricité in order to meet the ever-increasing demand for energy is erecting two large generating stations at Alost and Monceau-Sur-Sambre, which will increase the supply capacity up to 100,000,000 kWh. The area supplied comprises Louvain, Malines, Saint-Nicholas, Termonde, Alost, Roulers, Courtrai, Renaix, Mons, and Charleroi.

France.—The works of the Compagnie Electrique du Nord, at Beautor, department of the Aisne, were totally destroyed during the war. The reconstruction, begun at the beginning of 1920, is far advanced. The equipment of the new works comprises 16 Babcock boilers; two 6,000-kW turbo-alternators; one 10,000-kW and, later, two 10,000 kW turbo-alternators. Energy will be generated at 5 000 volts for the district and 45 000 volts for the main lines. The latter include:—A line in the direction of Hirson, two to Cauchy, whence distribution will be made to all the Northern mines, a line to Compiègne and Beauvais, one to Chauny, Soissons, and Pont-Ste.-Maxence, and one in the direction of Laon and Rheims. The partial commissioning of these installations is reckoned upon towards the end of the current year.

Russia.—According to the *Deutsche Allgemeine Zeitung*, for some months past the Russian Soviet Government has been making great efforts to supply towns and large industrial districts with electric power. The largest of the hydro-electrical stations to be erected by the main committee for municipal undertakings of the People's Commissaries is that of Svir-Volkovskaya. This station is expected to deliver one milliard kWh of electrical energy in the year—*i.e.*, twice as much as Petrograd consumed in 1916; this corresponds to a daily uninterrupted supply of 180,000 h.p. The station will be the largest in all Europe. In addition to supplying cheap electric power, the erection of the station will make shipping possible on the Svir, a tributary of the Marinskoye, whereby a connection will be made with the Volga and the Baltic. The works in connection with the station were commenced in 1918, and, according to the *Ost-Europa-Markt*, are making great progress.—*Economic Review.*

Extracts, published in the *Journal of Electricity and Western Industry*, from a paper read at the Eighth All-Russian Congress of Soviets, by M. Krzyanowski, show that "the railroads of the northern regions are to be electrified. The electrification of the Murmansk Railway is also to be undertaken soon. Great power stations are being built on the White Sea, and at Murmansk. There is excellent water power in this region, convenient sources for the production of electrical energy. Entirely new conditions for production are thus being created for the North. Great nitrogen works are there being established, also aluminium works. With artificial nitrogen, as well as with potash, it is intended to intensify agriculture in these regions. A connection by electric railway will be effected between the White Sea, Murmansk, and Petrograd. The Petrograd region will thus become an absolutely modern transportation region, with Petrograd as its central point. It has been calculated that in the region on the White Sea a million horse-power (in water power) can be exploited.

"The Petrograd region will therefore obtain power stations which will serve the transportation routes to the seas and to the interior, create new industries by using the mighty water power resources, and intensify agriculture into a model economy. The electrical line from Murmansk to Petrograd will render possible the opening up of the ice-free port of Murmansk, which hitherto has been very little used."

Jugo-Slavia.—The Jugo-Slav Government is preparing a scheme for the erection of a central power station at Kostolast, on the Danube, 90 km. below Belgrade, which is to supply electric power and lighting to Belgrade, Smederevo, Pogurévatz, Gotzka, Kovine, Panuchovo, and Zenun. The Ministry of Public Works has received numerous tenders from contractors.—*Review of the Foreign Press.*

Coventry.—Bulk Supply Charges.—The City Council on April 26th received a statement from the Electricity Committee that the manager had reported that the decision of the Committee of February 28th, 1921, regarding the scale of charges on the high pressure or bulk supply rates, had been conveyed to the Engineering and National Employers' Federation, and that, in response to a request, the chairman and himself had interviewed representatives of the Federation upon the subject, when the Federation asked that the following questions should receive consideration:—(1) The maximum charge for bulk supplies should not exceed the price charged for power to low-pressure consumers; (2) The percentage increase should be equitably distributed over the whole of the consumers. It was resolved that the Committee was unable to alter its previous decision.

Douglas (I. of M.).—Electricity Bill.—On April 15th the Douglas Electric Light and Power Bill was given a second reading in the Legislative Council. An amendment had been proposed by the Douglas Gas Light Co. This took the form of a clause stipulating that the prices charged for energy should be sufficient to cover the cost of production. Counsel for the Douglas Corporation (the promoters of the Bill) objected to the inclusion of such a clause. There was not a similar case in England, because in that country there were no gas companies, like the Douglas Gas Co., with unlimited powers to charge. It was agreed finally that the clause should be printed with the Bill, when it could be dealt with by the House of Keys. The Bill was then read a third time and passed.

Dungannon (Co. Tyrone).—Electricity Scheme.—At a meeting of the Urban Council, the clerk stated that one of the Committees had considered the question of public electric lighting, and asked the Council to deal with it. As far back as 1902 a Provisional Order was obtained, but the powers were allowed to run out, and they would now have to start afresh. Mr. Joseph Newell said the estimate at that time, made on the advice of the best experts in the United Kingdom, was for an outlay of £4,000. The only objectors were the Gas Co.'s shareholders. The Council referred the matter to the Finance and Lighting Committee to prepare data and report.

Dutch East Indies.—Water-Power Development.—New projects for the development of water power in the Netherlands East Indies continue to be launched, or to come up for consideration, whilst good progress is made with schemes already in hand. The Netherlands Indies Chamber of Commerce states that work on a power station in the Residency of Batavia was commenced last year, and it is presumed that when this station is finished more than 50,000 h.p. will be generated. The power from this station is designed to electrify the Batavia Railway and to supply light and power to the towns which the railway serves, among which Tandjong, Priok, Batavia, Meester Cornelis, Buitenzorg, and Soekaboemi are the best known. In the Preanger Regencies plant is under construction having an initial capacity of 3,300 h.p., and as soon as this is running an additional water reservoir is to be constructed, so that the initial power of this station may be doubled. On a tributary of the Tjisadana, to the west of Buitenzorg, still another station is to be erected, and the machinery at this third point of generation is calculated to develop between 25,000 and 28,000 h.p. The preliminary plans for this work have been completed already, and as soon as the machinery can be obtained actual constructional work will commence.—*Eastern Engineering.*

Electricity District.—West Riding (Aire and Calder) Inquiry.—The postponed inquiry which is to be held by the Electricity Commissioners at Leeds, has been fixed to take place on May 18th, at the Civil Court.

Golborne.—Bulk Supply.—In reply to an inquiry from the Lancashire Electric Power Co., the Urban District Council is to ask for estimates (*a*) for supplying electricity in bulk to the Council, and (*b*) for supplying and distributing the electrical energy itself.

Greenlaw.—Electricity Scheme.—Berwickshire County Council has decided not to take up the Greenlaw electric lighting scheme. A private company has been formed to carry out the project.

Londonderry.—Proposed Extensions.—The City electrical engineer (Mr. R. V. Macrory) has submitted a report to the Corporation upon the extensions necessary at the electricity works. These entail a cost of £53,500, made up of the following items:—One 3,000-kW turbo-alternator, &c., £27,000; switchgear and cubicles, £500; two boilers, chimney, &c., £15,000; one 1,000-kW rotary converter, &c., £6,000; foundations, £1,500; and contingencies, £3,500. Of this amount the Electricity Commissioners are prepared to sanction £40,227, subject to a deduction of £2,727 for the sale of old plant. This reduction is to take into account an almost certain fall in the cost of plant and materials before the extensions are finally approved. In addition to these plant extensions, further expenditure to the extent of £15,500 is recommended. This sum includes items of £6,500 for mains extensions, £4,000 for consumers' services, £1,200 for meters, and £1,000 for pillars, boxes, &c. The Commissioners approve the borrowing of this amount, with the exception of £2,000 for completion of a culvert and half the proposed expenditure upon meters. The engineer estimates that these extensions will increase the gross profits in 1922 from £3,594 to £16,558.

London.—St. Pancras.—The Borough Council is recommended to accept a loan of £20,765 for electricity purposes, offered by the London County Council. Application is to be made to the Electricity Commissioners for sanction to borrow £40,272 for the purchase of two water-tube boilers and £2,700 for the erection of a ferro-concrete pump house at the King's Road station.

Navan.—Electricity Scheme.—At an Urban Council meeting regret was expressed that the public electric lighting scheme had been postponed for 12 months, and it was decided that the earliest possible moment should be availed of for reviving and proceeding with it.

Newport (Isle of Wight).—Street Lighting.—The Electric Light Co. has informed the Town Council that the charge for electricity for public lighting has been increased as from April 1st from 4½d. to 6d. per unit.

Portrush.—Progress of Electricity Scheme.—The Irish Local Government Board having agreed to sanction a loan, the Urban Council has accepted the tenders of Messrs. Curran Bros. at £12,508 and Messrs. Cochrane & Elliott at £1,652 for the new electric lighting scheme, subject to satisfactory terms being fixed for the different sections and the early completion of the work as a whole.

Preston.—Purchase of Undertaking.—The Finance Committee has had under consideration a report of Mr. J. A. Robertson respecting the purchase of the undertaking of the National Electric Supply Co. and the provision of a new generating station on the South side of the River Ribble. The report has been adopted, and an application recommended to the Commissioners for a special order authorising the Council to supply electricity.

Ryde (I. of W.).—Street Lighting.—Owing to the high initial cost of lighting the town by electricity, the Town Council has decided to enter into a contract with the Gas Co.

Salford.—Street Lighting.—The Town Council is to apply for sanction to borrow £3,000 to cover the cost of street lighting by electricity required in connection with Lower Kersal and Weaste housing estates.

South Africa.—Electricity Supply Bill.—The Union Government has introduced an "Electric Supply Bill," providing for the establishment of an Electricity Board in which the control of electricity supply is to be vested, and which will decide all questions relating thereto. Provision is made for the appointment of local committees consisting of suppliers and consumers, which will have no executive powers, but will act in an advisory capacity. The Bill provides also for the establishment of Government generating stations, the first of which will probably be those required for the electrification of the railways. Sections will provide for a certain measure of control over municipal supplies. The various municipalities having electricity supplies are vigorously opposing the Bill so far as it affects their interests.

Southend.—Proposed Extensions.—In a report to the Corporation, the Electricity and Light Railways Committee recommends the following additions at the electricity works to meet present and future demands until a larger scheme can be put into operation:—Two 1,500-kW turbo-alternators, £40,500; motor-converters, £28,680; boiler, economiser, and accessories, £20,000; alterations to buildings, £4,000; foundations, £2,000; switchboard, l.p. and h.p. cables, pipes and valves, £9,250, making, with an addition of 10 per cent. for contingencies, £114,873, or £38 6s. 8d. per kilowatt.

Tamworth.—Electricity Scheme.—The Rural District Council has assented to the Atherstone and District Electricity Co.'s proposals to supply the district, on the understanding that the mains are laid within two years.

Walkerburn.—Hydro-Electric Scheme.—Messrs. H. Ballantyne & Sons have recently completed a scheme for supplying power to their two mills by means of the works on the Tweed. Two high-speed turbines have been installed, and a reservoir has been constructed in the adjacent hills at a height of 1,000 ft. By means of this reservoir, which is filled by pumping during the night and the week-end, the power obtained directly is augmented to meet the full requirements of the mills, a total of 450 h.p.

Weybridge.—Price Inquiry.—The Ministry of Transport is to hold a local inquiry, on May 3rd, into the circumstances in which the Urban Electric Supply Co. has applied for permission to increase its prices for electricity.

Worcester.—Proposed Extensions.—In bringing forward recommendations of the Electricity Committee to carry out extensions to the undertaking at a cost of £62,200, the chairman of the Committee said that the snm required to meet immediate demands was £3,900. The report was adopted.

TRAMWAY AND RAILWAY NOTES.

Australia.—Melbourne.—The Melbourne Press complains of the overcrowding of the cable cars, which recently has become very serious. Since the electric tramways were introduced as feeders to the cable routes in the city, the cable cars have proved totally inadequate. It is stated that the cable routes cannot be electrified for at least six years.

Bradford.—Permanent-Way Renewal.—Having failed to secure the sanction of the Ministry of Transport to run railless cars on the Eccleshill, Idle, and Thackley routes to save the cost of relaying the track, the Tramway Department is having to renew the permanent way at a cost of £35,700. The Advisory and Co-ordination Committee, whose duty is to cut down all avoidable expense of Corporation. Committees, has approved the Tramway Committee's recommendation that the reconstruction of the Bolton Road track, from Wapping Road to Lister Lane, be proceeded with immediately.

Bury.—Year's Working.—The loss on the tramway undertaking last year was £10,872, and on the Ratcliffe section £2,598. It has been decided to make good the deficiency out of the borough rate. Traffic receipts were £131,712, against £122,791 the previous year, and the total wages were £63,976, against £51,423. The amount paid for electrical energy was £17,597, against £15,251, and materials, &c., cost £31,706, against £18,857.

Continental.—France.—Sanction has been accorded to schemes proposed by the Chemin de Fer d'Orléans in the departments of the Cantal, Corrèze and Puy de Dôme, for the utilisation of the waters of the Upper Dordogne, Chavanon, and Rhue, for the generation of electricity for the working of its network, and more particularly for the Paris-Orleans line. The estimated average power obtainable, 70,000 kW, represents a yearly output of 400,000,000 kWh, equivalent to between 400,000 and 500,000 tons of coal. The plans for the utilisation of the Upper Dordogne are part of a general scheme for dealing with the whole of that river. They include in particular the construction of huge regulating reservoirs, which, by increasing the flow and lessening the rise, will allow of the fuller utilisation of the energy of the river, which totals at least 250,000 kW. The company is under special stipulations as to the disposal of the excess power, priority being given to the departments and owners of distribution concessions, the tariff being arranged by the Minister of Public Works. The highest points of this tariff are already fixed by a detailed scale, revisable periodically.

Le Triphasé, one of the companies which supplies the suburbs of Paris, is applying for authorisation and eventually a concession to lay a high-pressure underground main from its station at Asnières to Genevilliers, the Ile Saint Denis, St. Denis, and Epinay.

Sweden.—Sums amounting to 10,600,000 kroner have been voted by the Swedish Parliament for various railway extensions—namely, on the Inlands Railway, from Volgsjön to Gullivare, from Porjas to Jockmock, and from Jörn to Gubbljaure; and on the State railway system from Forsmo to Hating and Hällnäs to Stensele.

Italy.—A scheme to build an electric railway between Milan and Valtidone has been under the consideration of a meeting of provincial deputies and representatives of the communes of the three provinces represented, and it has been decided to make application for a concession, and to take steps to form a company to construct and work the line.

Doncaster.—Conductresses.—As a result of a conference between the Tramway Committee and the local branch of the Comrades of the War and representatives of the Unemployment Committee, it has been decided that the 20 conductresses still retained since the war shall be replaced by men. When the war ended there were 100 women in the service.

Hastings.—Strike.—The employés of the Hastings Tramways Co. came out on strike on Saturday owing to the dismissal of an inspector for alleged inefficiency.

Jamaica.—Cost of Railway Electrification.—*The Times* Kingston correspondent says that discussion is proceeding in Jamaica over the wide difference in the matter of cost mentioned in two reports which are before the Government for the proposed electrification of the Government Railway. The first report, by an expert of the American Westinghouse Co., indicated that the enterprise would cost £1,000,000, while the report presented by British engineers gave the cost as nearly double that sum. It is stated that there is considerable risk of the contract going to the United States if electrification is decided upon, as the British estimate is regarded as prohibitive.

Leeds.—Year's Working.—The Tramway Department has yielded a surplus of £5,580 on the past year's working, instead of a deficiency of £15,000 which was anticipated. Some months ago the situation looked very bad. but in recent times the department has made great headway and improved receipts. The exceptionally fine weather of the early spring is looked upon partly as the cause of the improvement, and bigger dividends on investments have helped. In spite of increased fares, the number of passengers carried has increased. At the same time, in view of the difficulties of the present times and the cost of renewals, &c., the department has decided that it is necessary to apply for powers to increase the statutory maximum fare from 1d. to 2d. per mile, though it does not follow that the new maximum, if secured, will be put into practice.

London.—Cheap Fares.—At the meeting of the L.C.C. on April 19th, the Chairman of the Highways Committee, replying to a question regarding the institution of long-distance 1d. fares upon the tramways in the middle of the day, said that close consideration was necessary before the matter could be decided upon; the deficit of £550,000 had to be faced.

Rochdale.—Year's Working.—Although the past year's revenue was £186,855, an increase of over £25,000 on the previous year, the increased expenditure on the Corporation tramways involved a loss of £9,335. There was a loss of £2,682 a year ago, and to provide for this total deficit of over £12,000, it is proposed to use the whole of the reserve fund, £10,282, and to rate for the remainder. The gross profit was £79,160, but capital and other charges show an increase of over £17,000. Increased fares were in operation for nine months of the year.

Swansea.—Threatened Strike.—*The Times* states that the Swansea tramway and omnibus employés have decided to strike to-night (Friday) if the coal dispute is not settled by that time.

United States.—Traffic Control.—A new type of traffic tower is being erected at a busy crossing in Detroit. The new tower is rectangular in shape, and is higher than the towers formerly used. The tower is located at an extremely busy and dangerous intersection, being in front of the city hall where Michigan and Monroe intersect Woodward Avenue. As the streets converge at this point, the intersection is broad, and the traffic is very congested on account of travel proceeding in various directions at sharp angles and turns being varied and not at right angles. Pedestrians find considerable difficulty in negotiating street crossings at this point. The new tower places the traffic officer well above the street, so that a clear view of all traffic can be obtained. Movement of street cars and vehicles is governed both by day and night by coloured lights, the lamps resembling automobile headlights in size and design. The lamps are mounted on top of the tower. Signal bells mounted on street lamp poles at the kerb corners are also used to give signals that traffic shall proceed or stop according to the regulations indicated by the coloured lights. Red, green and yellow lights are used to indicate the various movements of traffic.—*Electric Traction.*

Yorkshire.—Fare Increase.—The Rawdon District Council, last week, protested vigorously against the proposed application by the Leeds tramway department for authority to increase the statutory maximum fares from 1d. to 2d. per mile. It was pointed out that the fares had already been increased, and any further increase, now that prices were falling, should be avoided. The fare between Leeds and Rawdon, originally 4d., was now 6½d., and when a profit was made Rawdon ratepayers got no benefit in the way of relief of rates from the Leeds tramways.

The Yeadon District Council is also formally to oppose the application. It was held that the increase, if put into operation, would double the fares of ordinary passengers and increase workmen's fares four times.

At the Pudsey Town Council meeting, last week, Mr. J. B. Hyland, objecting, contended that both Leeds and Bradford, which served the district with tramways, forgot that in the past they had taken tremendous amounts out of their tramway undertakings for the relief of their own rates, and now they were beginning to lose a little they wanted other people to pay. The matter was left in the hands of a Sub-Committee.

TELEGRAPH AND TELEPHONE NOTES.

China.—New Wireless Station.—*Finance and Commerce* learns that the Mitsui Bussan Kaisha is constructing a high-power wireless station about 9 miles east of Peking, the plant covering nearly 1,000 mow. The sending station in the east, and the receiving station in the west, are about a mile apart. The power house and four of the six steel towers, each 700 ft. high, are finished; the remaining two towers will be ready within two months. The construction of this plant, which was commenced last April, was delayed by prolonged negotiations with over 300 small landowners, who had to be bought out. The contract with the Chinese Government was signed on February 21st, 1918, but no time was set for the completion of its provisions. The contractors guarantee the amortisation of the capital invested. The Government is reported to be considering the establishment of wireless telegraph stations at Chefoo and Weihsien, in Shantung, thus covering the district east of the Kiaochow-Tsinan Railway built by the Germans.—*Reuter's Trade Service* (Shanghai).

France.—Wireless Telegraphy.—At present France possesses four large transmission stations—Eiffel Tower, Basse-Lande, La Doua (Lyons), and Croix-d'Hins (Bordeaux); and six large receiving stations—Villejuif, Poitiers, Basse-Lande, Eiffel Tower, Neufchalet, and Chartres, which ensure communication with the outer world. Already commercial services are established with Great Britain, Hungary, Jugo-Slavia, Bulgaria, Rumania, the United States, China, Madagascar, and Africa, North, Central, and West. A scheme is being prepared for an intercolonial service with stages at Saida, Bamako, Brazzaville, Tananarivo, and Saigon. The Ministry has also entrusted the Extra-Parliamentary Wireless Telegraphy Commission with a supplemental scheme to include Djibouti, Noumea, Tahiti, the Martinique, and Guyana. Thus every French colony will possess a wireless station. There is a marine wireless system which places vessels in communication with Cherbourg, Lorient, Bayonne, and Oran, and the stations at Boulogne, Havre, Ushant, Bordeaux-Bous'at, les Saintes-Maries de la Mer, Marseilles, Nice, Bonifacio, and Algiers, are also open to business messages. The principal shipping companies have signed agreements with the wireless companies for the transmission to their vessels of news from the wireless stations. In France, local services have been established, especially among the hills, in order to provide against the breaking of telegraph wires in bad weather, and along the coast for communication with the adjacent islands. A contemplated interdepartmental service has been abandoned for financial reasons. In order to render the long-distance services more methodical, the hours for transmission to various parts of the world have been fixed according to a regular time-table. For instance, from Croix-d'Hins messages are dispatched to Shanghai from 3 to 5, to Tananarivo from 5 to 6, to Brazzaville from 7 to 9, and to the United States (Tuckerton) from 9 a.m. to 5 p.m., &c.—*Exportateur Francais.*

Guernsey.—The accounts of the Guernsey States Telephone Department for 1920 show total income £10,153, expenses (including allowances for sinking funds and depreciation, £2,827), £10,102, leaving a net profit of £51. The capital expenditure on construction account amounted to £62,131; £5,719 had been paid off a States 3 per cent. loan of £32,000 raised in 1905, and the reserve funds for depreciation and contingencies amounted to £32,692, but of this sum £30,131 had been used on construction work. A special sinking fund for the redemption of amounts taken from reserve for construction work amounted to £4,133. The number of subscribers' lines was 2,208; total number of lines, 2,662; and the number of calls was 1,668,767.

Italy.—New Wireless Plant.—By a Decree dated December 20th, 1920, approval is given to an agreement come to between the Italian Ministry of Posts and Telegraphs and the Italian Ministry of the Marine, providing for the radical transformation of the wireless plant at the Coltano naval wireless station, which is now to be equipped with the most modern machinery and apparatus for the transmission and receipt of messages, both private and public. A new station is to be built, which will be linked up with the State telegraph system, and be able to transmit messages across the Atlantic, and to the greatest distances. After the completion of the modernisation the station is to be handed over to the Ministry of Posts and Telegraphs.

New Zealand. — Printing Telegraphs.—Telegram printing is not exactly a new discovery, but the application of electrical machines which will enable a message to be typewritten at one end and received printed at the other is new to New Zealand. Some machines of this description were due to arrive in Wellington by the first week in March. Mr. E. A. Shrimpton, chief telegraph engineer, stated to the *Auckland Weekly News* that the consignment consisted of two multiplex machines, and one start-stop combination, which would enable communication by printed telegram to be established almost at once, either between Wellington and Christchurch or Wellington and Auckland.

Nova Scotia.—Meteor.—The Cunarder *Saxonia*, which arrived at Halifax, N.S., on the 19th inst., reported seeing at noon, 15 miles off Halifax, a meteor hurtling from the clouds at an angle of 45°, which burst into flames near the water, leaving a column of smoke behind it. The event was also seen from several points on land. Wireless operators reported unusual electrical disturbances for a period of 24 hours prior to the event, which ceased after the fall of the meteor.

Philippines.—New Cable.—The Commercial Pacific Cable Co. recently completed the laying of an underground cable between the towns of Sorsogan and Bacon, across the Sorsogan Peninsular, Lower Luzon Island which will connect at Bacon with the Commercial Pacific Cable Co.'s submarine cable running from Guam, and at Sorsogan will be joined up with a section of submarine cable running to Manila. This change has been made to remove the submarine cable from the San Bernardino Straits, where strong currents and a rough bottom have frequently been the cause of interruptions. The underground cable was manufactured by the Okonite Co., Passaic, N.J., and the whole change was expected to be completed by the end of April.

The cableship *George Ward* was at the end of March engaged in repairing one of the French Co.'s cables off the coast of France. This was her first work as a cable-ship; she was formerly the steam yacht *Beryl*, and was at one time used by the Prince of Monaco for deep-sea research work in all parts of the world.

This company has opened a new cable office at 75, Edmund Street, Birmingham, with direct connection with the ocean cables. —*T. & T. Age.*

Spain. — Semaphore and Wireless Station. — Endeavours are being made to obtain the construction of a semaphore and a wireless telegraph station on Monte Ferro at Vigo, but several details remain to be settled before the plan can be carried out.—*Reuter's Trade Service* (Barcelona).

Telegraph Service. — Deferred Telegrams. — The Postmaster-General announces that the deferred service by the routes of the North Atlantic Cable Companies (Anglo-American, Commercial, French and Western Union) to Canada, U.S.A., Cuba, British West Indies, and Australasia, has been restored. The rates chargeable are, in most cases, one-half of the ordinary rates shown in the "Post Office Guide."

The rate figures for Canada are still applicable to the route *via* Imperial, and to that route only.

Deferred telegrams for Australasia, British West Indies and the United States may be sent *via* Imperial at the same rates as by the other routes.

Figures are not allowed in the text of deferred telegrams by the above-mentioned services, except in the case of telegrams for Canada, British West Indies and Australasia routed *via* Imperial.—*Board of Trade Journal.*

On and after May 1st the rate for telegrams to Tanganyika will be increased to 2s. 4d. a word to Dar-es-Salaam, and 2s. 6d. a word to places inland.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Argentina.—June 13th. The Department of Overseas Trade has been informed by telegram that the Department of Sanitary Works is calling for tenders for the supply and erection of electric power batteries and lighting plant at Mar del Plata. Local representation is essential. When a copy of the specification is received by the Department of Overseas Trade it will be made available for consultation.

Australia.—Melbourne.—Postmaster-General's Department. May 31st. Telephone switchboards (Schedule No 1,670).*

May 31st. P.M.G. 29,500 porous cells, No. 1 size to specification (Schedule No. 1,685); 20½ tons ammonium chloride (Schedule No. 1,683).*

May 31st. Victorian Electricity Commissioners. Morwell power scheme: Street poles (Specification No. 47); copper cable (Specification No. 66). (April 15th.)

June 15th. Victorian Government Railways. 50 oil-immersed single-phase track and signal transformers for power signalling (Contract No. 33,901).*

June 22nd. One electric lifting magnet (capacity ½ ton), one 440-V motor generator.

June 29th. Supply of 1-ton platform type industrial storage battery trucks, also battery-charging equipment.—*Reuter's Trade Service* (Melbourne).

August 10th. 250 core-type impedance bonds for power signalling, with a capacity of 1,000 amperes per rail; also 50 miles of solid insulated copper wire, No. 14 Brown & Sharpe gauge, and 50 miles of solid insulated copper wire, 16 standard gauge.

August 17th. 3,000 sets of renewals for caustic soda primary cells.—*Reuter's Trade Service* (Melbourne).

August 30th. Board of Works. Four electrical centrifugal pumps, each with a capacity of twelve million gallons daily.—*Reuter's Trade Service* (Melbourne).

Perth.—May 25th. Postmaster-General's Department. Ironwork, as per Schedule 704. (April 22nd).

Barnsley.—May 3rd. Town Council. Electric light wiring for 100 houses. C. F. Moxon, architect, 3, Regent Street South.

Belgium.—May 27th. The Service d'Etudes et de Controle des Applications de l'Electricité, 52, Boulevard du Regent, Brussels. For the supply and installation of ten electrically-operated capstans in connection with the locks on the Upper Scheldt.

April 28th. Municipal authorities of Saint-Gilles-lez-Bruxelles. Cooling plant for the electricity generating station. Specification from the Service de l'Electricité, R 40, Rue de Bethléem, Saint-Gilles, near Brussels. Tenders to the College Communale.

May 5th. Municipal authorities of Erquennes (Province of Hainaut). Installation of a primary and secondary electricity distribution system in the town. Tenders to the Maison Communale, whence particulars may be obtained.

Brussels.—May 11th. Belgian Post and Telegraph authorities at La Salle de la Madeleine, Brussels. Supply of a quantity of telegraphic and telephonic apparatus, including 600 Morse manipulators and 250 milli-amperemeters.

Buenos Aires.—June 3rd. Board of Sanitary Works. Supply and erection of the plant and accessories for a new generating station, previous tenders having been called for in 1919 and 1920. The plant comprises three four-cycle Diesel engines of 375-h.p., and adapted to run on crude petroleum from Comodoro Rivadavia, and three three-phase alternators, each of 250-kW, 2,200 volts between phases, 50 cycles and a power factor of ·8.*

Edinburgh.—May 26th. Electricity Department. E.h.p. and l.p. switchgear for sub-station.

Fiji Islands.—The municipality of Suva invites tenders, closing June 30th, for the supply and erection of a 200-kW, 480/520-V, three-wire, d.c. generator, directly.coupled to a 300-h.p. vertical Diesel oil engine, together with accessories for generator and panel.—*Reuter's Trade Service* (Melbourne).

Ipswich.—Electricity Supply Department. One 500-kW rotary converter or motor converter. (April 15th.)

Jugo-Slavia.—May 1st. The Serb, Croat, and Slovene Ministry of Public Works. Erection of a power station, main conductors and transforming stations in connection with an electrical scheme at Kostolac for the supply of energy to Belgrade, Semlin, &c.*

Commercial Secretary to H.M. Legation at Belgrade has received an inquiry from a local contractor with regard to plant, &c., required for the electric lighting of a town in Serbia. The inquirer wants offers from United Kingdom firms for two 40-kW dynamos and 50 km. of overhead cable, &c., for the supply of current to about 1,200 houses. The Serb-Croat-Slovene State is one of the countries to which the Export Credit Scheme applies. The name and address of the inquirer may be obtained on application to the Department of Overseas Trade in London.

London.—Fulham.—May 4th. Electricity Department. Two Green economisers or other approved make of 400 and 440-tube capacity respectively. (April 22nd.)

St. Pancras.—Electricity Department. Paper-insulated, lead-covered, and armoured cable. (See this issue.)

Manchester.—May 2nd. Electricity Committee. Three steam turbine-driven boiler feed pumps. (April 15th.)

May 10th. Electricity Department. Weldless steel lamp columns. (See this issue.)

New Zealand.—June 28th. Public Works Department. Ten s.p. oil-filled transformers for the conversion of three-phase current at 50 cycles, the voltage ratio being 50,000/11,000, for Waikato power scheme.*

June 28th. Supply and delivery at Lyttelton of two 50-kVA, two 100-kVA and two 200-kVA condensers in connection with the Lake Coleridge electric power supply (Section 116).*

South Africa.—Pretoria.—May 10th. Municipality. Switchgear. Tenders, marked "Electric Light and Power Department, 1920 Extensions, Contract No. 5," to Deputy Town Clerk, Municipal Offices, Pretoria. Deposit, five guineas. Further particulars may be obtained from the general manager of the Electric Light and Power Department, or from the consulting engineer, Mr. G. M. Clark, 40-42, Meischkel's Buildings, Johannesburg.

Southampton.—May 14th. Electricity Department. 3-phase, 6,000-V cable. (See this issue.)

Uruguay.—June 28th. Ministry of Public Works. Three electric gantry cranes and a "Temperley" type aerial transporter for the Port of Paysandu. Tenders in Spanish and framed in accordance with the model to the Ministry of Public Works.*

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Belgium.—Ten firms submitted tenders last week to the Service d'Etudes et de Controle des Applications de l'Electricité, in Brussels, for the supply and installation of the necessary plant for the electrical operation of the locks on the Upper Scheldt. The lowest was that of Messrs. Bracke & Monin, of Ghent (853,452 francs), and the highest that of the Société Anglo-Belge Electrique, of Brussels (1,296,557 francs).

Government Contracts.—The following Government contracts were placed during March, 1921 :—

Admiralty (Contract and Purchase Department).

Electrically-driven booster set.—Electric Construction Co., Ltd.
Fans and spare parts.—Veritys, Ltd.
Insulating materials.—H. Clarke & Co. (Manchester), Ltd.; Mica and Micanite Supplies, Ltd.; E. J. North Hardy & Son.
Motors.—Lancashire Dynamo Co., Ltd.
Switchboard panels.—British Thomson-Houston Co., Ltd.
Transformers.—Metropolitan-Vickers Electrical Co., Ltd.

War Office.

Valves for wireless telegraphy.—General Electric Co., Ltd.; Mullard Valve Co.
Electric lighting (Windsor Combermere Barracks).—Jackson & Boyce.

Post Office.

Protective apparatus.—Evershed & Vignoles, Ltd.
Telegraph apparatus.—Power Equipment Co., Ltd.; Walters Electrical Manufacturing Co., Ltd.
Telephone apparatus.—British L. M. Ericsson Manufacturing Co., Ltd.; A. C. Cosser, Ltd.; Peel-Conner Telephone Works; Phonophore Construction Co., Ltd.; Reid Bros. (Engineers), Ltd.; Sterling Telephone and Electric Works, Ltd.
Leclanché battery boxes.—Siemens Bros. & Co., Ltd.; W. D. Tucker and Sons, Ltd.
Telegraph and telephone cable.—Callender's Cable & Construction Co., Ltd.; Hackbridge Cable Co., Ltd.; London Electric Wire Co. and Smiths, Ltd.
Cords for telephones.—British Insulated & Helsby Cables, Ltd.
Cable drums.—Western Electric Co., Ltd.
Ducts.—Mountford, Phillips & Co. (1920), Ltd.
Electric cable-hauling machine, Dover submarine cable depot.—Johnson and Phillips, Ltd.
Laying conduits.—Birmingham-Worcester (section 1): Wyatt Bros. Camberwell, Southwark, &c.; Acton Vale, Kensington, Paddington, and St. Marylebone, Southwark Street area, Brighton-Worthing (section 11): Portsmouth, Shedfield, and Willesden, Wembley, &c.: O. C. Summers, Dudley-Stourbridge, Cradley Heath, and Birmingham-Dudley-Tipton: Martin & Element, Ltd. Wallsend: W. Turner (Ardwick), Ltd. Belfast-Newtownards: J. Ross & Son. Manchester-Bury-Burnley (N.W. district): J. Wimpenny & Co. Hornsey, Islington, &c., Hammersmith, &c., Fulham, &c., and Westminster, Chelsea and Holborn: A. Thomson and Co. Weybridge, Woking, Chertsey, Byfleet, &c.: Hardy & Co. London-Dartford-Chatham (Gravesend Spur): H. Farrow. London-Uxbridge-High Wycombe (South Midland section 11): Grieg & Matthews.
Manufacture, supply, drawing-in, and jointing cable.—Mill Lane-Streatham Exchange and Reading Spur: Western Electric Co., Ltd. London-Weybridge: W. T. Henley's Telegraph Works Co., Ltd.
Transmitting set (North Foreland Wireless Station).—Radio Communication Co., Ltd.
H.D. coper wire.—R. Johnson, Clapham & Morris, Ltd.
Enamelled wire.—London Electric Wire Co. & Smiths, Ltd.
G.I. strand wire.—Shropshire Iron Co., Ltd.; F. Smith & Co. Wire Manufacturers, Ltd.

High Commission for India.

Accumulators.—Edison Accumulators, Ltd.
Cells (sections).—J. Stone & Co., Ltd.
Armature coils.—General Electric Co., Ltd.
Crucibles.—Morgan Crucible Co., Ltd.
Insulator cups.—Taylor, Tunnicliff & Co.
Dynamos, &c.—J. Stone & Co., Ltd.
Ebonite.—North British Rubber Co., Ltd.
Generating sets.—General Electric Co., Ltd.
Switchboard.—Ferguson, Pailin & Co., Ltd.
Voltoids.—Brunner, Mond & Co., Ltd.
Copper wire.—British Insulated & Helsby Cables, Ltd.; Callender's Cable and Construction Co., Ltd.

Crown Agents for the Colonies.

Electric light fittings.—Chloride Electric Storage Co., Ltd.
Lux cells.—Chloride Electric Storage Co., Ltd.
A.c. motors.—British Thomson-Houston Co., Ltd.
Pumps and motors.—Metropolitan-Vickers Electrical Export Co., Ltd.
Stoneware troughing.—Callender's Cable & Construction Co., Ltd.
Switchboard section.—Siemens Bros. & Co., Ltd.
Telegraph poles and insulators.—Bullers, Ltd.
Telephones.—British L. M. Ericsson, Manufacturing Co., Ltd.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.
Telephone switchboard.—British L. M. Ericsson Manufacturing Co., Ltd.
X-ray apparatus.—Watson & Long.

H.M. Office of Works.

Engineering services, Hertford House electric lift.—W. Wadsworth and Sons, Ltd. Houses of Parliament, main and sub-main boards: British Thomson-Houston Co., Ltd. Kew, insurance office electric wiring: Alpha Manufacturing Co., Ltd. Leeds, removal and erection of electric lift: Marryat & Scott, Ltd. National Physical Laboratory, cables, &c.: Pirelli-General Cable Works, Ltd.

Board of Public Works, Dublin.

Belfast, electric work and supplies.—A. Stevenson.

London.—Battersea.—Electricity Committee. The Committee recommends that the following contracts be renewed :—

Electricity meters.—Chamberlain & Hookham, Ltd., and Ferranti, Ltd., for one year.
Electrolytic meters.—Reason Manufacturing Co., Ltd., for one year.
Cables, &c.—Callender's Cable & Construction Co., Ltd., for one year.
Box compounds and Trendita bitumen.—Dussek Compounds, Ltd., for six months.

St. Pancras.—Electricity and Public Lighting Committee. Recommended :—

Erection of ferro-concrete pump-house, £2,700.—D. G. Somerville & Co.
Six 1,000-amp. circuit-breakers, two 2,800-amp. do., £164.—Park Royal Engineering Co. Eight tenders received.
Two additional water-tube boilers, complete with pipework, &c., £47,190.—Babcock & Wilcox, Ltd.

Rochdale.—The Corporation Tramways Committee has decided to order steel tires from Belgium. The tender quoted a price of £25 5s. per ton free at port at Antwerp, and, even after adding freight charge of £2 5s. a ton, there will be a saving of £17 10s. a ton as compared with British tenders. All the British quotations were at the same figure—£45 a ton.

Wellingborough.—Board of Guardians :—

Electrical work in connection with laundry alterations.—Wellingborough Electric Supply Co.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, April 29th. At Caxton Hall. Westminster, S.W. At 8 p.m. Lecturette, "Rambling Remarks on Expert Evidence," by Mr. W. A. Tookey.

Friday, May 6th. At Caxton Hall, Westminster, S.W. At 8 p.m. Lecturette, "Fire Resistance of Aggregates for Reinforced Concrete," by Mr. D. W. Wood.

Society of Engineers (Incorp.).—Monday, May 2nd. At 17, Victoria Street S.W. At 5 p.m. Ordinary meeting.

Institute of Metals.—Wednesday, May 4th. At the Institution of Mechanical Engineers, Storey's Gate, S.W. At 8 p.m. Annual May lecture, by Prof. T. Turner, on "The Casting of Metals."

Institution of Civil Engineers.—Wednesday, May 4th. At the Institution, Great George Street, S.W. At 4 p.m. Presentation of the Kelvin Medal to Dr. W. C. Unwin, F.R.S., by the Right Hon. A. J. Balfour, O.M., F.R.S.

Chemical Society.—Thursday, May 6th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary meeting.

Institution of Electrical Engineers.—Thursday, May 5th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Continuation of discussion on "Tariffs."

Scottish Centre.—Friday, April 29th. At Dundee. (At 7.30 p.m. Paper on "Some Thermal Characteristics of Electric Ovens and Hotplates," by Messrs. E. Griffiths and F. H. Schofield.

Western Centre.—Monday, May 2nd. At the Grand Hotel, Bristol. At 6.30 p.m. Address by the President, Mr. Ll. B. Atkinson. A dinner will be held after the meeting at which the President will be present.

Edinburgh Electrical Society.—Friday, May 6th. At the Philosophical Institute. At 8 p.m. Annual meeting.

Roentgen Society.—Friday, May 6th. At Manchester. Paper by Prof. W. J. Bragg, and a demonstration by Prof. A. V. Hill.

NOTES.

The Kelvin Medal.—The presentation of the first award of the Kelvin Medal will be made by the Right Hon. A. J. Balfour, O.M., F.R.S., in the hall of the Institution of Civil Engineers, to Dr. William Cawthorne Unwin, F.R.S., on Wednesday, May 4th, at 4 o'clock.

The Medal was founded in 1914, principally by British and American engineers, to commemorate the achievements of Lord Kelvin in those branches of science which are especially applicable to engineering. The award is dealt with by a Committee of the Presidents of the representative British Engineering Institutions, after their consideration of recommendations received from similar bodies in all parts of the world, and, in accordance with the terms of the Trust, it is made to the person whom the Committee finds to be most worthy to receive this recognition of pre-eminence in the branches of engineering with which Lord Kelvin's scientific work and researches were identified.

Finsbury Old Students' Association.—The annual smoking concert of the Finsbury Technical College Old Students' Association was held at Anderton's Hotel, on April 22nd. Dr. G. T. Morgan, O.B.E., F.R.S., was in the chair, and all those present voted it a very successful affair, especially the musical programme arranged by Mr. L. M. Clark, A.I.C., F.C.S., which left nothing to be desired. During the evening a Wallis-Jones Medal was presented to Mr. L. Gowing Scopes, F.C.S., for the best paper contributed during the year by an old Finsbury student, his paper being on "The Properties of Some Chlorhydro-carbons and their Uses in Chemical Analysis."

Smoothing Out the Load Curve.—The following is an extract from a brochure entitled "Water Power and Fuel Problems," reprinted from the Tenth Annual Report of the Commission of Conservation, Canada:—"As a means of smoothing out the load curve, 'staggered' hours for closing appear to offer great promise. A recent investigation made in Boston showed that at least 15,000 kW in generating capacity would be saved on the system of the Edison Electrical Illuminating Co. if 30 industrial establishments would change their working hours by 30 minutes. Fifteen thousand kilowatts represent about one-sixth of the total estimated peak load of the Boston system for this winter. The comparatively small change in closing hours required to effect such a large increase in available capacity is very striking."

X-Ray Motor Ambulance.—An X-ray motor ambulance wagon, presented by the Eccentric Club to the College of Ambulance, and equipped by the Red Cross authorities, is now available for service in London and a surrounding area of 25 miles. Accompanying the wagon is an operator and staff of specially trained assistants and ambulance men. The ambulance is intended primarily for men disabled in the war, and for the sick or injured in civil life who are too ill to be moved. Application should be made for it by doctors, to the Managing Secretary, College of Ambulance, 56, Queen Anne Street, Cavendish Square, W. 1 (Telephone, 4652 Mayfair). The ambulance is free to the poor, but charged for in the case of those who can afford to pay.—*The Times.*

The Lord Rayleigh Memorial.—It has been decided that the memorial to the late Lord Rayleigh, F.R.S., which is being promoted by a Committee of Fellows of the Royal Society and Members of the University of Cambridge, shall take the form of a plaque containing a medallion in Westminster Abbey. Up to the present time a sum of between £1,400 and £1,500 has been subscribed for that purpose.—*The Times.*

No May-Day Strike in Paris.—The Paris correspondent of *The Times* says there is to be no general strike in Paris on May 1st this year. At a meeting of the trade unionists of the Seine Department recently the "principle" of a general strike was adopted, but at the same time the delegates of the railwaymen and transport workers announced that their men would not cease work. Gas and electricity workers and men in the public services will also work as usual.

Weekly Wage Rates.—Some information with regard to wages is given by Dr. Macnamara (Minister of Labour) in a written reply to a Parliamentary question. He states that, among organised workpeople, the increases since 1914 in weekly rates of wages for full time ranged from about 100 per cent. in a few cases to over 300 per cent. in a few others. The general average is probably in the neighbourhood of 160 per cent. or 170 per cent. It is not practicable to state in detail in what cases reductions in wages have been agreed upon specifically for the purpose of lowering prices and stimulating employment, but reductions of wages were taking place in the railway services, the Civil Service and the woollen and worsted industries, and also in hosiery, civil engineering, vehicle building, and other trades, in accordance with fluctuations in the cost of living. In the iron and steel industries automatic reductions of wages were taking place according to the fall in the selling price of products.—*Machinery Market.*

The Electrical Trades Benevolent Institution.—On Monday last the annual general meeting of the Institution was held at the offices of the Cable Makers' Association. Mr. J. Y. Fletcher, chairman of the Committee of Management, presided, and there was a small attendance of members.

The report of the committee stated that the number of members and subscribers was 306; the total income from contributions for the year was £1,724, including shares given by Mr. E. Manville, M.P. With the receipts from dividends and other sources, the total income was £2,337, compared with £3,445 in 1919 (a year which benefited by two special appeals). After paying grants and expenses, a balance of £2,006 was placed to capital account. The total amount of the invested funds was £14,356, a sum "obviously far from adequate to meet the demands for pensions which are certain to be made in the near future." Assistance has been given to every qualified person who has applied for it. The situation of the labour market will doubtless lead to a far larger number of grants being necessary this year. Local advisory committees are in full working order in Cardiff, Glasgow, Manchester, and Newcastle-on-Tyne, and are doing splendid work for the Institution; it is hoped that during 1921 similar committees will be formed in Birmingham, Leeds, and Liverpool. The number of collectors shows a gratifying increase, due to the operations of the local advisory committees, but there is still an insufficient number working on the staffs of firms; the committee appeals to the heads of firms to encourage members of their staffs to become members of the Institution, and to induce one member of the staff to undertake the collection of the subscriptions. Only those who have been members for five or more years, or their widows and children, are qualified to apply for pensions. Mr. E. Manville presided over the annual festival on December 15th, and his appeal resulted in a collection of £1,137. He was ably supported by the vice-presidents, Mr. Ll. B. Atkinson and Mr. W. O. Smith.

The chairman remarked that printing, stationery, and postage expenses had been £128, compared with £86 in the previous year; secretarial and office expenses were less—£146, compared with £171. The secretary was now acting in an honorary capacity. The result of the annual festival differed little from the previous year, but other subscriptions (£306) showed a falling-off compared with £638 in the previous year, and other donations, £350, compared with £1,041. The previous year benefited by a legacy of £100. The total income from investments was £613. Six grants were made, compared with four in the previous year. The annual festival this year, to be held on October 26th, would be presided over by Mr. Ll. B. Atkinson.

The report and accounts were adopted, and the members of the committee who retired by rotation were re-elected *en bloc*, together with Mr. J. H. Farthing, vice-chairman of Manchester and District Local Committee, and Mr. A. H. Allen. In view of the death of Mr. T. E. Gatehouse, a vote of condolence with his family and the Electrical Review, Ltd., was passed. Hearty thanks were tendered to the hon. secretary, Mr. F. B. O. Hawes, for his valuable services in the past, and for his willingness to continue to do the work of the Institution. The hon. auditors were re-elected, and votes of thanks were accorded to the hon. solicitors, the Press, the chairman, and the Cable Makers' Association. Rule 10, clause (*c*), and Rule 11, clause (*d*), were amended to provide for the case of local advisory committees, and a confirmatory meeting will be held on June 27th.

France's Reclaimed Coal Pits.—The Anzin mines, in the North of France, noted for their extremely deep shafts, were reported on April 21st to have been pumped free of water. During the war period the Germans destroyed all the pumping gear as well as the shaft fittings. After the shafts had been partially repaired, new electrically-driven pumps had to be taken down several hundred feet in order to reach the water in the more distant galleries.—*Evening News.*

Service Notes.—The big battle cruiser *Inflexible* which took such a prominent part in the Battle of Jutland, and in the Dardanelles—in the course of which she was severely strained—is to be sold out of the service. The *Inflexible* was the first battle cruiser fitted with electrically-driven big gun turrets. Lieut. H. Bellman, Glamorganshire Fortress Engineers (Electric Lights Company) has relinquished his commission. but retains his rank. A number of Territorial officers who served with Electric Lights Companies during the Great War, have been appointed to the Reserve of Officers on relinquishing their commissions.

E.P.E.A. Meeting.—On April 20th a meeting was held at Newcastle, under the auspices of the Electrical Power Engineers' Association. The chair was taken by Mr. J. N. Waite, and Messrs. P. S. Thompson and G. W. Essex also spoke. It was mentioned that the Association now had over 4,000 members, 500 of whom were in Newcastle and district.

Railway Electrification.—The manager of the London and North-Western Railway Co., in a paper to the Manchester Statistical Society, on April 21st, remarked that the country was on the threshold of great electrical development, and that the electrification of railways would give a great stimulus to a national system of electrical power production.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Members of the Institution and others will be glad to hear that the work of redecorating the Institution building is being rapidly proceeded with, and that there is every prospect that the Institution will be reinstated, at least on the ground floor, by the middle of May.

The following nominations for election as ordinary members of Council (which are additional to those already made by the Council) have been received :—Lieut.-Col. F. A. Cortez-Leigh, T.D., R.E., nominated by Messrs O. H. Baldwin, S. W. Baynes, J. H. Bowden, G. Broughall, R. H. Houghton, C. Jones, H. W. Jones, P. V. McMahon. E. T. Ruthven Murray, L. L. Murray, C. W. Neele, P. J. Pybus, C.B.E., P. Rosling, A. M. Sillar, W. J. Thorrowgood, and A. H. Walton. Mr. W. C. P. Tapper, nominated by Messrs. A. W. Blake, F. A. Bond, E. Calvert, A. C. Cramb, F. W. Purse, L. L. Robinson, C. N. Russell, A. H. Shaw, C. N. Staniland, and W. C. Ullman.

Benevolent Fund.—In our issue of December 24th we announced that Mr. E. M. Hughman, of Bombay, had offered a donation of £250 to the Benevolent Fund of the Institution of Electrical Engineers, on condition that 19 similar donations were received. The offer expires on June 30th, 1921. The Committee charged with raising the fund has obtained Mr. Hughman's consent to the sums of £250 not being contributed solely by single donors, but by group subscriptions. The Territorial Centres of the Institution are taking steps to organise such group collections, which will doubtless be supported by members of the Institution of all classes. The Secretary of the Institution of Electrical Engineers, 1, Albemarle Street, London, W. 1, will reply to any inquiries on this subject.

Summer Meeting.—Up to the present 288 names have been received, including 87 ladies. A circular giving details of the arrangements has been received from the Secretary as we go to press.

North Midland Territorial Centre.—The committee of this Centre has circulated a letter in support of the nomination as an ordinary member of the Council of the Institution, of Mr. Thos. Roles, city electrical engineer, Bradford. The committee feels that Mr. Roles would be a very desirable addition to the Council of the Institution, on account of his personal qualifications and his very active services to the Institution and to the North Midland Territorial Centre. Mr. Roles was recently chairman of the Yorkshire Electricity Supply Linking-up Committee, and is the immediate Past-President of the Incorporated Municipal Electrical Association. He is at present a member of the Council and Executive Committee of the British Electrical Development Association, a member of the British Engineering Standards Association, representing the I.M.E.A., and a member of the Joint Committee of the B.E.A.M.A. and the I.M.E.A., for dealing with matters of interest to the two Associations. We may add that he is one of the most popular, as well as efficient, members of the Institution, and can be relied upon to say what he thinks and to "play the game."

Junior Institution of Engineers.—Under the auspices of the Junior Institution of Engineers, a paper upon industrial electric lighting was read recently by Mr. N. Thornton, A.M.I.E.E., at Newcastle-on-Tyne. Mr. Thornton complained that many electric lighting installations were carried out in a haphazard manner, questions of design and the efficient use of lights being disregarded.

Faraday Society —Physico-Chemical Problems Relating to the Soil.—The Faraday Society is organising a general discussion on the above subject to take place during the afternoon and evening of May 31st next in the rooms of the Chemical Society, London, which will be presided over by Sir A. Daniel Hall, K.C.B., F.R.S., chief scientific adviser to the Board of Agriculture. The discussion will be opened by Dr. E. J. Russell, F.R.S., director of the Rothamsted Experimental Station, who will generally survey the subject. A series of papers dealing with soil moisture, organic constituents, absorption and colloidal phenomena will then be put forward as a basis for discussion. It is expected that among those present will be Prof. Sven Oden, of the University of Upsala. Further particulars of the meeting may be obtained from the Secretary of the Faraday Society, 10, Essex Street. London, W.C. 2.

Institute of Metals.—At a meeting of the Sheffield Centre, on April 15th, Mr. H. A. Greaves, one of the inventors of the Greaves-Etchell steel-melting furnace, read a paper describing a new type of electric furnace for non-ferrous metals. After a survey of the principal existing types, the author said that the outstanding feature of the new furnace was a permanent resistance supported directly above the metal. This arrangement, it was claimed, was far more efficient than if the heat had to be reflected from the walls and roof of the furnace. Of course, in the arc furnace the heat was directed down upon the metal, but in that type the volatilisation of the metal and the damage to the furnace walls were greater.

Gosport Rotary Club.—On April 14th, Captain W. H. Upton Marshall, R.E. (T.), M.I.E.E., delivered a lecture to the members of this Club, upon "Electricity." The lecturer explained the provisions of the Electricity (Supply) Act of 1919, and gave an indication of the improvements aimed at by its application to various parts of the country. Portsmouth's position in connection with the scheme was explained, and the lecturer briefly outlined the history of the electricity undertaking. He said that he understood that Gosport was taking a supply for lighting from the Tramways Co. He considered that unsatisfactory—a better arrangement would be to take a bulk supply from a large supply station.

Edinburgh Electrical Society.—On April 22nd, Mr. James Plucknett, A.M.I.E E., gave a very interesting lecture on "Relay Automatic Telephones."

The lecturer explained the apparatus in full, and the general lines on which it worked, and finally took his audience through a maze of connections, showing what happened from the time a caller took off his receiver until it was again replaced, and he stated that he pinned his faith on the relay system on account of the entire absence of complicated moving parts. Subsequently, an adjournment was made to inspect the Relay Exchange which Mr. Plucknett's firm has recently fitted in an Edinburgh office. This was the first installation of the kind in the East of Scotland. During the course of the evening it was mentioned that the Relay Co. had 10 exchanges on hand for India, and its first thousand line exchange for the British Post Office was in course of completion at Fleetwood.

Manchester Wireless Society.—On April 5th Mr. Alexander Marr (the Vice-President) read a paper on "The History of the Telephone." The lecturer sketched the history of the development of the telephone from the time of its invention by Prof. Alexander Graham Bell up to the present day.

On April 6th, by the courtesy of the North-Western Section of the Institution of Electrical Engineers, members of the Society were enabled to hear a lecture by Prof. Marchant on "Recent Developments in Wireless Telegraphy."

On April 9th a very successful whist drive and dance was held at the headquarters, nearly 100 members and friends being present.

Chief Technical Assistants' Association.—The annual dinner of the Association was held on April 16th. Mr. J. R. J. Bowden. A.M.Inst.C.E , presiding. A number of visitors attended. and the opportunity was taken to present to Mr. and Mrs. J. H. Parker (a former chairman of the C.T.A.A. and Past-President of the E.P.E.A.), a handsome solid silver tea and coffee service as a token of esteem and appreciation from the C.T.A.A. for their devoted efforts in the interests of the technical staffs. The musical entertainment was of a high order, and provided again by Mr. W. E. Bradshaw, of Islington, ably supported by Messrs. Ricketts and Young ; a most enjoyable evening was spent.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Mr. E. Guthrie Bowers, electrical engineer to Messrs. Bruntons, of Musselburgh, is to sail to-day, April 29th, to take up the appointment of assistant mechanical and electrical superintendent to the Bombay Port Trust.

Messrs. E. J. P. Benn and Frank Elliott, representing the Industrial League and Council, have left for the United States to convey fraternal greetings to similar organisations on that side of the Atlantic, and to study in the big industrial centres the problem of re-adjustment of wages, in view of falling prices, and steps for the re-establishment of overseas trade.

Mr. F. Freshwater, who has retired from the position of manager of the Teesside Tramways, Stockton-on-Tees, upon the municipalisation of the system, has been presented by the staff with a gold-mounted walking stick and a wallet of notes, together with a gold brooch for Mrs. Freshwater.

Mr. C. E. Allsopp, of the Bradford Corporation Electricity Department, was elected, last week, as president of the Bradford Engineering Society.

Mr. J. G. Richardson, telegraph superintendent, Edinburgh, was the recipient of an illuminated address and a Georgian silver tea service from the Edinburgh Telegraph Department, at a conversazione on Saturday evening, on the occasion of his retirement.

Limerick Corporation has appointed Mr. F. Flynn acting electrical engineer, with Mr. Grund as assistant.

Mr. Campbell, who is retiring from the position of borough engineer at Huddersfield, after 23 years' service in that capacity, to take up private practice, was presented last week by Mr. Jagger, deputy engineer, with an electric reading lamp, from the office staff, and a dispatch case from the workmen of the Highways and Tramways Permanent-Way Departments.

Mr. H. J. Skinner, assistant distributing engineer in the Hackney Borough Council electricity department, has resigned his position.

Prof. Einstein has accepted an invitation from King's College, London, to lecture at the College in May.

Mr. A. B. Cartland, of 3, Creechurch Lane, Leadenhall Street, London, E.C. 3, has been appointed sole representative for London and South Counties for Messrs. Wm. Whittaker (Burnley), Ltd., boiler furnace manufacturers, and Messrs. The "Premier" Appliances Co., Ltd., boiler expansion joints.

We understand that Mr. J. H. Wild, M.I.E.E., for many years with the Lancashire Dynamo and Motor Co., Ltd., of Trafford Park, and since 1916 assistant superintendent of electrical manufactures to Vickers, Ltd., has left the latter firm, and joined the board of Nathan & Allen, Ltd., of Westminster. Mr. E. P. Lucking who has been closely associated with the firm of Nathan & Allen for seven years, has also joined the board of the new company.

Obituary—Mr. John Aitchison.—The death took place on April 17th, at Chalmer's Hospital, Edinburgh, of Mr. John Aitchison, who, from the time the installation was put down, had held the position of electrician at Floors Castle, Kelso.

Will.—The late Mr. C. A. Barrett (of the Hoffmann Manufacturing Co., Ltd., Chelmsford), left £413,106 net personalty.

NEW COMPANIES REGISTERED.

Olivers, Electro-Platers, Ltd. (174,314).—Private company. Registered April 20th. Capital, £2,000 in £1 shares. To carry on the business of electrical and mechanical engineers, electricians, engineers, and contractors, manufacturers of electric apparatus, electro platers, electrotypers and stereotypers, polishers, electro depositors, enamellers and lacquerers, metal refiners, motor car, boat, omnibus, van, and carriage proprietors, &c., and to adopt an agreement with H. D. Oliver. The first directors are: H. D. Oliver (managing director), 42, South Market Road, Great Yarmouth; G. Richardson, Braehead, Bonhill, Dumbartonshire; G. E. Wolsey, Westwood, Southtown, Great Yarmouth; S. R. Woodger, Gable End, Marine Parade, Great Yarmouth; H. Williment, 31, Regent Street, Great Yarmouth. Secretary: H. Williment. Registered office: 42, South Market Road, Great Yarmouth.

J. H. Humphrey, Ltd. (174,271).—Private company. Registered April 18th. Capital, £1,000 in £1 shares. To adopt an agreement with J. H. Humphrey, of 5, High Fold Lane, Uttley, Keighley, for the acquisition of the business of an electrical engineer carried on by him. The permanent directors are: F. J. Cowie, 62, Duckworth Terrace, Bradford, engineer; J. H. Humphrey, 5, High Fold Lane, Utley, Keighley, electrical engineer; S. Barraclough, 22, Duckworth Terrace, Bradford, engineer. Qualification: 50 shares. Secretary: W. G. Hunt. Registered office: Downham Street, Bradford.

Bromford, Ltd. (174,255).—Registered April 16th. Capital, £500,000 in £1 shares (250,000 preference). To carry on the business of manufacturers of and dealers in metal tubes, conduit tubes, and other kinds of fittings for electric wiring, and all apparatus, articles, and accessories used in connection with the erection and fitting up of electrical installations, metal rollers, wire drawers, steel makers, ironmasters, electrical, mechanical, hydraulic and general engineers, &c. The minimum subscription upon which the directors may proceed to allotment is 5,000 shares. The first directors are: J. H. Aston, Beaudesert Park, Henley-in-Arden; J. Baker, The Grange, South Road, Smethwick, near Birmingham; G. Beesley, The Pump House, Barnt Green, Birmingham; J Rollason, Hampton Manor, Hampton-in-Arden. Qualification: £500. Remuneration of chairman: £300 per annum; of other directors (except managing director): £200 per annum. Solicitors: Pinsent & Co., 6, Bennetts Hill, Birmingham. No notice of situation of registered office was filed at time of incorporation.

John Collier & Co. (Electrical Engineers), Ltd. (174,260).—Private company. Registered April 16th. Capital, £20,000 in £1 shares (12,000 "A" and 8,000 "B"). To take over the business of an electrical engineer carried on by J. Collier at 29, King Street West, Manchester. The first directors are: J. Collier, Pullwyke, Ambleside (permanent); J. Ratcliffe, 72, High Lane, Chorlton-cum-Hardy, Manchester; W. T. Reynolds, 26, Delaunays Road, Higher Crumpsall, Manchester. Qualification: 1,000 shares. Registered office: 29, King Street West, Manchester.

Nathan & Allen, Ltd. (174,343).—Private company. Registered April 21st. Capital, £10,000 in £1 shares. To take over the practice of Nathan & Allen, electrical engineers, of 25, Victoria Street, S.W. The first directors are: F. B. Nathan, 14, Charleville Mansions, W.14; J. H. Wild, Nantwych, St. Botolphs Road, Worthing; F. S. Allen, 20, Grey Coat Gardens, Westminster; E. P. Lucking, 15, Chatsworth Gardens, Acton, W. 3. Qualification: 150 shares. Registered office: 25, Victoria Street, S.W. 1.

Woodaloid, Ltd. (174,326).—Private company. Registered April 20th. Capital, £1,000 in 900 participating preferred shares of £1 each, and 2,000 deferred shares of 1s. each. To carry on the business of mechanical or electrical engineers, pattern makers, founders, workers in wood and wood substitutes, hardware manufacturers, &c. The first directors are: A. B. Shaw, 252, South Norwood Hill, S.E. 25; S. J. Rouse, 2, Tanfield Court, Temple, E.C.; W. R. Gaff, 7, Rusham Road, Wandsworth Common, S W. Registered office: 2, Tanfield Court, Temple, E.C.

Indurit Products Co., Ltd. (11,695).—Private company. Registered in Edinburgh April 16th. Capital, £1,000 in £1 shares. To carry on the business of manufacturers of "Indurit" and other electrical, insulating, and moulding materials. The first directors are: W. Hunter, 4a, St. Andrew Square, Edinburgh, technical consultant; R. Howden, 50, Leamington Terrace, Edinburgh, gentleman; J. H. Fairgrieve, Cherry Cottage, Uddingston, analytical chemist; W. Grant, Broomknowe, Mossend, engineer; D. W. Cowe, 1, Park Place, Trinity, Leith, gentleman. Qualification: 50 shares. Secretary: H. Howden. Registered office: 4a, St. Andrew Square, Edinburgh.

Particulars of the **Electrolytic Zinc Co. of Australasia, Ltd.**, have been filed pursuant to Section 274 of the Companies (Consolidation) Act, 1908. The capital is £3,000,000 in £1 shares (1,500,000 8 per cent. cumulative preference and 1,500,000 ordinary). A private company was incorporated in Victoria, Australia, on June 2nd, 1910, as the "Electrolytic Zinc Co. of Australia Proprietary, Ltd.," to quarry, crush, smelt, calcine, refine, dress and amalgamate, manipulate electrolytically or otherwise, and prepare for market, ores, metals, fluxes, tailings, concentrates, slimes, mineral substances, and other products of mines in Australia or elsewhere. It was resolved on September 6th, 1920, that the word "proprietary" be omitted from the title, and that the company be converted into a public company. The British address is at Pinners Hall, Austin Friars, E.C., where A. J. Smith is authorised to accept services of process and notices. The directors are: Hon. W. L. Baillieu, T. B. Birkbeck, M. Cohen, A J. F. de Bavay, C. Fraser, W. M. Hyndman, B. Kelly, G. C. Klug, H. A Sheppard, Hon. G. Swinburne, J. L. Wharton, and W. S. Robinson, all of Melbourne; G. W. W. MacKinnon, 24, Evelyn Gardens, S.W. 7; F. A. Govett, Holiday House, Sunningdale, near Ascot; and G. G. Hay (as alternate to F. A. Govett), 18, Stonebridge Park, Willesden, N.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Sun Electrical Co., Ltd.—Satisfaction to the extent of £275 on April 11th, 1921, of debenture stock dated March 31st, 1911, securing £7,000.

Lancashire Ordnance Accessories Co., Ltd.—Particulars of £50,000 debentures authorised July 16th, 1920, whole amount issued (registered April 14th, 1921, pursuant to Order of Court). Property charged. Company's undertaking and property, present and future, except uncalled capital.

Quead, Ltd.—Satisfaction to the extent of £2,000 on March 31st, 1921, of debentures dated November 29th, 1920, securing £5,000

Uxbridge & District Electric Supply Co., Ltd.—Mortgage dated April 5th, 1921, to secure £1,000, charged on certain land and premises in Hillingdon West, Middlesex. Holder: E. J. Garner, 118, High Street, Uxbridge.

Cammell Laird & Co., Ltd.—Conveyance dated March 31st, 1921 (supplemental to trust deeds dated March 22nd, 1905, and July 9th, 1901, to secure £500,000 4½ per cent. debenture stock and £1,000,000 5 per cent. debenture stock). Charged on certain land and premises at Penistone, Yorks. Trustees: Rt. Hon. Lord Stuart of Wortley, 7, Cheyne Walk, Chelsea, S.W., and A. Tongue, 13, St. Ann Street, Manchester. Also conveyance dated March 30th, 1921 (supplemental to trust deed dated January 1st, 1914, securing £500,000 5 per cent. first mortgage debenture stock), charged on above-mentioned properties. Trustees: Law Debenture Corporation, Ltd., 24, Old Broad Street, E.C.

London Electric Wire Co. & Smiths, Ltd. (101,353).—Return dated March 25th, 1921. Capital, £1,250,000 in 750,000 ordinary and 500,000 preference shares of £1 each, 644,070 ordinary and 400,000 preference shares taken up, £35,035 paid, £694,035 considered as paid. Mortgages and charges: Nil.

Northampton Electric Light & Power Co., Ltd. (28,640).—Return dated March 9th, 1921. Capital, £250,000 in 10 "A," 212,601 "B" ordinary, and 37,389 "B" preference shares of £1 each, all issued and fully paid-up in cash. Mortgages and charges: £71,625.

CITY NOTES.

Urban Electric Supply Co., Ltd.

The annual general meeting of this company was held on April 20th at Winchester House, Old Broad Street, Mr. P. D. Tuckett presiding. In proposing the adoption of the report, the chairman said that the results for the past year, although they showed a substantial improvement over those of the previous 12 months, were still far from being satisfactory. They had now a connected load 70 per cent. larger than in 1914, and nearly 90 per cent. larger than in 1913, when they were paying the preference dividend with every prospect of an ordinary dividend in the near future; yet, instead of deriving a more than equivalent increase of profit from that increased load, they were to-day, after making the increased depreciation provision which the enhanced cost of renewals now called for, actually deprived of any return on their share capital. Before the war the total working costs were about £80,000. Last year they exceeded £280,000, an increase over 1919 of £60,000, of which the increased price of coal and the increased rate of wage accounted for nearly £50,000. Until confidence was restored, and a commercial equilibrium established between costs and revenue, there could be no active development, and certainly no prospect of a cheap or abundant supply, so far as their small isolated undertakings were concerned. If with current costs and rates of charge they were denied the right to earn an adequate return on their pre-war capital, how was it possible for them to extend the business by the expenditure of further capital on plant and mains costing nearly three times as much and with capital costing nearly twice as much? Even if the expenditure would enable them to secure some reduction of their generating costs, the capital charges would render it prohibitive. Thus, at a time when there was every prospect of an increasing demand for electricity, they had no alternative but to reverse their progressive policy so as to avoid at all costs any development involving capital expenditure. Their customers were bound to suffer, but until costs fell or the Government faced the facts and provided an appropriate remedy, the difficulty would remain. However much consumers might want a supply, and however anxious they might be to give it them, it was commercially impracticable for them to face the cost.

At present they were compelled to charge some consumers more than they should, because they were prevented from charging others as much as they should, for there was this very marked and important difference between maximum rates now and before the war. Then they were maximum rates in fact, with a sufficient margin over the rates actually charged. To-day they were in practice minimum rates with less than no margin. He believed the whole system of control by maximum rates was wrong. Either they were high enough to be inoperative as before the war, or by their inadequacy as at present they ran counter to every economic law and so destroyed the very basis on which the development of the business depended. Small undertakings like theirs had suffered much more severely than the larger ones. He would explain the main differences affecting them, and he could do so the more readily because he was a director of the City of London Electric Lighting Co., which was one of the most successful of the larger undertakings. Apart from summer-time and early shop closing, which had generally deprived the smaller undertakings of a disproportionately large proportion of their comparatively small revenue, thereby raising both their capital and working costs per unit, they had been hit twice as hard as the larger undertakings by the increased price of coal and the increased rates of wage, without having been able to compensate themselves by making percentage increases in their rates of charge to the same extent that the larger undertakings had been able to do; and in this connection they must bear in mind that coal, wages, and salaries represent over 80 per cent. of their working costs. A large undertaking, using large turbine generating sets, consumed some 2 to 3 lb. of coal per unit, whereas this company, with their small reciprocating sets, could not expect to consume much less than 5 lb. or 6 lb. per unit. The increased price of coal hit them, therefore, twice as hard as it hit the others. Then, as to wages. Before the war in their small country towns the class of labour and supervision they employed was very different to that employed in the great cities and large industrial centres. The nature of their business compelled them to run their stations cheaply, and as a rule their men under the easier and pleasanter conditions were content to work longer hours at a considerably lower wage. But now that wages and working hours were regulated by Joint Industrial Councils on a more or less uniform standard throughout the country, it had had the effect of increasing wage rates altogether disproportionately, besides compelling them in some cases to employ an additional shift. To take a hypothetical example, where the City Co. were paying £2 before the war, the Urban Co. were paying little more than £1 for a corresponding service, so that, although they might now be paying £5 against the Urban £3 10s., their wages bill was increased 150 per cent. where this company's was increased 250 per cent. With regard to the question of compensating price, before the war the average lighting rate of the City Co. was little more than 3d. per unit, whilst they were generally charging from 5d. to 6d., but whereas the City Co. had been able to follow their rising costs by corresponding increases of price, until they were now charging 8d. per unit, thanks to their 8d. maximum rate having afforded them an ample margin, the Urban Co., whose costs were altogether disproportionately increased, had only recently been allowed to charge up to 10d. per unit in half their undertakings and up to 1s. per unit in the remainder, their original maximum rates of 7d. and 8d. having afforded them no similar adequate margin within which to adjust their prices. In other words, the City Co., with doubled costs, had been free to more than double its price, whereas this company with trebled costs had been condemned to starve for three years and could now barely double theirs. He was not saying that 10d. and 1s. might not appear fairly high rates compared with those charged by large undertakings or those to which recently they had been restricted, but they were not high in relation to the costs which had been imposed on the company, nor would they appear high if they had been allowed gradually to advance them contemporaneously with their rising costs. Turning to the Electricity (Supply) (No. 2) Bill, the speaker said: "What fate awaits it I am unable to say, but it is certainly ill-calculated to restore confidence to a sorely tried industry, and I shall be much surprised if it does not meet with strenuous opposition. Should its controversial provisions lead to its rejection or withdrawal, I do not know what steps may be taken to ensure the grant of the enlarged powers in regard to prices which the welfare of the industry makes it so vital for the Ministry of Transport to possess, but until their powers are enlarged I see little prospect of our obtaining further relief so far as maximum rates are concerned. In these times we must no doubt all expect to suffer, but I see no justification whatever for subjecting our small undertakings to the impossible conditions under which we are compelled to work them and at the same time arbitrarily denying us the right to meet those conditions, so far as it might be possible for us to do so, in the same way that every untramelled industry has been free to do, and has been obliged to do. . . . It would be well for you not to lose sight of the fact that the capital value of our plant has largely increased, that the underlying basis of the business is essentially stable, and that we consequently only require fair trading conditions to enable us to earn a reasonable return." Proceeding to refer to the accounts, Mr. Tuckett said that in the net profit and loss account there was a substantial increase in the interest charges, due to the increased capital expenditure which they had been forced to incur during the past two years in making good the war-time arrears, whilst their increased earnings had involved them in an additional income tax charge of £6,500, leaving them with a net balance of £25,840, as compared with £7,606 a year ago. He was afraid the shareholders would feel some disappointment at the directors' inability to recommend the resumption of a preference dividend, but, despite the substantial improvement shown, the company's financial position rendered it impossible for them to deplete their cash resources at the present time. Owing to their inability to adjust their rates of charge to their constantly rising costs, he estimated that they had been deprived during the past few years of something not far short of £150,000, which would have been available for the payment of dividends and for meeting their other current financial needs. As it was, all their available resources had been absorbed in providing the additional working capital which their higher working costs now entailed or were required to meet such current capital expenditure as their statutory obligations inevitably compelled them to incur. Regarding the future, the outlook for the current year was by no means assured. They were doing all they could to reduce their working costs, but with over 80 per cent. of the total represented by coal, wages, and salaries, over which they had a very limited control, it was not easy to effect any large reduction independently of the general reduction which they all hoped to see before long. The only other means of improving the position was by increasing the revenue. They could not do that by active development involving capital expenditure, and, except in one case which was now pending, they were of opinion that it would be inopportune and futile to press for a further increase in their selling rates until they knew the fate of the Bill now before Parliament under which the Ministry of Transport was seeking enlarged powers.

Mr. E. Charrington seconded the motion, and the report was adopted.

Automatic Telephone Manufacturing Co., Ltd. Mr. J. Taylor, presiding at the annual meeting, held at Liverpool on April 19th, said that the profit for the year was £15,369, plus £9,341 brought forward. Depreciation, preference dividend, and other outgoings having been paid, there remained a balance of £6,861 to be carried forward. It was not possible to pay a dividend on the ordinary shares. With regard to the agreement made in March, 1920, with the International Automatic Telephone Co. for the promotion of sales of the Strowger automatic telephone in colonial and foreign territories, this alliance was undoubtedly proving successful, and would be justified. The directors' efforts had been chiefly concentrated on the arrangement necessary to cope with a larger volume of business, and this had involved the expenditure of a large amount of money, which had not shown any immediate profit-earning result. The first fruits were, however, manifesting themselves in valuable orders received from Japan, India, South America, and elsewhere, and many large telephone administrations had finally decided that for economic reasons the advantage of automatic over manual telephones was already beyond dispute. This company had found it necessary to very largely increase its engineering and manufacturing capacity. As the expense involved was for development purposes, which should favourably reflect on future business, they had decided to charge only two-thirds to the 1920 account, the balance being charged to a development account. During 1920 they had to do a considerable amount of reorganisation and construction work, which had temporarily militated against their earning capacity, but such work was necessary, and the directors had every confidence in the results provided the work-people did not prejudice by adherence to a policy of limited output the company's ability to meet foreign competition, and provided also that general international business was of a normal character. A hopeful feature was the company's railway signalling department, because when released from Government control the railways of the country would necessarily have to spend money in improvements, and from the opinions expressed by railway engineers on the different devices introduced by the company it would appear that a fair share of the business should be secured. Finally, the speaker expressed the belief that the results of 1920 were better in fact than would appear from the balance sheet; time would prove this to be so.

Mr. D. Sinclair, managing director, seconded the adoption of the report, and it was carried.

Metropolitan-Vickers Electrical Co., Ltd. Mr. J. Annan Bryce (chairman) presided on April 20th over the twenty-first annual general meeting of the company. The chairman, in moving the adoption of the report, first commented on the accounts, and pointed out that the capital now stood at £2,395,000, viz., £1,135,650 ordinary shares, £1,234,370 preference shares, and £25,000 deferred shares. The prior lien debentures continued to diminish in amount with increased rapidity, owing to the operation of the sinking fund, and last year £10,900 was extinguished. "Sundry creditors and credit balances" showed the large increase of nearly £1,200,000. This item included reserve for income tax, corporation tax, and excess profits tax, but the increase was mainly caused by the large amounts due to suppliers of material owing to the great increase in the turnover. The general reserve account had been increased by the appropriation of £100,000. The balance carried forward was increased by nearly £8,000. On the credit side of the balance sheet no alteration had been made under the heading "patents, goodwill, &c." "Works, machinery, &c.," had risen by, roughly, £100,000, owing mainly to additions to buildings, machinery, and plant., depreciation amounting to £68,000, and a large expenditure on maintenance, having been written off as usual. "Stock and materials on hand" showed the large increase of £1,140,000, caused by the greater volume of business. Special care had been taken to value on a conservative basis, and every effort was made to keep purchases of material as low as possible. "Sundry debtors and debit balances" also showed the large increase of over £800,000 due to the same cause, much greater volume of business. "Cash in hand and at bankers" stood at about £60,000 less than last year. "Sundry investments" were £373,000 less than last year, due to the realisation of short-term securities, the proceeds of which had been applied to meet the needs of the greater volume of business. Coming to the profit and loss account, the gross profit was £81,555, and the net profit £83,231 larger than in 1919. Considering the interruption of business caused by the railway strike and the moulders' strike at the end of 1919, which greatly affected the results of 1920, and were indeed even still to some extent affecting the operations of the current year, they would consider it satisfactory that they were able to appropriate £100,000 to reserve, £35,000 to special depreciation, increase the carry over, and raise the dividend on the ordinary shares from 8 to 12½ per cent. The orders received during 1920 were in value about 80 per cent. greater than those received in 1919, while the orders completed were in value about 50 per cent. greater. The tonnage of orders completed represented an increase of about 30 per cent., a remarkable improvement, in view of the fact that electrical machinery was always becoming lighter in weight owing to the increase of efficiency in the material used in its construction. The increase of tonnage completed, moreover, reflected very great credit on the efficiency of the organisation. Last year he said that there were signs of the recognition by employers of the need for more human sympathy with their workers. He believed the feeling of sympathy was growing every day. It was recognised by every sensible man that the worker should be helped to maintain in part at least the improved standard of living which he enjoyed during the war, and that meant a widening of the pre-war margin between wages and cost of living. When the working day was shortened it was alleged that output would be maintained or increased. So far from that being the result, even the output per man per hour was less, with the result of an immense reduction of output and increase of cost. If the coal question was not settled at once industry would be unable to carry longer the burden of taxation under which it was staggering, a burden so heavy that many great concerns were forced to borrow to pay their taxes; a fact known to every banker, though the Treasury denied it. The excess profits duty had, indeed, made a belated departure, but its extinction would give no relief where no excess profits were being earned. Industry demanded another financial relief—a reduction of the bank rate. There was a further difficulty, the competitton of other countries—America, Belgium, Germany, and France. In none of these countries was the reduction of output per man a feature as it was with them. In America the production per man in almost all the great industries was about three times as great as with this country, and so, though the workman had high wages, and a possibly higher standard of life, the cost of production was lower. The present coal crisis was caused by America underselling us in every Continental country, in spite of the handicaps of a much longer haul to the port of shipment. In Germany unskilled labour got from 14s. to 17s. per week, skilled labour got from 35s. to 42s. per week, and with a ten-hour day. The German exporter was favoured by a very low exchange, and so in almost every article for which he had not to import the raw material he could undersell them by 50 per cent. and make profits up to 50 per cent. A few months ago an English concern had to place a large order for constructional steel. The lowest British tender was one million pounds. A German firm of repute tendered at £550,000 and got the order. Here in England, as long as the recent legislation imposing a 50 per cent. reparation duty is in force, there will be little imported from Germany, but the competition from it would have to be met everywhere except in France, the only other country which had imposed similar legislation. In Belgium and France also exports were favoured by a low exchange, and their labour, especially in Belgium, was working much harder than ours. Unless, therefore, Britain could reduce its costs by an increase in output and greater efficiency and economy in every direction, the outlook for its exports, on which hitherto the prosperity of the country had principally depended, was dark. Especially dark was it so long as the Continental countries remained impoverished. If they kept poor they could not buy from Great Britain. Referring to the workers, the chairman said the number of male workers had increased from 4,013 to 6,594, and women from 778 to 885. In the nine years since 1912 the average weekly earnings of men had increased from £1 7s. 6d. to £3 15s. 10d., and of women from 12s. 3d. to £2 0s. 1d., these figures including boys, girls, and night shifts. In the same period the pay of apprentices had been about trebled. The number of staff was about 2,300, consisting of about 1,550 men and 750 women. Of the latter, many were engaged in work of a highly technical character. A central canteen was opened in January; it seated 2,000 men, and 1,750 had already arranged to purchase their meals at it. A canteen seating 1,500 for the use of the staff would be opened in a few weeks. Three new departments had been started with the view of increasing efficiency and promoting economy. They were called respectively: Production, process, and inspection departments, and the increased efficiency attained had already amply justified their creation. The new research building was already partly occupied, and the rest would soon be ready for occupation. The department was doing most valuable work, not only in testing but in scientific investigation for the purposes of the company and allied concerns. The education department continued to expand. At the end of 1920 it had under training some 1,450 boys and men, of whom 100 were college apprentices of the university graduate type, 100 school apprentices from public and secondary schools, and 800 trade apprentices. A benevolent fund to relieve cases of hardship arising through illness, accident, or other causes of distress among the workpeople had recently been established, and its members already numbered 2,115. The fund would be maintained by an annual subscription from the company, contributions from members, &c. The company had lately taken over the management of the electrical department at Messrs. Vickers' works at Sheffield. This arrangement avoided the necessity of the provision of further buildings and equipment at Manchester, and would in other ways prove of advantage to the company, especially by creating a close co-operation in the manufacture and sale of the products.

Sir F. H. Barker (vice-chairman) seconded the motion.

Mr. Birks asked if the board contemplated renewing the option to the shareholders to convert their preference shares to ordinary shares. The number which had been so converted was rather disappointing, and he thought the operation had been checked by the low price of the shares in the market.

The chairman said the reopening of the question of conversion would want consideration, as it would require an alteration of the articles of association.

The motion was carried.

International Automatic Telephone Co., Ltd.

Mr. D. Sinclair presided at the meeting held at Liverpool on the 19th inst. He said that this was a company holding shares in the Automatic Telephone Manufacturing Co., and was formed as a means of strengthening the whole position. A large number of questions, many of them of an international character, had to be considered, and Mr. Adams and the president of the company, and Mr. Mellinger, a director, were now on the Continent negotiating and arranging matters in the interests of the company, for it was necessary to be in touch with telephone interests in almost all parts of the world. The company had secured and handed over to the Automatic Telephone Manufacturing Co. orders for larger exchanges in South America, Japan, India, and other countries, including an order from Mesopotamia for about £28,000 of equipment. When a country like Mesopotamia could do that it could readily be understood that when the forward countries really took up automatics the field was very large indeed. He expressed the regret of the directors that it had not been possible to pay a dividend for 1920, but it was hoped that the work done and the large amount of money put into the business would in the relatively near future earn profits, which would compensate those who had done the work as well as the shareholders.

A shareholder wanted to know if orders could not be obtained from nearer home than the East.

In reply, Mr. Sinclair said that the British Post Office had not come up to the scratch to the extent that had been expected, but grumbling did not help, and things were now looking better than they did.

North Metropolitan Electric Power Supply Co.

The net revenue for 1920 was £96,175, compared with £62,381 for 1919. Adding the interest and dividends received and the balance brought forward, the total is £103,395. The following are deducted: Mortgage, loan, and debenture interest, £18,700; debenture reserve fund, £2,000; contribution to reserve account, £16,011. Out of the balance of £66,683, a dividend on the 6 per cent. cumulative preference shares is paid requiring £35,999, and a dividend of 7½ per cent. per annum on the ordinary shares absorbs £26,251, leaving £4,433 to carry forward. The total units sold during the year represented an increase of approximately 18 per cent., compared with 1919. As from December 24th, 1920, a supply of electricity in bulk has been given to the Harrow Electric Light and Power Co., Ltd. A bulk supply agreement has been concluded with the Welwyn Garden City, Ltd., for distribution in the Welwyn Garden Estate. Negotiations have been proceeding with the Metropolitan Electric Tramways Ltd., and the Middlesex County Council for an increase of the rates of supply to the 56 route miles of tramways and light railways operated by the Tramway Co., and a satisfactory arrangement has now been made. The company has obtained judgment in an action against the metropolitan borough of Stoke Newington under the Courts (Emergency Powers) Acts for an annulment of the pre-war supply contracts with the Council. Negotiations are now proceeding with the Council for a continuation of the supply upon improved terms to the company. The North Metropolitan Electrical Power Distribution Co., Ltd., in which the company is interested, has made satisfactory progress, and is paying an ordinary dividend at the rate of 4 per cent. for 1920. The increased rates authorised by the Ministry of Transport for supply for private purposes were introduced as from the commencement of the midsummer quarter, 1920. Additional generating plant has been installed at the Brimsdown power station, and will be ready for use within the next few months. Extensive alterations and improvements are in progress at this station for the installation of further generating plant, with the consent of the Electricity Commissioners. The consent of the Minister of Transport under the Public Utility Companies (Capital Issues) Act, 1920, has been obtained to the increase of the borrowing powers of the company by the creation and issue of mortgage debentures or debenture stock or the raising of loans to an extent not exceeding one-half the amount of the share capital issued and paid up.

Meeting held April 27th.

French Companies.

The report for the financial year to August 31st, 1920, of Commentry-Fourchambault et Decazeville shows a net profit balance of 5,162,661 fr., or 87,220 fr. above that of the preceding year. This result has been achieved after liquidating 3,208,555 fr. of new works, against 2,070,442 fr. in the year preceding. A dividend of 100 fr. per capital share and 75 fr. per share *de jouissance* is proposed.

The Compagnie Continentale pour la Fabrication des Compteurs à Gaz et autres Appareils is about to issue 10,000 500-franc bonds, at the price of 495 fr., yielding 7 per cent. interest, free of tax, present and future, and repayable in 20 years from February 15th, 1922.

The Société d'Electrochimie et d'Electrométallurgie is issuing bonds to the value of 15,000,000 fr. The bonds are of 500 fr. nominal, bearing 6.5 fr. interest, free of tax, present and future, and are issued at 490 fr. They are repayable in 25 years from 1926, either by drawings or purchase on the market.

An issue of 24,000 500-franc bonds is being made by the Société Electro-Cable, 20,000 of which are allotted to M. Henry Debauge, and 3,400 to Debauge et Cie, as payment for their assets.

The board of the Tramways Electriques de la Rive gauche de Paris has decided to make payment of the balance of the dividends for the years 1918 and 1919 at the rate of 2,725 fr. net to nominative shares, and 2.06 fr. to shares to bearer, against return of coupons.

The report of the Compagnie des grands Travaux de Marseilles shows a profit of 1,454,105 fr., after providing for various sinking funds, allowing of the distribution of a 50 fr. dividend. New and interesting outlets had been opened for electric enterprise in the liberated territory and in Spain, Cilicia, and Argentina. Older undertakings or those under construction were proceeding normally, notwithstanding the financial difficulties of the moment.

Italian Companies.

The Società Tramvie Elettriche Bresciene has increased its capital to 12,000,000 lire, in order to complete the conversion to electric working of the tramways of Bresciana, formerly belonging to the Società Elettrica Bresciana.

The following Italian electric companies have augmented their capital: The Società Idroelettrica del Fasanella, to 500,000 lire; the Società Romana di Elettricità, from 6,000,000 to 30,000,000 lire; the Società Elettrica ed Elettrochimica del Caffaro, from 8,000,000 to 12,000,000 lire; the Società Anonima Guarnierè, of Milan, from 500,000 to 2,000,000 lire; the Società Elettrica Interprovinciale di Verona, from 3,000,000 to 15,000,000 lire; and the Società Adriatica di Elettricità from 60,000,000 to 100,000,000 lire.

The Società Idrolettrica Ligure, of Spezia, as a result of its last working, has decided to write down its capital from 14,910,000 to 7,455,000 lire, and to raise its capital to 25,000,000 lire.

With a capital of 1,000,000 lire has been launched in Rome the Società Italiana Rappresentanze Elettriche (S.I.R.E.) for the representation and trading in electric lamps, heating and lighting apparatus, and other electrotechnical articles.

The Società Idroelettrica Piemontese Lombarda Ernesto Breda, with a capital of 60,000,000 lire, has been established at Milan, for the generating and utilising of water power in general, and especially for the working of the plant on the Lys, constructed during the war by the Società Italiana E. Breda.

The Società Italiana di Elettrochimica, after setting aside 600,000 lire to the sinking fund, 1,155,000 lire to the shareholders at the rate of 7.70 lire per share, and carrying over 5,187 lire, has decided to increase the company's capital to 21,000,000 lire.

The Società Idroelettrica del'Ossola, of Milan, has closed its 1920 account with a net profit of 60,116 lire, the assets of the company being valued at 795,458 lire.

Stock Exchange Notices.—The Committee has specially allowed dealings in the following:—

Electrolytic Zinc Co. of Australis.—1,100,000 cumulative participating preference shares of £1 each (10s. paid).

Indian Electric Supply & Traction Co., Ltd.—The surplus on working in Cawnpore during the year 1920 was £34,970 (against £27,933 in 1919), and including transfer fees, bank interest, and discount on Treasury bills in England, the credit side of net revenue shows a total of £40,557. London expenditure was £2,462 (£2,309 in 1919), and after providing £3,113 for debenture interest, the profit is £34,981, plus £3,803 brought forward. There is put to reserve for depreciation and renewals £6,000; to general reserve £6,500; written off debenture issue expenses, £2,500; written off new share issue expenses £514. The preference dividend for the year requires £7,562. The total distribution on the ordinary shares is 10 per cent. for the year (£9,767); and the directors' commission on the dividend is £342 and £524, leaving £5,075 to carry forward, subject to taxation. Meeting: London, May 4th.

Brush Electrical Engineering Co., Ltd.—The accounts for the year ended December 31st, 1920, show a net profit of £191,096, to which must be added £74,726 brought in from 1919, making a disposable total of £265,822. £13,000 is placed to depreciation account; the expenses of the new issue of ordinary shares made in 1920 amounting to £15,576 are written off; £2,044, being a further 4 per cent. for the year, is paid to the 6 per cent. second prior lien debenture holders; £53,377 added to general reserve, raising this account to £75,000. A dividend of 15 per cent. per annum on the ordinary shares, absorbing £38,557, will be recommended, leaving a balance of £143,268 to be carried forward, subject to E.P.D., income and corporation profits taxes, and directors' additional remuneration.

Madras Electric Tramways (1904), Ltd.—Gross profit for year ended December, 1920, £41,103. After debiting interest and London office expenses, making provision for debenture stock, sinking fund, and putting £15,000 to depreciation and renewal account, the balance is £15,693, plus £4,944 brought forward. Preference dividend, less income tax, £6,000; 8 per cent., free of tax, on the ordinary shares, £4,580; contribution to employés' gratuity fund, £1,000; to general reserve, £3,500; carrying forward, subject to E.P.D., if any, £5,556. The traffic receipts and running expenses in rupees show increases of 16.6 per cent. and 24.4 per cent. respectively on 1919. The balance from running account shows a considerable increase, but in comparing the figures with the previous years, regard must be had to the par value of the rupee, which was 2s. for 1920, instead of 1s. 4d. as formerly.

Metropolitan Electric Tramways Co.—Revenue for 1920, apart from dividends receivable, amounted to £957,555. Deducting all expenses chargeable to revenue, including debenture and loan interest, and setting aside £10,000 for reconstruction and renewals, there remains £8,424, plus dividend receivable on holding in North Metropolitan Electric Power Supply Co., and sum brought forward, making available £37,406. Directors recommend placing to reserve £10,868; dividend on preference shares, balance of 4½ per cent. per annum for 1918 and ½ per cent. per annum on account of 1919, carrying forward £1,538. Benefit of increased fares was only obtained by company during six months of year, while increased working expenses prevailed throughout the whole of the year. Reconstruction of portion of track in Tottenham district was carried out during the year. The Company purchased and cancelled £8,848 4½ per cent. and £3,962 5 per cent. debenture stock.—*Financial Times.*

British Electric Transformer Co., Ltd.—The report for 1920 states that after paying all manufacturing costs and expenses of administration, the net profit is £70,267, plus £10,523 brought forward, making £80,790. There is to be put to reserve £10,000; to depreciation reserve £3,000; preference dividend absorbs £18,836; dividend of 10 per cent., and a bonus of 2½ per cent. for the year require £40,625; extra remuneration to directors, £2,150; carried forward £6,178. The directors report the death of Mr. F. J. Marchment, a director. Annual meeting: April 29th.

London United Tramways, Ltd.—Gross receipts for 1920 totalled £532,742, an increase of £36,200. Working expenses £482,597. Balance £50,144, compared with deficit of £144 for 1919. After charging debenture and loan interest there is £695 as a deduction from deficit for years 1918 and 1919. The effect of increased fares, says the *Financial Times*, was only felt by the company during part of the year, while the increased working expenses prevailed throughout the whole of the year.

Belgium.—The report of the Société Generale Belge d'Entreprises Electriques, of Brussels, for last year shows a profit of 1,825,787 fr., as compared with only 784,152 fr. in 1919.

The Société des Ateliers de Constructions Electriques de Charleroi reports a profit of 6,719,081 fr. for the past financial year; a dividend at the rate of 5 per cent. is being declared.

Montreal Light, Heat & Power Companies.—A dividend of $1¼ on Montreal Light, Heat & Power consolidated shares and one of $2 on Montreal Light, Heat & Power Co. common shares are announced.

Sweden.—Accumulatorfabriks Aktiebolaget Tudor has decided to increase its share capital from the present 1,000,000 kr. to 2,000,000 kr. by the issue of new shares of 1,000 kr. each at par.—*Reuter's Trade Service* (Stockholm).

British L.M. Ericsson Manufacturing Co., Ltd.—A dividend of 8 per cent., free of tax on the ordinary shares is announced. After putting £10,000 to reserve, £18,721 to depreciation, and paying £13,148 as income tax, &c., £39,094 is to be carried forward, subject to repayment of E.P.D. and payment of corporation tax.

Rhondda Tramways Co., Ltd.—The directors are recommending that there be paid on the preference shares 2 per cent. balance for 1915 and 6 per cent. on account of 1916. It is proposed to convert the 6 per cent. cumulative preference shares into 8 per cent. non-cumulative participating preference shares.

Fairbairn Lawson Combe Barbour, Ltd.—Profit for 1920, after providing for corporation tax and setting up special reserve for other taxation, £206,414, plus £32,982 brought forward. Further dividend of 7 per cent. on ordinary shares, making 10 per cent., and bonus of 5 per cent. (free of tax) on ordinary shares recommended.

Calcutta Electric Supply Corporation, Ltd.—Final dividend for the year 1920 of 6 per cent., making 10 per cent. for the year, with an added bonus of 1 per cent. Both the dividend and the bonus will be paid free of the amount allowed for Indian taxation.

Mexborough & Swinton Tramways Co.—The dividend for 1920 is 2½ per cent., free of tax.

STOCKS AND SHARES.

Tuesday Evening.

The principal item of interest this week in Stock Exchange markets is the effect of the Budget upon prices. Nobody had expected Mr. Chamberlain to introduce anything but a humdrum Budget, so that the presentment of the national accounts surprised nobody in being more or less colourless, except to the unfortunate taxpayer. The Budget frequently has an influence over gilt-edged stocks, and of late years the effect has been, excepting one or two Budgets, to make prices lower. This year, however, the markets for national securities rose sharply on the Chancellor's speech, with its news of a 3½ per cent. conversion loan. The strength of good stocks is well maintained, and further rises have occurred in various Home Railway prior-charge descriptions, including those of the Undergrounds. Both Metropolitan preference and District debenture have gone up during the last few days.

Various improvements have been secured by shares in the electrical manufacturing group. Since the announcement of the English Electric 8 per cent. dividend a steady inquiry has been noticeable for these and kindred shares. The report of the English Electric Co. aroused a little wonder as to whether the directors were altogether wise in making a distribution so substantial at a time like the present. But the shares have risen 2s. to 14s. 6d., and the preference are better at 14s. Siemens hardened to 22s. 6d., Electric Constructions to 16s. 3d., Edison Swan ordinary gained a florin at 12s., and Cromptons at 15s. are 1/16 up. The North Metropolitan Electric Power Supply Co. issues an unexpectedly good report, showing an increase in the net revenue of £34,000 at £96,000. The ordinary dividend goes up from 4½ per cent. to 7½ per cent. The company's business progresses favourably, and agreements for the supply of bulk electricity have been arranged for the Harrow Electric Light Co. and the Welwyn Garden City, Ltd. Upon this, British Electric Traction has advanced 4 points to 30, London and Suburban ordinary picked up to 2s. 3d., and the preference to 5s.

On Friday in this week the River Plate Electricity Co. holds its meeting, at which a dividend of 7 per cent. for the year on the ordinary stock will be declared, making the sixth consecutive year in which this rate has been distributed. The company is a holder of 5 per cent. obligations in the German Trans-Oceanic Electric Co., and these bonds are to be exchanged for an obligation of the Compañia Hispano-Americana de Electricidad, a Spanish Corporation. The report points out that a dividend, of what amount is not stated, has been paid upon the company's shares in the Argentine Electricity Co., Ltd., and that the interest has been met upon the 5 per cent. debentures held in the Tucuman Tramways Co.

Babcock & Wilcox are 1/16 up at 2⅝. In spite of the public's manifest disposition to buy fixed-interest stocks and shares, there is still some demand for ordinary issues in which scope exists for capital appreciation when trade settles down into more normal channels. Vickers have risen to 14s. 3d. on hopes of a 5 per cent. dividend. The tax-free preference now stand at the same price.

The cable market is firm throughout. The Eastern group resumes its steady improvement. There are small rises in Western Telegraphs, Eastern Extensions and Eastern Telegraph ordinary. The floating amount of stock available for buyers is small, and any stock which comes in finds a ready home. Cuba Submarines are again 10s. higher at 7½. Marconi's advanced to 2½, and, in point of fact, have been still better. No little discussion is going on as to what the next dividend is likely to be. The optimists pin their hopes to a substantial Government grant for compensation, while, on the other hand, some point out that it may be as well to qualify exuberant expectation in view of disappointments that have occurred in the past. Marconi preference keep pace with the ordinary, and are 2 7/16. Canadians are quoted at 8s.; the Radio shares have scarcely moved.

Metropolitan Electric preference have risen to 3 1/16, and Chelsea ordinary at 3⅛ are also ⅛ better. The City of London Electric Co.'s 8 per cent. second preferences were left in the hands of the underwriters to the tune of 42 per cent. The ordinary shares offered at 22s. 6d. were all taken by the public. The company's prospectus appeared at as bad a time as could possibly have prevailed for an issue of this sort, and it is not surprising that of the 300,000 preference the underwriters should have to take 127,000. Buyers promptly came into the market, however, and the price rose to 6d. discount after opening lower. The new ordinary are called "par" to 1s. premium, par being the issue price. The new Central Electric 8 per cent. Notes are higher at 2 premium.

Mexico Tramways Fives are 3 up at 40, and Mexican Light & Power Fives gained a further 2½ points at 67, making a rise of 5 in a fortnight. Canadian Generals are lower at 120, and so are Brazilian Tractions at 34. Home Railways became somewhat dull, because of the coal strike. Nevertheless, the Budget speech carried a crumb of consolation to proprietors of the stocks; the Chancellor referred to the possible claims upon his surplus that might arise in respect of liabilities to the railways, under the war agreements. In the rubber market there is no change from the stagnant conditions that must prevail while the price of the raw produce remains so flat.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1919.	Dividend 1920.	Price April 26, 1921.	Rise or fall.	Yield. p.c.
Brompton Ordinary..	12	12	6	—	£10 0 0
Charing Cross Ordinary . ..	7	8	8⅞	—	10 6 6
do. do. do. 4½ Pref...	4½	4½	2⅞	—	7 16 6
Chelsea..	4	6	8⅛	+ ⅛	9 12 0
City of London	13	14	23/3	—	12 0 10
do. do. 6 per cent. Pref...	6	6	17/-	—	7 1 2
County of London	8	8	7⅝	—	10 9 10
do. do. 6 per cent. Pref...	6	6	8	—	7 10 0
Kensington Ordinary	7	9	4⅛	—	10 18 2
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref ..	6	6	2¾	—	10 18 2
Metropolitan	6	7	8¼	—	10 15 4
do. 4½ per cent. Pref. ..	4½	4½	3 1/16	+ ⅛	7 7 0
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	6	—	2½	—	9 2 10
South Metropolitan Pref... ..	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	5⅛	—	9 16 2

Telegraphs and Telephones.

	1918	1919			
Anglo-Am. Tel. Pref.	6	6	78½	—	7 12 10
do. Def...	88/6	1½	16¾	—	9 10 6
Chile Telephone	8	6	5⅝	—	5 6 8
Cuba Sub. Ord.	7	7	7½	+ ½	9 6 8
Eastern Extension	10	10	16⅛	+ ⅛	6 4 0
Eastern Tel. Ord.	8	10	161½	+1½	6 8 10
Globe Tel. and T. Ord.	8	10	16	—	8 6 0
do. do. Pref.	6	6	9	—	6 13 4
Great Northern Tel.	22	22	22	—	10 0 0
Indo-European	13	10	30	—	8 6 8
Marconi	25	25	2½	+ 1/16	—
Oriental Telephone Ord.	10	12	2 3/16	—	*5 9 7
United R. Plate Tel.	8	8	6⅛	—	6 10 8
West India and Panama	1/3	Nil	3/16	—	Nil.
Western Telegraph..	8	10	16⅛	+ ⅛	*8 4 0

Home Rails.

	1919	1920			
Central London Ord. Assented ..	4	4	44½	—	9 0 0
Metropolitan	1¼	1½	25	- -	6 0 0
do. District	Nil	Nil	14½	—	Nil
Underground Electric Ordinary ..	Nil	Nil	2	—	Nil
do. do. "A" ..	Nil	Nil	6/-	—	Nil
do. do. Income ..	4	2	71½	—1	2 16 0

Foreign Trams, &c.

	1918	1919			
Anglo-Arg. Trams, First Pref. ..	Nil	6½	2⅝	—	10 9
do. do. 2nd Pref. ..	Nil	Nil	3	—	Nil
do. do. 5 % Deb. ..	5	5	59½	—	8 8 0
Brazil Tractions	Nil	Nil	34	—2	Nil
British Columbia Elec. Rly. Pfce.	5	5	55	—	9 1 10
do. do. Preferred	2½	6	54½	—	*8 14 0
do. do. Deferred	Nil	8	51½	—	*11 17 6
do. do. Deb. ..	4½	4½	68½	+1	7 5 4
Mexico Trams 5 per cent. Bonds..	Nil	Nil	40	+3	Nil
do. 6 per cent. Bonds..	Nil	Nil	22½	-	Nil
Mexican Light Common	Nil	Nil	11½	—	Nil
do. Pref.	Nil	Nil	18	—	Nil
do. 1st Bonds	Nil	Nil	67	+2½	Nil

Manufacturing Companies.

Babcock & Wilcox	15	15	2⅝	+ 1/16	6 6 4
British Aluminium Ord.	10	10	16/3xd	—	12 6 2
British Insulated Ord.	12½	15	1 9/16	—	9 12 0
Callenders	26	15	1 7/16	—	10 18 2
" 6½ Pref.	6½	6½	17/6	—	7 8 7
Crompton Ord.	10	10	15/-	+ 1/16	13 6 8
Edison-Swan	10	10	12/-	+2/-	—
do. do. 5 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	16/3	+6d.	12 6 0
English Electric	—	8	14/6	+2/-	11 0 8
Do. Pref.	—	6	14/-	+1/-	8 11 8
Gen. Elec. Pref.	6½	6½	19/-	+6d.	6 16 10
do. Ord.	10	10	24/6	+ 1/16	*8 6 6
Henley	26	15	1 5/16	—	11 8 6
do. 4½ Pref.	4½	4½	8¼	—	6 18 6
India Rubber	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	1¾	—	9 2 10
Siemens Ord.	10	10	1⅛	+ 1/16	*8 17 10
Telegraph Con.	20	20	20	—	*6 18 9

* Dividends paid free of Income Tax.

AUTOMATIC CABLE PROTECTIVE GEAR.

The Ferranti-Hawkins System.

The Ferranti-Hawkins system of cable protection (Ferranti-Hawkins-Hanstock patent, 1919) which has recently been placed upon the market by Messrs. Ferranti, Ltd., may be described as a combination of the Merz-Price and Ferranti-Feld systems of protection; its chief utility lies in its application to the protection of feeder cables, although it may be employed to protect apparatus of other kinds. It is suitable for use on a.c. systems from which, in the event of a breakdown of insulation, a current will flow to earth through the fault, and by its use it is claimed that perfect discrimination is obtained between sound and faulty apparatus, so that only the latter is disconnected. The chief advantages claimed for the gear are its freedom from accidental operation, simplicity, and the absence of parts subject to high pressure.

Component Parts.—On referring to the diagram of connections (fig. 1), it will be seen that the cable to be protected is threaded through a special core-balancing current transformer at each end of the feeder requiring protection, the secondary circuits of the current transformers being taken through relay coils and pilot wires in a manner similar to that adopted in the Merz-Price system of protection.

The transformer (fig. 3), as applied to a three-phase cable, is shown diagrammatically by fig. 4; its core surrounds all three cores of the main cable, which thus forms the primary winding, and a secondary winding encircles the core and is connected to the relay. The vector sum of the load currents in the three cores of a healthy three-phase cable is zero at every instant whether the load is balanced or not, and under normal conditions, therefore, no flux is induced in the transformer core, and consequently no current in the secondary winding. But on the occurrence of a fault current to earth the vector sum no longer equals zero, and a flux *a b c d* (fig. 4), is induced in the core, thus producing a current in the secondary winding which actuates the relay.

To ensure that the secondary winding shall not be affected by the magnetism due to the currents in individual conductors it is sometimes necessary to surround the cable with an inner magnetic shield as shown in fig. 5. It is not considered safe for the transformer core to be in contact with the insulation of the cable; the transformer can, therefore, be fitted with a pair of porcelain insulators and a Pertinax tube.

The relay is illustrated by fig. 2, and consists of an electromagnet excited by current from the secondary winding of the transformer. The armature of the magnet is controlled by a sliding weight which can be adjusted according to a scale marked in amperes of fault current. A single-pole switch is mounted beneath the magnet, and when the armature is attracted to the latter it overbalances the switch blade, which thereupon falls into a contact and closes the trip circuit of the main switch. After operation the switch is reset by hand in the "off" position by raising a knob which projects beneath the case. The relay must be mounted in a truly vertical position, and a plumb bob is provided to ensure that being done.

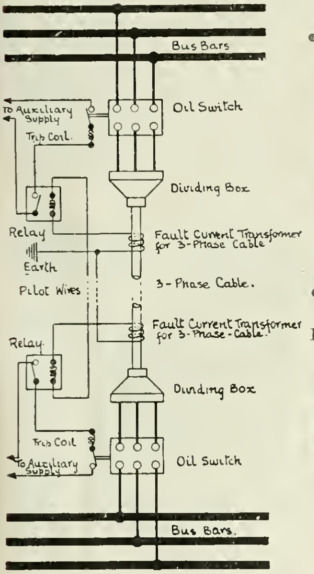


Fig. 1.—Diagram of Connections.

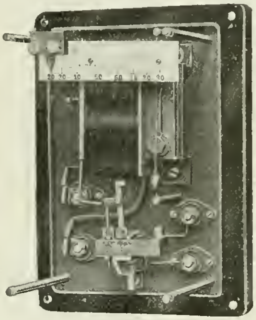


Fig. 2.—Relay with Cover Removed.

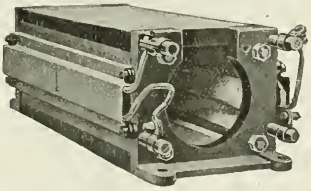
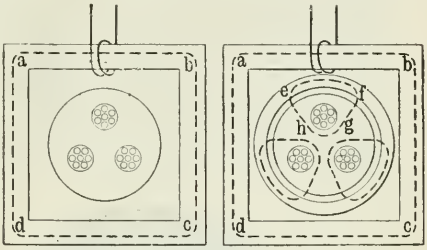


Fig. 3.—Transformer.



Figs. 4 and 5.—Cable and Transformers.

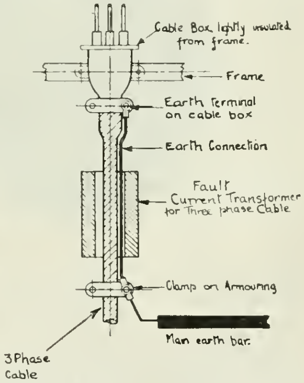

Cable Box lightly insulated from frame.
Frame
Earth terminal on cable box
Earth Connection
Fault Current Transformer for Three phase Cable
Clamp on Armouring
Main earth bar.
3 Phase Cable

Fig. 6.—Method of Earthing Sheath.

When the transformer is used with lead-covered or armoured cable it is important that the earthing of the lead covering and armour be carefully considered, otherwise the satisfactory operation of the apparatus may be interfered with. The best method is to bond the lead covering and armouring to the cable box and to connect an earth wire from the cable box through the transformer to the main earth bar, as shown in fig. 6. The cable box must be lightly insulated from any supporting earthed framework.

The three chief advantages claimed for the protective method under consideration are:—

(*a*) *Freedom from any tendency towards accidental operation.*—In the first place, in the Merz-Price system the current transformers are connected in the individual phases so that the iron circuit of each transformer has a flux induced in it, and by means of the opposition of the secondary windings of the current transformers at the two ends of the protected cable the flux is prevented from causing any secondary current to circulate through the pilot wires and the relay coils. The current transformers may have very similar characteristics, and give precisely similar terminal voltages at normal loads, but still differ sufficiently to produce a current in the secondary circuit under short-circuit conditions, and it is possible that this current may be of sufficient magnitude to operate the relays. This tendency is entirely absent in the Ferranti-Hawkins system, since it may be assumed that even under short-circuit conditions the algebraical sum of the currents in the three phases of the cable or cables which pass through the current transformers will be zero and, therefore, no flux will be induced in the iron circuits of the current transformers.

In the second place, in the ordinary Merz-Price system, so long as there is any load on the circuit protected, each current transformer will tend to send a current through the pilot wires and relay circuit, and if an accidental short circuit occurs between the cores of the pilot cable or the connections thereto at any point, the current will immediately flow through the relay coils, thus causing the operation of the protective gear, although no fault exists on the protected cable, which operation will lead to a shut-down of part of the system. With the system under review, since under normal conditions the current transformers do not tend to supply any secondary current, an accidental short circuit on the pilot circuit will not cause operation of the gear.

(*b*) *Simplicity.*—A comparison will show that instead of employing three current transformers and three relay elements at each end of every cable to be protected, the above-described system employs only one current transformer and one relay element at each end of the protected circuit. Further, in the case of a single cable being protected, the system only requires two pilot cables against three, and for the case where several cables are laid in parallel, each cable will require one pilot wire with an additional pilot wire common to all the cables to provide a common return.

(c) *Absence of high-pressure apparatus.*—With regard to the third advantage claimed, it is obvious that it is not necessary to install current transformers insulated for the supply voltage; those used slip over the cable outside any sheathing or armouring which may be used, no special insulation of any kind being required. Apart from other obvious advantages, this fact means that the current transformers can be examined or tested at any time without risk and without its being necessary to shut down any part of the electrical installation.

The protection afforded by the Ferranti-Hawkins system in practice is said to be quite as adequate as that afforded by other systems. The only fault conditions under which operation would not be obtained would be those which are obtained when a short circuit occurs between phases without a simultaneous fault to earth. This condition, however, is assumed to be so very improbable that it may safely be neglected. The sensitivity of the gear is at least as great as that of other patterns, and its operation can readily be obtained with a fault current of 50 amperes to earth under the worst possible conditions, or an even lighter setting could be given if it was found to be desirable to do so.

"Kalecore" Cable.

This is an improved form of cable specially adapted for use with the Merz-Hunter split-conductor system of feeder protection, and as its name implies, is produced by Callender's Cable and Construction Co., Ltd. Fig. 7 illustrates an 11,000-volt, 0.15 sq. in., 6-core, 3-phase, paper-insulated and lead-sheathed "Kalecore" cable, and the arrangement of connections by which it is utilised for the purpose of automatically protecting a feeder is shown in fig. 8. The two split conductors forming one phase are led to the switch at each end of the feeder through a current transformer having a double primary winding, the two windings being arranged in opposition so that, so long as there are equal currents in the two conductors, the effects of the two primary windings are opposed, and no current flows through the secondary winding of the current transformer and, consequently, the relay is inoperative. Immediately there is any leakage, however, the currents are no longer equal, and the relays operate at each end of the feeder, thus opening the circuit breakers.

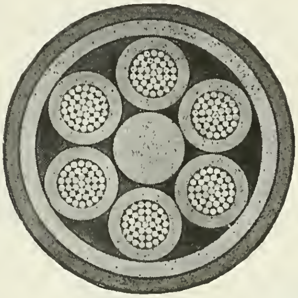


Fig. 7.—An e.h.p. "Kalecore" Cable.

The two conductors, or splits, forming each phase are situated at opposite ends of a diameter in the "Kalecore" cable (in other forms of split-conductor protection they are adjacent to each other) and the arrangement of conductors, it is claimed, avoids the possible danger that a fault on one split might spread to the other split of the same phase, and thus tend to prevent operation of the automatic device by developing equal faults on both splits. In actual fact, the tendency of a fault on one split, if it spreads, is to damage adjacent conductors which are the splits of the other two phases; the effect of a spreading fault in the "Kalecore" cable is, therefore, to bring into action the relays of all phases of the cable.

The diametrical arrangement of split conductors also ensures that there will be no inductive out-of-balance between the splits of any phase, which is important, because it avoids unnecessary tripping of the switches. The two currents in the split conductors of each phase divide according to the relative impedance of the splits, and precise equality of impedance cannot be secured; there will always be some slight difference, although it may be only a fraction of 1 per cent., and if it is not kept small, the automatic gear may tend to operate on momentary overloads (even when the feeder is not faulty), but the "Kalecore" construction of cable, due to the similarity of the conductors and their symmetrical arrangement, secures extremely close equality of the splits, thus allowing the relays to be adjusted to respond to extremely small fault currents and, at the same time, to be unresponsive to the heaviest overloads. When a dead short circuit occurs at the delivery end of the feeder and full bus-bar pressure is maintained at the generating end, the current in the feeder is limited solely by the feeder impedance, and will generally reach a value of several thousand amperes, depending on the size and length of the feeder. The "Kalecore" system will withstand, it is claimed, even these severe conditions and, at the same time, will respond instantly to fault currents of a few amperes only.

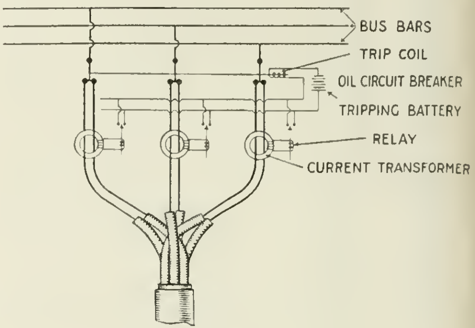


Fig. 8.—Diagram of Connections

The following advantages are claimed for the system: It responds instantly to small leakages and isolates faulty feeders at the inception of the fault without shock to the main system; no circumstances other than a fault within the feeder protected will cause the gear to operate, and it cannot remain in service wrongly connected. The manufacture of the cable is no departure from standard practice and requires no auxiliaries such as metallic shields, pilot wires, shaped conductors, &c. The cable joints are simple, straightforward, of standard construction, and the current transformers are of the bar primary type, without turns. There is no danger of access of high-pressure currents to the relay circuits.

Screened Pilot Cable.

The use of screened pilot cable is an improvement (Beard-Hunter patent, 1917, which has been introduced by Callender's Cable & Construction Co., Ltd.) on the original Merz-Price protective arrangement for feeder cables and makes, it is claimed, the apparatus safer against improper operation on heavy overloads and, therefore, more reliable.

The condition under which improper operation may occur is an overload amounting to many times the normal full load of the feeder. Under these circumstances a fairly large voltage is generated in the secondary windings of the current transformers, as this voltage is proportional to the current in the primary winding. It is true that the voltages of the two current transformers are in opposition, but the pressure is free to produce a capacity current in the pilot cable insulation, and in the case of long feeders carrying very heavy momentary overloads, the pilot capacity current produced in this way may be sufficient to operate the relays. This difficulty has been overcome by the arrangement now described. Each core of the pilot is surrounded by a sheath, so that all the capacity current must flow from the core to the sheath. The sheath is connected to the current-transformer secondary winding in such a way that the capacity current circulates in the circuit composed of the pilot core, sheath, and current-transformer secondary winding. As a result the capacity current is entirely diverted from the relay, and the system becomes immune from operation on heavy overloads.

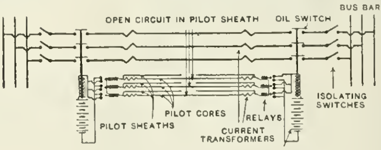


Fig. 9.—Diagram of Connections.

The diagram, fig. 9, shows the complete arrangement of connections to comply with the above description, and a drawing showing in cross-section the 3-core screened pilot cable used for this purpose is given in fig. 10. A section of a combined pilot and telephone cable is shown in fig. 11, illustrating the manner in which telephone communication can be very cheaply provided by incorporating the cores in the pilot cable, and the following comments in connection with the apparatus composing the system will be of assistance to those installing and using it.

A quick-acting oil switch is in practice found to be advantageous, as faults are removed without shock to the general electrical system. Switches which complete their opening in as short a time as one-twentieth of a second are used, and the tendency is to use even quicker switches, the mechanism of which should be proof against sticking and rusting.

On the design and construction of the current transformers depends more than anything else the successful operation of this system. It is obvious that the two current transformers opposing each other at each end of a feeder must have precisely similar characteristics, and it is necessary for them to produce an exact balance. Moreover, this condition of balance must hold for all the values of current which may be carried by the feeder while it is sound. For instance, a fault on some other apparatus on the system may momentarily pass through the feeder a current amounting to as much as 50 times the normal full load. In fact, absolute safety is only ensured when the current transformers will balance with the largest current which can possibly pass through the feeder. This current may be calculated by dividing the voltage of the circuit by the impedance of the feeder. It is preferable to use current transformers in which the primary winding consists simply of a copper bar without turns, and in order to keep down the secondary voltage on heavy currents, the core of the current transformer usually contains an air gap.

It is advisable not to use too complicated, too delicate, or too sensitive a relay; one which will operate with the secondary current produced by a feeder leakage of 50 amperes is sufficiently sensitive for practical requirements. In the case of relays which are not self-resetting the battery is left connected to the tripping coil after the switch has operated, and there is risk of the battery being exhausted; therefore, an auxiliary switch should be provided on the oil-switch mechanism which will open the battery circuit when the oil switch is open. Self-resetting relays avoid this complication, but they do not make such reliable and definite contact as the other type.

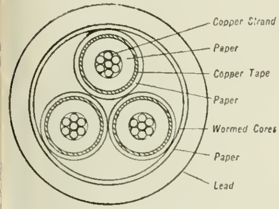


Fig. 10.—Screened 3-core Pilot Cable.

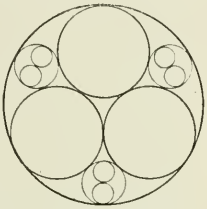


Fig. 11.—Combined Pilot and Telephone Cable.

If the switch trip coil requires 15 volts to operate it, it is advisable to use a primary battery giving not less than 25 volts to allow for bad condition of the tripping mechanism and a partially run-down battery. Schemes for avoiding the use of batteries and utilising l.p. a.c. for tripping the switches are, generally, unsatisfactory, because the switches have really to be tripped only when there is a fault on the feeder, and at such times the a.c. pressure is liable to fall momentarily much below its normal value. The only really reliable course is, therefore, to provide a tripping supply quite independent of the main circuits, *i.e.*, a small secondary battery.

It must not be overlooked that the protective apparatus operates only for feeder faults, and faults on the switchgear, busbars, and other apparatus would not be switched off if the system contained nothing but feeder protective gear. To meet this condition overload relays may be used, but care must be taken that they will not operate before the protective relays. The protective relay should be instantaneous in its action, and the switch which it controls should not take more than one-fifth of a second, as a maximum, to open the circuit. If, therefore, the overload relays will ignore overloads which do not last for half a second or longer, the protective gear will always have time to remove the fault before the overload relays come into action. Provided this precaution is taken, overload relays may be used quite freely on feeders, the general guiding principle being that a busbar fault in any particular sub-station should shut down as small an area as possible.

New Socket for Electrical Line Posts.—M. Vernholes, a French engineer, has designed a new socket for supporting the wooden posts of electrical transmission lines, which he has patented and called "AVA," says the *Revue Générale de l'Electricité*. The socket is very simple and light, constructed of reinforced concrete, easy to transport and install, and does not comprise any ironwork or bolts It is made up of four vertical side-pieces strongly connected together at the top, bottom, and middle. The lower part is buried in the soil, the middle being to level, and the upper part supports the foot of the post, which is firmly fixed to it at about one foot above the ground. It can be fitted to posts of any diameter. —*Technical Review.*

THE TESTING AND APPROVAL OF ELECTRICAL APPLIANCES IN ONTARIO.

We have received from the Department of Overseas Trade a copy of a memorandum prepared by Mr. W. P. Dobson, laboratory engineer, Hydro-Electric Power Commission of Ontario, which is reproduced below:—

In the elimination of fire and accident hazards from electrical installations two closely related but separate features are involved. One of these has to do with the method of installation, and necessitates a visual examination of the completed work to detect hazards due to improper or careless methods. The other feature is supplementary to this, and is concerned with the quality and condition of the materials and apparatus employed. It involves careful tests under standard conditions which are not usually obtainable except in a laboratory. This feature of electrical inspection may be designated approval testing as distinct from the first feature or field inspection. Approval testing is the function of the Approval Laboratory of the Commission.

In the early days of the Electrical Inspection Department the work of approval was carried on by that department in conjunction with field inspection. Devices and materials which bore the label of Underwriters' Laboratories of the United States were accepted as satisfactory in any installation. Much material, however, continually appeared on the market, which had not been approved by the underwriters' laboratories, and such material was examined and approved by the Electrical Inspection Department. Labels were distributed to manufacturers for use with certain types of goods, such as service boxes, motor starters, and electric signs. The number and variety of devices and materials appearing on the market increased so rapidly that it was found impossible for the Inspection Department to carry on both approval and field inspection, especially in cases where laboratory tests were necessary. Accordingly, in 1917 the approval testing was turned over to the Laboratories Department of the Commission, and a section was organised to carry on the work under the name of the Approval Laboratory.

Scope of Work.—The scope of the work is indicated by the wording of the announcement made by the Commission at the time of the organisation of the Approval Laboratory. This reads as follows:—

Pursuant to Power Commission Act, 6 Geo. V., Chapter 19, Section 10, 1916, and amendments thereto, and the Rules and Regulations of the Hydro-Electric Power Commission, covering the design and construction of electrical machinery, apparatus, appliances, devices, material, and equipment for use in the generation, transmission, distribution, or use of electrical power or energy in the Province of Ontario, in connection with any electrical installation or wiring for electric light, heat, or power, where the electric pressure delivered to or from the same exceeds 10 volts, manufacturers of, jobbers, agents, and dealers in, electrical machinery, apparatus, appliances, devices, material, and equipment, and others interested are hereby notified that the Commission orders that, on and after three months from date of this notice, no such electrical machinery, apparatus, appliances, devices, material, or equipment used or to be used as above may be used, offered for sale, or disposed of in the Province of Ontario unless and until the design and construction of same has been submitted to the Hydro-Electric Power Commission of Ontario and approval of such has formally been obtained.

(This notice was published in Ontario on January 17th, 1918.)

While any device designed to operate on a circuit of over 10 volts comes within the jurisdiction of the Approval Laboratory, the work of approval testing has been confined chiefly to devices rated at 600 volts or less; special attention being given to those classes of appliances which are sold to the public for unrestricted use.

The following incomplete list will indicate the diversity of devices and materials which have been submitted for approval and tested in the Laboratory:—

Wires for electric ranges, earthing clamps, conduit and conduit fittings, enclosed motor starting switches, switch boxes, electric signs, cabinets and cut-out boxes, panel boards, high-frequency generators, electrically operated pumps, rectifiers, sockets, receptacles, lamp shades, lamp fixtures and fittings, wire connectors, air heaters, pressing irons, automobile heaters, cooking appliances such as ranges, toasters, and grills, elevator switches, farm lighting plants, oil-break switches, plug and cartridge fuses (renewable and non-renewable), current taps, cut-out bases, rosettes, bell-ringing transformers, electrical soldering tools, soldering lugs, insulating devices, outlet bushings and fittings, auto-starters, washing machines, oil and gasoline pumping outfits, elevator controllers.

Method of Procedure.—It is incumbent upon the manufacturer to obtain approval of the design and construction of his product before offering it for sale in Ontario. To obtain this approval, the device in question is sent to the laboratories accompanied by a formal application to the Commission. The necessary tests are then carried out, and the manufacturer is advised of the changes, if any, which are necessary to bring the device up to standard. It is sometimes necessary to submit two or more samples before one is produced which is in accord with the requirements. When a device has finally been constructed which is considered by the Laboratory to be free from fire and accident hazard, a report is prepared describing in detail the construction of the device, the tests which were made upon it, and a recommendation that it be approved.

Approvals Committee.—This report is submitted to each member of a committee composed of representatives of the Hydro-Electric Power Commission, the electrical manufacturers, dealers, jobbers, and professional societies, and the fire underwriters.

The personnel of this committee is as follows:—

W. F. Dobson, chairman; A. S. L. Barnes, secretary; W. C. Cale, Approval Laboratory; Wills Maclachlan, L. G. Ireland, R. T. Jeffery, E. M. Wood, J. F. S. Madden, Hydro-Electric Power Commission; A. G. Hall, Electrical Inspection Department, Hydro-Electric Power Commission, J. A. McKay, representing Canadian Association of Manufacturers of Electrical Supplies; C. E. Schwenger, representing Association of Municipal Electrical Utilities of Ontario; O. V. Anderson, representing Canadian Electrical Association; S. A. Gaskell, representing Canadian Association of British Manufacturers and British Electrical and Allied Manufacturers' Association; C. H. Carlisle, representing Canadian Manufacturers' Association; Joseph Rogers, representing Canadian Electrical Supply Jobbers' Association; K. A. McIntyre, representing Ontario Association of Electrical Dealers and Contractors; F. R. Ewart, representing Toronto Section, American Institute of Electrical Engineers; William Taylor, representing Associated Boards of Trade of Ontario; R. Driscoll, representing Canadian Fire Underwriters' Association.

Each member of this committee is asked to read the laboratory reports and signify his approval or disapproval. When agreement among the members of the committee has been reached, the report is presented to the Commission with the recommendation that the device in question be approved for use in Ontario.

When the recommendation has been sanctioned by the Commission the manufacturer is so advised, and an "approval number" is issued, which serves to identify the particular device or line of devices approved. A card index of approved devices is distributed to the district inspectors of the Commission, and to others interested. This forms a continuous record for the use of the inspectors, and contains sufficient information to enable them to identify any approved device which may be brought to their notice.

Re-examination.—When a device has been approved, the manufacturer enters into an agreement with the Commission to manufacture all future devices in exact duplicate of the sample approved. The Commission agrees to allow its name to be placed upon the device, together with the approval number mentioned above, thus signifying that it has passed the necessary tests. This is usually accomplished by placing on the name plate the abbreviation "H.E.P.C. App. No. —." On certain devices, such as enclosed switches, cabinets, conduit, fuses, &c., labels are used. These are furnished by the Commission, and are affixed by the manufacturer.

In order to keep a check on the quality of the product of any factory, periodic tests are made in the laboratory on samples selected in the factory or purchased in the open market. A representative of the Laboratory also visits the manufacturers to examine their product and render them assistance in any matter relating to approval.

By this means it is possible to keep a continuous check upon the various classes of electrical devices and to detect cases of hazardous construction.

Although the majority of the manufacturers making use of the Laboratory are located in Ontario, its services have been made use of by other Canadian manufacturers and by a considerable number of American manufacturers, whose goods have not been submitted for approval to Underwriters' Laboratories. Many of these manufacturers, however, have obtained the underwriters' approval, and in such cases their goods are listed in the records of the Commission upon payment of the cost of listing, provided they also conform to the requirements of the inspection department. It is necessary, however, that all such goods be so listed before being distributed in Ontario.

Standards.—All tests on devices and materials submitted are made with reference to standards where such exist. These are specifications of the various features of construction considered necessary to minimise fire and accident hazard, and of the tests necessary to determine how the specifications have been complied with. The standards in general use in America are those based upon the National Code of the United States prepared by the National Board of Fire Underwriters, in co-operation with electrical manufacturers, inspection authorities, and other interested bodies. These follow standards of construction and wiring in use in the United States and generally adopted throughout Canada.

The standards adopted by the Commission at the inception of the work agree in all essential details with those of the Underwriters' Laboratories in so far as they relate to the fire hazard, but conform to the rules and regulations of the Commission for inside electrical installations where these differ from the National Electrical Code. These differences deal chiefly with the elimination of danger to persons from shock, a feature of inspection which until recently has not been emphasised by the underwriters.

The preparation of standards must of necessity lag somewhat behind the progress of manufacture, hence, standards are not yet available covering all classes of devices on the market.

Standards for the following materials and devices have been promulgated by the Commission: Rubber-covered wire and cable, armoured cords and cable, cartridge enclosed fuses, snap switches, cabinets and cut-out boxes, electric signs, panel boards, knife switches, cut-out bases, soldering lugs, flexible cords, ground clamps.

These standards specify in detail the various features which are considered worthy of attention from the viewpoint of safe construction, such as clearance between live parts and ground and between points of opposite polarity, thickness of metal, current density, &c. They also specify dimensions of various devices such as fuses, cut-out bases, screw shells, &c. Many devices are submitted for approval, however, for which no specific standards exist. Consequently the Commission has, with the co-operation of the manufacturer and other interested parties, prepared standards for certain classes of materials and devices, as such were found necessary. Those prepared to date are: Electric washing machines, enclosed switches, electric ranges.

Much assistance is rendered the Laboratory by the Inspection Department in reporting cases of sub-standard construction, and in obtaining market samples for laboratory examination. The various organisations represented on the Approvals Committee also co-operate in the criticism of laboratory reports and, in particular, the Canadian Associated Manufacturers of Electrical Supplies in the work of preparing standards.

The importance of the approval testing work need not be emphasised. There are several self-evident facts, however, the full significance of which may not be universally realised, even by the electrical fraternity. The approval testing has been referred to as supplementary to field inspection. It is in reality of fundamental importance to the latter, since safe methods of installation are of no avail without properly constructed appliances and materials. The importance of the work to the safety of the public and of property cannot be over emphasised. The fire loss from electrical causes is still large. The danger to life even in low-voltage appliances has not been wholly removed. Consequently continued vigilance in the construction of materials and appliances is an essential feature contributing towards safety in the use of electricity. The growth in the use of electricity by the public at large will depend on safe construction of appliances as much as upon economy and convenience. It is therefore incumbent upon all who are interested in furthering the use of electricity to co-operate in the maintenance of safe standards of construction.

THE LONG-DISTANCE TELEPHONE SYSTEM OF THE UNITED KINGDOM.

Discussion at Manchester.

Members of the North-Western Centre of the Institution of Electrical Engineers discussed Sir W. Noble's paper on the above subject, which was abstracted in our issue of April 1st, on March 22nd, when Mr. J. Frith presided and Mr. A. D. Hart deputised for Sir W. Noble.

Mr. W. J. **Medlyn** said that the author had compared gutta-percha insulated conductors and the newer paper-insulated lead-covered cables from the point of view of efficiency in speech transmission, but another point of very great importance was the cost. Apart from the additional duct space required, the average cost per line in the older type of cable was so great that its extensive use would have been a heavy financial burden tending to retard the natural development of the service.

Regarding traffic development since the trunk lines were taken over by the Post Office in 1896, the first record showed that during the year ending March 31st, 1898, there were 5,888,274 trunk calls; eight years later that number had increased to 18 millions, and by 1913 the latter figure was doubled, making 36 millions, whilst the latest published statistics for March, 1915, showed that the total had risen to 40,587,833, and provision was being made for a big increase on the last-mentioned total during the next few years. A complete network of cables already existed between all the South Lancashire towns, including Manchester and Liverpool, and extending north as far as Preston and Burnley, and also into Yorkshire. They had faith in the development of the system, because they knew that substantial progress in overtaking the arrears had already been achieved. One of the most important improvements was the increase in facilities for intercommunication between the main centres of industry, and in most cases a call originating in Manchester could now be put through almost on demand to the principal towns in South and Mid-Lancashire. There were now 132 lines working in existing cables between Manchester and Liverpool, and a new cable carrying 160 additional lines was nearly completed; the work of laying a new cable between Manchester and Oldham was also well advanced, and additional lines between Manchester and London would be available in the course of a few months, and a repeater station in Manchester would work in connection with that cable. Other extensions were in hand which would relieve them of the anxiety of maintaining the service and would give a more stable, secure, and regular service.

Mr. T. E. Herbert thought that the development of the work of cable balancing initiated by Messrs. Tremain and Martin to its present-day form constituted a most remarkable achievement. It was a source of wonder that such delicate tests of such extreme accuracy were made on the roadside by means of the specially equipped motor van. The details of the apparatus, together with an account of the principles involved and detailed instructions for the organisation of such work, would shortly be available. The completion of the vast schemes necessary to obtain the full benefit of all the work done necessarily took time. The supplies of raw materials and their conversion into lines and apparatus had thrown a huge burden on the manufacturers, and in Lancashire it was not difficult to appreciate what they had and were doing to provide the requisite supplies. For obvious reasons the precise financial effect of the various developments sketched in the paper had not been dealt with, but that aspect of the subject was constantly under review, and the economies effected were as remarkable as the scientific achievements. The thermionic valve appeared to have solved most of their problems, but they were only at the beginning of its development, and possibly the receiver microphone relay might have to be rescued from the scrap heap to enable trunk circuits to be separated electrically from the lines of varying length to which necessarily they had to be extended. A number of problems resolved themselves into questions of economics, and there were many cases where it was cheaper to provide extra lines or lines of heavier gauge than to provide the auxiliary apparatus necessary with lesser line plant. At the moment such remarks applied to the carrier or wired-wireless system. In its present stage of development it had several limitations, but in future it would be possible to do for the proverbial shilling what would now cost half-a-crown.

Mr. G. S. Wallace said that the first part of the paper provided an opportunity for those concerned with the manufacture of telephone and telegraph cable to voice their views on the problems that had been put to them by the Post Office authorities during the past few years. They were concerned not only with the electrical properties of the cable, but also with its size and mechanical strength, and the cost of special machinery for handling a non-standard type of cable must in certain cases be very heavy. Had the time yet arrived when cable could be manufactured and balanced in the factory on more standard lines than it was at present? Up to a few years ago the difficulty had been to obtain any commercial speech transmission on ordinary standard telephone cable of over forty or fifty miles in length, irrespective of cost, but sooner or later the cost per circuit in the cable itself would be a vital factor. Cable of different designs might give equally satisfactory results in practice, and the cost of manufacture would be reduced and the rate of delivery accelerated the more the principle of standardisation could be adopted.

Mr. T. Plummer referred to fault localisation on long-distance cables as being a very important matter; he had been a sceptic regarding the ability to find those faults, but he now bore testimony that it was possible to do it by the new system of testing. For example, on the cable from Birmingham to Liverpool, by tests at intermediate points made simultaneously, it was possible to locate faults down to a distance of, perhaps, 100 yards. That was a remarkable achievement when it was borne in mind that the faults they were looking for were ones which, on an insulation loss of thousands of megohms per mile, did not amount to a thousand megohms per mile. In those balanced cables the insulation had to be so perfect that it was regarded as being faulty when the insulation resistance fell to 3,000 or 4,000 megohms per mile. The speaker bore witness to the very good working of those cables; they required practically no attention, and one man was able to look after quite a large number of them—a very important point in connection with maintenance. The maintenance cost of the repeater was extremely small. No reference was made in the paper to the ringing arrangement, which was far more difficult to repeat than the speech.

Mr. T. E. Stretch hoped that the paper would not have the result that every time they ran a pair of wires into a rural district the local people would expect the line to be underground.

Mr. A. E. Banks thought it significant that each step towards improved speech transmission and extended means of communication had been accompanied by increased volume of traffic, a sure indication (if indeed any were required) that a definite field existed for still greater development in those directions. Regarding signalling, the method of applying a vibrating reed so as to produce currents of a frequency suitable for transmission by repeaters appeared to be promising.

Mr. J. M. Jackson touched upon maintenance of the underground work; underground cables would break down just as overhead wires did, though not so frequently, and a tribute ought to be paid to the Post Office research engineers for the very good work they had done in devising a system of localising higher resistance faults.

Mr. L. H. Crane, referring to the proposal for a cross-country overhead system on steel towers and the special way-leave powers, if any, that were contemplated in connection therewith, presumed that a special Act of Parliament would be required after the lines of the Acts required for the construction of railways, as the present powers of the Post Office would be quite inadequate. In the repeater circuit, fig. 8, he understood that the up side could not speak at the same time as the down side. If that was correct, would it not in practice lead to trouble in cutting off through both ends endeavouring to speak at the same time? From the size of the filament batteries he understood that the valves were in circuit with the battery permanently, or at least during the day time. Was it not possible to arrange the circuits so that the valves were only in circuit when required, namely, when the line was connected at both ends by either operator or subscriber? Suitable relays could be designed for connecting in the balancing circuit of the repeater shown in fig. 2 to effect that purpose which would also enable automatic calling and clearing signals to be arranged for. Perhaps some form of polarised relay might solve that problem.

Mr. C. E. Morgan understood the application of the four-wire repeater circuit was limited to circuits in the region of 200 miles in length. In connection with the two-wire repeater circuit they could not have a main greater than a cable equivalent to 12. In a number of cases there was a demand in the neighbourhood of 7, 8 or 9, which seemed to mean keeping up the overhead lines.

Mr. A. D. Hart, in replying to the discussion, explained that Sir William Noble's difficulty in drafting the paper was to keep it within reasonable limits. If he had started out to deal with fault localisation, that section alone would have been as big as the paper itself, and a long paper would have been necessary to explain the ringing arrangement. Also Sir William had in mind the fact that those subjects were dealt with in the professional papers of the Institution of Post Office Engineers. The tests made between London and Liverpool were made with a cable which did not contain screened conductors; the cable was of quad formation for some distance out of London and then dropped into twin formation. The multiple twin which they now used was a later development, and another type which had fallen out of use was that known as the quad pair. Martin and Tremain did continue their tests on screened conductors, but not in connection with that cable. There was no difficulty whatever in working valves in series for telephone-repeater working, but the limit was in the cable. The fact that they had to crowd so many conductors into a telephone cable meant that the mutual interference between the neighbouring circuits was a measurable quantity. If they pushed up the amplification for the repeater by adding valves in series, then they increased the mutual interference. Two valves in series were sufficient to give much more than could safely be put into the telephone cable, *i.e.*, in practice the repeaters could be spaced out on an underground cable to about 60 miles apart, sometimes 70. If they were taken beyond that distance the attenuation would be so great that the amplification that would be necessary at the repeater would give serious trouble. Probably the minimum distance over which the four-wire repeater circuit would be used might be four or five miles. For trunk circuits it was rather difficult to give a minimum distance, but certainly with the two-wire repeater, which would be used on the London-Manchester cable, they could cover most of the requirements, because if they could ensure a standard in that current, say, 12 miles corresponding to a reduction ratio between the sending and receiving currents of about 4 to 1, they would be getting a quality of conversation very much better than they could get on many of the circuits at the present time. The current taken by the valve now in use (a sample of which was exhibited) was 0.8 A, and the power expended in the filament was roughly 4 W, which gave an electron emission of about 10 amperes. That gave all they required. They would like a filament that would give that same electron emission for a less expenditure of energy, but the low-wattage valves they had tested up to the present were not entirely suitable for telephone-repeater work. It was absolutely essential that the grid voltage-plate current curve of a valve for telephonic repeater purposes should be an absolutely straight line. The switching-on of valves only when they were wanted obviously meant a complication of relays. They were aware of the necessity for transmitting ringing currents, signalling, calling, and so forth, but the first essential was that they should transmit speech, and any addition to those circuits of automatic means of calling and so on meant complication. A further development, the details of which would be published shortly, was a method of signalling for groups of repeater circuits automatically by means of a device which was familiar to telegraph engineers. Suppose ten circuits between two points which they could not afford to supply with signalling arrangements; they could put a multiplex distributor on the tenth circuit and let it distribute ringing current to each of the others. Manchester was to be a telephone-repeater station, and a very important one apparently because it was a sort of focus for all the long-distance lines in that part of the country, and the Manchester repeater station would grow as the underground cables increased. The speaker did not agree that the microphone repeater might have to be resuscitated.

Radium.—*The Times* states that over £500,000 has been raised in Denmark by a national fund for the purchase of radium.

JAPANESE HYDRO-ELECTRIC AND ELECTRICAL MANUFACTURING WORKS.

Two noteworthy articles dealing with the remarkable progress made in recent years in Japan in the utilisation of water power and in the manufacture of electrical machinery and apparatus were published in the Japanese section of the *Times Trade Supplement* on April 16th, 1921. The following abstracts of the articles, which have been written by Mr. R. Torikai, Professor of Electrical Engineering at the Imperial University of Tokio, will no doubt be read with interest by those who have not perused the originals in our contemporary:—

The Hydroelectric Works.

At the outset the author recalls the fact that Japan is a very narrow and mountainous country. A chain of lofty mountains extending along the whole length of the islands forms a high central axis, on both sides of which hundreds of rivers rush down to the sea. The great difference between the uplands and the plain and the relatively short distance between the mountains and the coast render these rivers swift and unsuitable for navigation. But this physical configuration has a practical advantage as it has endowed Japan with abundant water power resources. The investigations made by the Department of Communications, which controls the supply of electricity, indicate that the islands possess sufficient water power to generate 5,000,000 h.p., and concession rights have so far been granted for 1,000,000 h.p. Applicants for rights have to obtain permission from the Department of Communication and the Department for Home Affairs before they are able to take practical steps in the direction of utilising any water powers, and failure to begin operations within a specified period involves the cancellation of the permit.

The first generating station was established 30 years ago by the City of Tokio, which erected the Sosui Works. A waterway, divided partly into canals and partly into tunnels, was constructed from Lake Biwa to the city. The works was modelled according to the American system in use at that period, and was equipped with alternating current generators at 133 cycles. This station was continued in use until 1912, when the city constructed a modern station of a capacity of 6,000 kW. After the completion of the former the use of hydro-electricity gradually extended all over Japan, and since 1910 a large number of hydro-electric works, with an average capacity of 10,000 kW, have been erected. Not only so, but the high price of coal and the general industrial progress of the country have recently imparted a further impetus to the development of hydro-electric works.

Although the hydro-electric works in size and equipment are not comparable with those in various countries in Europe and America, the professor states that the natural features of the country and the progress already made indicate that hydro-electricity has a great future. Electricity is generated both by water power and from coal, is used for lighting and transport purposes and in chemical and other industries. Electric light is in almost universal use in Japan to-day, and even in small villages and in remote places in the heart of the mountains it is available to the inhabitants.

Coming to consider the generating works in existence, the author remarks that the loftiest mountains are situated in the centre of the country, where the district is known as the Japanese "Alps"; here and at some of the lakes is to be found the greatest head of water. Accordingly the large and typical electrical undertakings have naturally utilised these centres, and have concentrated on the supply of power to the two great industrial centres of Tokio and Osaka. In the case of the Ujikawa Electric Co., Lake Biwa is the source of water power. The capacity of the power house is 35,000 kW, three phase, at 11,000 volts and 60 cycles. This is stepped up to 55,000 volts and transmitted to Osaka, which is 20 miles distant, and is there reduced to 11,000 volts and distributed over the city by means of underground cables, which is the usual system of distribution in the large cities. The company, in conjunction with the Osaka Electric Company, which has an output capacity, generated from coal, nearly equal to the former, has been supplying most of the energy for Osaka. Owing, however, to the growth in the demand having exceeded the output capacity, the Ujikawa Company is now erecting a second station. But instead of providing long tunnels and canals for the conveyance of the water, the company is building a dam across the river Uji and thus raising the level of the water to a sufficient height to generate the necessary power.

The Ujikawa Co. and the Inawashiro Electric Co. are the two largest concerns in Japan. The Inawashiro is a volcanic lake in the north of Japan, and is the source of a river which flows towards the Wakamatsu Plains, the difference in level between the lake and the plains exceeding 1,000 ft. In order to utilise the potentialities of the site, the company proposes to erect four large power houses, two of which have already been completed and are supplying power to Tokio. The generating capacity of the first of the two stations is about 40,000 kW at 11,000 volts and 50 cycles. The voltage is raised to 111,000 and the current transmitted for a distance of 150 miles to Tokio by means of copper conductors on steel towers.

The two companies in question represent the hydro-electric undertakings in the western and eastern districts. Many other companies are also engaged in the business, and the names of five are mentioned as possessing power stations of over 10,000 kW, transmission lines over 50 miles long, and pressures of from 55,000 to 66,000 volts. In addition to these, many new schemes based on the utilisation of the power of the "Alps" have been prepared in order to meet the growing and unlimited demand for supply. In this connection the names of four companies are cited as having been constituted for affording a delivery to Tokio and two for the supply of Osaka. These schemes make provision for a considerable output, ranging from 60,000 kW in one case to 170,000 kW in a second and to 300,000 kW in each of two other projects, while the intended distance of transmission extends over 200 miles at pressures of 165,000 volts.

After referring to the technical error of two frequencies having been adopted of 50 and 60 cycles respectively, Prof. Torikai mentions the problem of the electrification of the railways and the organisation of the supply of power. All the tramway systems and inter-urban lines, he says, are at present operated by electricity, and the Railway Board, which manages the nationalised railways of Japan, has prepared plans for the conversion of the railways to electric traction, which are now before the Parliament.

The Manufacturing Works.

The second article by Prof. Torikai, treating of the Japanese as manufacturers, points out that there were only a few works of small size in the country before the year 1910. These were occupied with the production of the smaller types of machines, whilst almost all the electrical apparatus had to be obtained from other countries. But simultaneously with the growth in the use of electrical power there has been a steady advance in the manufacture of electrical apparatus. Nevertheless the productive capacity in dynamos and motors is still far below the requirements of domestic consumption, and as a consequence these continue to be imported on a large scale.

The author admits that, generally speaking, the electrical manufactures made in Japan do not stand comparison with the products of other countries, and he therefore thinks that the frequent criticism of the crudeness of these and other manufactures calls for some explanation. As a rule this defect is attributed to lack of scientific research. While agreeing that the same progress in research has not yet been made in Japan as in Europe and America, the professor does not consider that this alone accounts for the inferiority in question. In his opinion Japan has made sufficient advance in scientific investigation to meet her industrial requirements, and constant progress is being made in this direction. It has, however, to be borne in mind that Japan is a remote country which has been practically isolated for 2,000 years, and that until recent years the pursuit of business, trade and commerce was despised and regarded with contempt. One result of this isolation, combined with the obstacles of the language, is that Japanese students, in order to prepare themselves for scientific studies and research work, have to spend more than five years in learning foreign languages. It has also to be remembered that until about 50 years ago there were no Japanese workmen trained in modern industries; and all the skilled artisans of to-day have been trained during the past 30 years. On the other hand, their fellow workers in Europe and America have the benefit of generations of skilled training behind them. Under these circumstances the author ascribes the defects of some Japanese manufactures to this lack of experience.

Discussing in detail the manufacturing industry, Prof. Torikai states that at present there are 15 large works which are constructing dynamos of over 1,000 kW, the largest being the Shibaura, the Hitachi, the Mitsubishi, and the Okumara, which are capable of turning out the largest types of machines. Steam turbo-generators of 10,000 to 11,000 kW have been built by the Mitsubishi Co. All the water turbine generators for the Ujikawa Electric Co., each of 7,000 kW at 11,000 volts, and all the dynamos of about the same capacity for the second power station of the Inawashiro Electric Co., were supplied by the Shibaura Co. In other words, all the largest generators in use in Japan have been made by native firms. The Hitachi and Okumara works, which have also made a number of large machines, are also endeavouring to construct hydraulic turbines of moderate size, but this branch has not yet been fully developed.

It is apparent, the author remarks, that Japan is now self-reliant in the production of ordinary dynamos, but these machines are not very much cheaper than those imported from abroad, owing to the fact that Japan is not yet self-supporting in all essential materials, seeing that certain raw and semi-finished products have to be imported. Investigations, however, have recently been made into the question of the availability of domestic supplies of such materials.

The manufacturing works mentioned also produce practically all other electrical apparatus, such as electric railway material, heaters, domestic appliances, &c.; but only a few of the works manufacture electrical measuring instruments. No difficulties are encountered in the production of meters for switchboards and for general industrial purposes, but the industry is not yet able to construct the finer scientific instruments, where absolute accuracy is a *sine qua non*, such as electrometers, ampere balances, standard resistances, &c.

Prof. Torikai proceeds to remark that the manufacture of electric incandescent lamps has been thoroughly mastered, and all such requirements can now be met by native firms, but owing to patent rights, practically all the lamps are of the "Mazda" type. Some new lines of Japanese invention have recently appeared on the market, and their manufactnre will be gradually developed in the future. Besides insulators, which can be produced even for a 220,000-volt line, progress has been made with the production of conducting wires and cables, and the author says that in addition to being able to meet the whole of the demand in the home market, the four existing cable factories are also able to carry on an export trade.

ELECTRICAL IMPORTS AND EXPORTS OF JAPAN.

The following statement shows the import and export trade of Japan in 1919 in electrical and similar goods. For purposes of comparison, figures for 1918 have been added, together with a note of increases or decreases.

IMPORTS.

Country whence imported	1918 Yen	1919 Yen	Inc. or dec. Yen
Posts and materials for electric lines :—			
United States	16,000	151,000	+ 135,000
Insulated electric wire (metal armoured).—			
Total	7,000	71,000	+ 64,000
United States	5,000	3,000	– 2,000
United Kingdom	1,000	68,000	+ 67,000
Insulated electric wire, other.—			
United States	70,000	145,000	+ 75,000
Steam turbines.—			
Total	275,000	836,000	+ 561,000
United States	275,000	588,000	+ 313,000
Switzerland	—	152,000	+ 152,000
Gas engines, petroleum engines, and hot-air engines.—			
Total	505,000	966,000	+ 461,000
United Kingdom	—	38,000	+ 38,000
Sweden	15,000	160,000	+ 145,000
United States	480,000	757,000	+ 277,000
Kwantung Province	5,000	—	– 5,000
Steam engines.—			
Total	463,000	540,000	+ 77,000
United Kingdom	22,000	121,000	+ 99,000
United States	416,000	367,000	– 49,000
Kwantung Province	13,000	—	– 13,000
France	—	35,000	+ 35,000
Germany	3,000	—	– 3,000
Steam boilers and parts.—			
Total	7,535,000	8,335,000	+ 800,000
Kwantung Province	116,000	—	– 116,000
United Kingdom	1,285,000	2,636,000	+1,351,000
United States	6,015,000	5,626,000	– 389,000
Other countries	47,000	—	—
Dynamos, motors, transformers, &c.—			
Total	3,061,000	5,245,000	+2,184,000
Kwantung Province	17,000	10,000	– 7,000
United Kingdom	38,000	187,000	+ 149,000
Sweden	—	292,000	+ 292,000
United States	2,976,000	4,763,000	+1,787,000
Dynamos combined with motive machinery.—			
Total	485,000	736,000	+ 255,000
Kwantung Province	1,000	105,000	+ 104,000
Sweden	—	199,000	+ 199,000
United States	483,000	431,000	– 52,000
Telegraphic and telephonic instruments and parts.—			
Total	91,000	265,000	+ 174,000
United Kingdom	1,000	5,000	+ 4,000
France	1,000	8,000	+ 7,000
Denmark	14,000	3,000	– 11,000
United States	75,000	247,000	+ 172,000
Water turbines and Pelton wheels.—			
Total	82,000	1,787,000	+1,705,000
United Kingdom	—	637,000	+ 637,000
France	13,000	355,000	+ 342,000
Switzerland	32,000	778,000	+ 746,000
Sweden	4,000	—	—
United States	33,000	15,000	– 28,000
Incandescent electric lamps.—			
Total	44,000	72,000	+ 28,000
United Kingdom	4,000	1,000	– 3,000
United States	39,000	70,000	+ 31,000
Filaments for incandescent lamps.—			
Total	320,000	119,000	– 201,000
United Kingdom	107,000	15,000	– 92,000
France	7,000	13,000	+ 6,000
United States	202,000	89,000	– 113,000
Submarine telegraph or telephone cables.—			
United States	6,000	—	– 6,000
Wattmeters.—			
Total	460,000	519,000	+ 59,000
United Kingdom	23,000	6,000	– 17,000
Switzerland	201,000	198,000	– 3,000
United States	236,000	292,000	+ 56,000
France	—	21,000	+ 21,000
Ammeters and voltmeters.—			
Total	218,000	253,000	+ 35,000
United Kingdom	1,000	1,000	—
United States	217,000	250,000	+ 33,000
Accumulators.—			
Total	26,000	100,000	+ 74,000
United Kingdom	—	3,000	+ 3,000
Germany	4,000	—	– 4,000
United States	22,000	97,000	+ 75,000
Carbon for electrical use.—			
Total	275,000	682,000	+ 407,000
United Kingdom	20,000	50,000	+ 30,000
France	3,000	4,000	+ 1,000
United States	251,000	627,000	+ 376,000

EXPORTS.

Country to which exported	1918 Yen	1919 Yen	Inc. or dec. Yen
Electrical machinery and parts thereof.—			
Total	3,984,000	4,443,000	+ 459,000
China	1,005,000	1,409,000	+ 404,000
Kwantung Province	1,513,000	1,687,000	+ 174,000
Hong Kong	62,000	66,000	+ 4,000
British India	207,000	134,000	– 73,000
British S.S.	53,000	35,000	– 18,000
Dutch India	275,000	446,000	+ 171,000
French Indo-China	11,000	33,000	+ 22,000
Asiatic Russia	13,000	160,000	+ 147,000
Philippine Islands	34,000	43,000	+ 9,000
Siam	16,000	39,000	+ 23,000
United Kingdom	33,000	72,000	+ 39,000
France	245,000	39,000	– 206,000
United States	2,000	6,000	+ 4,000
Canada	10,000	5,000	– 5,000
Chile	20,000	17,000	– 3,000
Argentine	20,000	9,000	– 11,000
Egypt	28,000	7,000	– 21,000
Cape Colony and Natal	83,000	24,000	– 59,000
Australia	296,000	155,000	– 141,000
New Zealand	53,000	27,000	– 26,000
Peru	—	5,000	+ 5,000
Telephones and parts thereof.—			
Total	421,000	630,000	+ 209,000
China	182,000	143,000	– 39,000
Kwantung Province	172,000	218,000	+ 46,000
Hong Kong	4,000	1,000	– 3,000
British India	4,000	5,000	+ 1,000
Dutch India	42,000	36,000	– 6,000
Asiatic Russia	12,000	220,000	+ 208,000
Electric lamps.—			
Total	2,570,000	1,677,000	– 893,000
China	482,000	456,000	– 26,000
Kwantung Province	242,000	196,000	– 46,000
Hong Kong	157,000	145,000	– 12,000
British India	267,000	39,000	– 228,000
British S.S.	25,000	17,000	– 8,000
Dutch India	108,000	39,000	– 69,000
French Indo-China	31,000	19,000	– 12,000
Asiatic Russia	37,000	60,000	+ 23,000
Siam	51,000	23,000	– 28,000
United Kingdom	143,000	3,000	– 140,000
France	135,000	11,000	– 124,000
Italy	61,000	65,000	+ 4,000
United States	53,000	351,000	+ 298,000
Canada	239,000	54,000	– 185,000
Peru	18,000	13,000	– 5,000
Chile	15,000	20,000	+ 2,000
Argentine	17,000	1,000	– 14,000
Brazil	1,000	1,000	– 16,000
Egypt	55,000	26,000	– 29,000
Cape Colony and Natal	28,000	9,000	– 19,000
Australia	379,000	66,000	– 313,000
New Zealand	11,000	10,000	– 1,000
Philippine Islands	7,000	34,000	+ 27,000

Country to which exported	1918 Yen	1919 Yen	Inc. or dec. Yen
Electric insulated wire.—			
Total	8,324,000	8,411,000	+ 87,000
China	1,312,000	1,445,000	+ 133,000
Kwantung Province ...	622,000	1,444,000	+ 822,000
Hong Kong	173,000	203,000	+ 30,000
British Indies	1,349,000	195,000	– 1,154,000
British S.S.	119,000	135,000	+ 16,000
Dutch India	1,025,000	1,660,000	+ 635,000
French Indo-China ...	40,000	51,000	+ 11,000
Asiatic Russia	70,000	906,000	+ 836,000
Philippine Islands ...	44,000	23,000	– 21,000
Siam	44,000	96,000	+ 52,000
United Kingdom	63,000	—	– 63,000
France	10,000	—	– 10,000
United States	7,000	6,000	– 1,000
Peru	13,000	110,000	+ 97,000
Chile	86,000	111,000	+ 25,000
Argentine	305,000	367,000	+ 62,000
Brazil	—	14,000	+ 14,000
Egypt	107,000	20,000	– 87,000
Cape Colony and Natal ...	214,000	132,000	– 82,000
Australia	2,485,000	1,315,000	– 1,170,000
New Zealand	231,000	141,000	– 90,000

Yen = 2s. 0½d.

THE FARADAY SOCIETY.

I.—The Electrolytic Recovery of Zinc.

At the March meeting of the Faraday Society, after the delivery by Prof. Porter of the Presidential Address (reported in our issue of April 8th, p. 439), a discussion took place, based on an exhaustive paper presented by Mr. S. Field, on the electrolytic process for the recovery of zinc from its ores. Abroad, notably in America and Tasmania, the process has already to a considerable extent displaced the old distillation method. Thus at Anaconda the plant in operation has a capacity of 100 tons a day, and that at Trail in British Columbia 40 tons a day. At Risdon, in Tasmania, a 10-ton a day plant is in operation, while extensions up to 100 tons a day are being rapidly pushed forward. It is clear, therefore, that the technical difficulties associated with the method have been surmounted, and the superiority of the product over distilled zinc (it reaches a 99.95 per cent. grade) being quite unquestionable, the matter of its applicability in any country becomes essentially an economic one. Not entirely economic, however, for there is a question of broad national policy involved, and it will be recalled that during the war our dependence upon oversea supplies of spelter was a matter which gravely affected the national security. During the past five years the average annual production of zinc in Great Britain has been 50,000 tons, against a consumption of 150,000, although at present it has probably fallen to some 20,000 tons. This fall Mr. Field ascribes mainly to the approaching exhaustion of the supplies of the high-grade ores required by the distillation process, and he puts forward the thesis that the industry can be saved for the country by the introduction of the electrolytic method which can be applied to the treatment of the low-grade and complex ores still plentiful in Cornwall, Scotland, and elsewhere. The contention stands or falls depending on the cost of electrical energy. Now, the process described by Mr. Field consumes 3,200 kWh per ton of cathode zinc for the deposition and some 800 for subsidiary purposes, 4,000 units per ton in all. The author was of opinion that steam-generated energy from low-grade fuel on the scale required for a 10 ton a day plant can be sold for .35d. a unit and for .32d. on a 20 ton basis. Taking the figure at one-third of a penny, we arrive at £5 11s. per ton of cathode metal, a figure which, if substantiated, makes the process a possible one in this country. The discussion naturally turned round this question of price of electrical energy, but it did not go very far. The matter is admittedly in a state of flux at the moment. As Mr. W. R. Cooper pointed out, the advocates of the process should stir up the Electricity Commissioners. They certainly should, if the experience quoted by Mr. H. M. Ridge—himself an experienced worker in this field—be typical. Mr. Ridge, even before the war, was unable to contract for the supply of electricity in bulk for electrochemical purposes for less than 85s. per h.p.-year, and that figure would now have to be doubled. On the other hand, the Tasmanian electrolytic zinc industry was obtaining electricity for 40s. or 45s. per h.p.-year. Mr. Donald F. Campbell thought that Mr. Field's figures were not impossible of achievement, for the pre-war cost of generating power with gas from coke ovens or waste colliery products was about .33d. The electrolytic process was exceptionally favourable to the generating station in that both load factor and power factor were high. Whether the process was possible here depended on the price of coal; that it would in time displace distillation was extremely probable when it was remembered that the old process demanded 5 tons of coal to produce 1 ton of zinc, and that the advantages as regards labour and purity of product were all with electrolysis.

We proceed to the consideration of the process itself. Briefly described, this consists in calcining sulphide ores to render the zinc soluble in dilute sulphuric acid, by which it is extracted as zinc sulphate. The sulphate solution is purified and then electrolysed with insoluble anodes. The zinc is deposited in an easily detachable form, and it is finally melted down into ingots. The spent electrolyte, rich in free sulphuric acid, is used for leaching a fresh supply of calcined ore. It contains some 3 per cent. zinc and 10.5 per cent. free acid.

It is clear that the essential features of the process are the purification of the electrolyte and the subsequent electrolysis, and the success of the latter depends almost entirely on the degree to which deleterious impurities have been removed from the electrolyte. These impurities are: (1) iron, arsenic, antimony, and cobalt, which are removed by oxidising agents such as air, ozone, lead, and manganese dioxide; (2) copper, cadmium, and nickel, which are removed by means of zinc dust, the presence of a small amount of mercury as sulphate helping the removal of these metals and ensuring complete removal of the cobalt. In the paper Mr. Field discusses the methods of purification in some detail, and these deserve close study. At the meeting he showed in a striking fashion the harmful results on the deposited zinc of anything more than some five parts of cobalt and 0.2 part of nickel per 1,000,000.. These metals, in fact, are the impurities most commonly met with, and the most insidious. It was not until this fact was realised and methods devised for their almost complete elimination that electrolytic zinc extraction became practicable. Both cobalt and nickel accumulate in the solution and act corrosively, but with a curiously marked difference. The former promotes the formation of pinholes that penetrate the thickness of the deposit, which then quickly dissolves from the back in contact with the cathode. The effect of nickel is to engender small holes which widen, and ultimately a deep and sharp hole is cut clean through the zinc deposits. Both effects are most curious and interesting.

The neutral purified solution of zinc sulphate is acidified until it contains 3 per cent. free sulphuric acid and 8 per cent. metallic zinc, and it is then electrolysed, using lead anodes and aluminium cathodes. The current maintains the desired optimum temperature of 40-45 deg. C. Each cell, at that temperature, absorbs 3.35 volts and gives a current efficiency of 90 per cent. A series of cells is arranged in cascade, the solution flowing from one to the next. Electrolysis is allowed to continue until the acidity rises from 3 to 10.5 per cent., and the zinc content falls from 8 to 3 per cent. An inspection of the accompanying current-efficiency curve makes it clear why these limits of acidity are chosen, and no further comment is necessary. The diagram also shows that the average energy consumption is some 3,200 kWh per ton of zinc deposited.

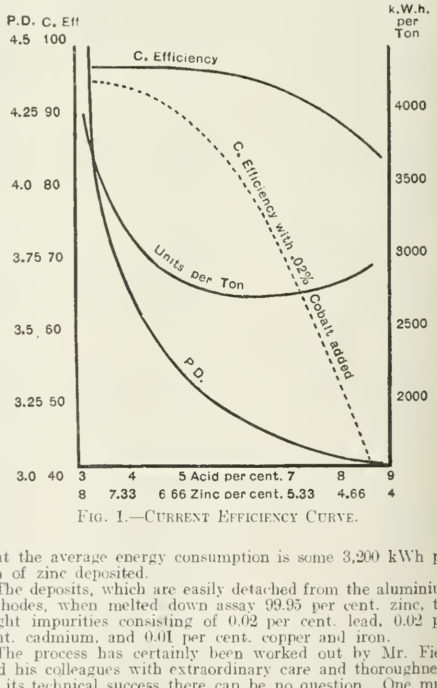


Fig. 1.—Current Efficiency Curve.

The deposits, which are easily detached from the aluminium cathodes, when melted down assay 99.95 per cent. zinc, the slight impurities consisting of 0.02 per cent. lead, 0.02 per cent. cadmium, and 0.01 per cent. copper and iron.

The process has certainly been worked out by Mr. Field and his colleagues with extraordinary care and thoroughness. Of its technical success there can be no question. One must hope that the zinc market and the availability of sufficiently cheap energy will, when times become more stabilised, enable the electrolytic process to compete on fair terms with zinc smelting abroad so that this country may become assured of a home zinc industry producing the metal from native ores.

II.—Electrolytic Iron.

A paper presented by Mr. W. E. **Hughes** gave the results of a study of the crystalline forms of electro-deposited iron and the effect of acid upon its structure. The experiments described dealt with deposits obtained from a ferrous chloride bath containing calcium chloride, and it was found that structurally they fall into two types, *normal* or *fibrous*, depending on the conditions prevailing. A close connection between the macroscopic and microscopic features of the deposits was observed, thus enabling an operator to form an opinion as to the internal structure of his deposits from their external features. Thus, (*a*) a very close-grained, matt, and, so far as the unaided eye can see, non-crystalline exterior connotes a fibrous interior; while (*b*) a crystalline external appearance is the mark of a coarse grained internal structure —one that approaches more or less closely to the normal type. (c) A bright metallic appearance indicates that the internal structure is of such fine grain that it is visible at higher magnification only.

The conditions which determine the class of deposit were generalised by the author as follows:—

1. Acidity causes the deposit to possess a fibrous structure; excess of acid causes the structure to be of extremely fine grain.

2. As the acid diminishes in concentration the structure of the deposit changes from the fibrous to the normal type.

3. Undisturbed deposition results in a structure that becomes coarser and coarser in grain size as the deposition continues. This increasing coarseness is marked, macroscopically, by an increase in the size of the crystals on the surface of the deposit.

III.—The Electrolytic Reduction of Glucose.

Prof. **Alexander Findlay** and Mr. **V. H. Williams** presented a note on "The Electrolytic Reduction of Glucose." Previous work on this subject has yielded conflicting results, and the authors have, therefore, made a careful study of the reduction under varying conditions of temperature, current density, and current concentration, using both graphite and pure lead electrodes. The reduction of glucose to the corresponding hexahydric alcohol is in itself a process of importance, but so far as the electrolytic method is concerned negative results were obtained. It is suggested that the production of formic acid and a pentose interfered with the production of the alcohol.

NORTH WALES AND CHESTER ELECTRICITY DISTRICT.

We have received the following communication from the Electricity Commission:—

The Electricity Commissioners having considered the evidence submitted at the recent inquiry at Llandudno into the two schemes submitted respectively by the Corporation of Chester and by the North Wales Power & Traction Co., Ltd. (hereinafter called "the company"), have arrived at the following conclusions:—

1. The area provisionally determined received general assent except in respect of certain districts on the eastern side of the area.

The Electricity Commissioners have decided to confirm the boundaries of the district as provisionally determined, subject to the inclusion of the Municipal Borough of Congleton, the urban districts of Alsager and Sandbach, and the rural district of Congleton, and to the exclusion of the urban districts of Northwich, Middleswich, and Winsford, and the rural district of Northwich.

2. The scheme promoted by the Corporation of Chester contains proposals for (*a*) the development of a series of low-fall water power stations (without storage) on the river Dee between Llangollen and Erbistock; (*b*) the establishment of a new steam generating station on the Dee estuary; (*c*) the temporary utilisation of supply from H.M. factory, Queensferry; (*d*) the establishment of a small water power station in the Vale of Clwyd; and (*e*) ultimate co-operation with the company for a large supply from their hydro-electric system.

From the evidence submitted to them, the Commissioners have come to the conclusion that the engineering proposals in this scheme cannot be approved, inasmuch as (*a*) it would be impracticable at the present time to develop low-fall water-power stations on the river Dee; and in any event, such development would have necessitated a stand-by steam plant for ensuring reliability of the supply; (*b*) the erection of a coal-fired station on the Dee estuary is unnecessary, and the cost of generation at such a station would compare unfavourably with that of a supply from the North Wales hydro-electric system; (*c*) no definite proposals are included for the full development of the water-power resources of the western part of the district.

Moreover, the scheme, which provides for the establishment of a Joint Electricity Authority consisting of representatives of local authorities and bodies prepared to accept financial responsibility, failed to secure adequate public support.

The Commissioners consider that a supply from H.M. factory, Queensferry, should be utilised temporarily. The information given with regard to the development in the Vale of Clwyd was insufficient to warrant a favourable opinion, although the Commissioners recognise that this small water power may hereafter be utilised.

3. The scheme promoted by the company provides for the utilisation of the water power resources of the western area by the improvement of Cwm Dyli, the further development of Dolgarrog, and a new and extensive development at Maentwrog.

The Commissioners are satisfied that the engineering developments at Cwm Dyli and Dolgarrog are sound. Comparisons with independent and earlier reports have also established the soundness of the proposed first development at Maentwrog, while an examination of the scheme for the second development has reasonably satisfied the Commissioners of its feasibility.

Subject to the Commissioners being satisfied that the agreement between the company and the Aluminium Corporation, Ltd., who own the Dolgarrog works will be such as to safeguard the power supply therefrom, the Commissioners have decided to accept the engineering proposals of the company's scheme. The adoption of this scheme will, in their opinion, ensure an ample supply of electricity to meet the requirements of North Wales with a sufficient surplus for distribution at commercial rates to districts outside North Wales. Such an additional outlet will enable the full economic development of the available water power to be undertaken.

The acceptance of the scheme by the Commissioners will be subject to (i) the company obtaining any further statutory powers which may be necessary; (ii) the company satisfying the Commissioners as to their ability to raise the capital required; and (iii) a consideration of the amount payable by the company in respect of back dividends.

The Commissioners are satisfied that the provisions of Sections 43 and 45 of the North Wales Electric Power Act, 1904, for the revision of maximum prices and of the relation between price and dividend sufficiently safeguard the public.

4. A Joint Electricity Authority is necessary for the district for the purpose of local supervision in the public interests over the development and co-ordination of the supply of electricity, more particularly as important natural sources of power are being utilised. Having regard, however, to the local circumstances, the best interests of the district would be served by the delegation or transfer by the Joint Electricity Authority to the company of its powers of supply with certain exceptions.

The Electricity Commissioners have accordingly decided to prepare a draft order providing for the establishment of a Joint Electricity Authority for the district defined in paragraph 1.

(i) In settling the representation on the Joint Electricity Authority, the Commissioners will give due consideration to the proposals embodied in the scheme submitted by the Chester Corporation, and to the representations made by various local authorities, but they will have regard to the necessity for constituting a body which will not be too large to be efficient.

(ii) The order will provide for the delegation or transfer to the company, by deed to be approved by the Commissioners, of such of the powers of the Joint Electricity Authority as the Commissioners may determine.

The intention of the Commissioners is that while the supply of energy in bulk throughout the whole district shall be in the hands of the company, such powers shall be reserved to the Joint Electricity Authority as will enable it to facilitate the development and co-ordination of supply by the company and other authorised undertakers in the area, and in particular to control the development of distribution in all present unoccupied areas (subject to the existing right of local authorities or companies to apply for special orders to establish local distribution undertakings); to supervise generally the exercise by the company of such of the powers of the Joint Electricity Authority as may be delegated or transferred to the company; and to advise the Commissioners on matters affecting the supply in the district.

(iii) The order will embody the outlines of the technical scheme to be undertaken by the company, but will provide that modifications thereof may be made with the approval of the Commissioners.

(iv) The order will require the Joint Electricity Authority to submit within a period of two years from the date of its formation proposals for securing a supply in unoccupied areas where there is a reasonable prospect of such supply being remunerative.

(v) The order will not impose upon the Joint Electricity Authority any financial responsibility other than its own administrative expenses, which will be met by contributions from each of the interests represented on the Authority.

Pending the establishment of the Joint Electricity Authority, the Commissioners will ask the parties concerned to form a small provisional committee, with whom the Commissioners can consult from time to time with regard to any development of supply in the district.

The observations of the parties represented at the recent inquiry will be invited on the clauses of the draft order before the Commissioners hold the further inquiry required by Section 5 (4) of the Electricity (Supply) Act, 1919.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

10,520. "Gasfilled incandescent electric lamps." E. Y. Robinson. April 11th.

10,521. "Incandescent electric lamps." E. Y. Robinson. April 11th.

10,526. "Portable electric sanding and planing machine." H. E. Brand and J. A. Burgoyne. April 11th.

10,550. "Electric switch, fuse, &c., boxes." W. J. Woodrow. April 11th.

10,561. "Transformers for high voltages." E. Haefely et Cie. April 11th. (Switzerland, October 16th, 1920.)

10,575. "Single-fluid primary cell." F. Weatherill. April 11th.

10,585. "Apparatus for regulating asynchronous electric machines by means of a commutator machine arranged behind." E. C. R. Marks (Siemens-Schuckertwerke). April 11th.

10,591. "Telephone exchange systems." A. H. Adams. April 11th. (United States, May 13th, 1920.)

10,595. "Telephone systems." Ges. fur Drahtlose Telegraphie, April 11th. (Germany, April 12th, 1920.)

10,597. "Amplifiers for telephone circuits." Soc. Industrielle des Téléphones. April 11th. (France, November 18th, 1920.)

10,599. "Transformation of alternating electric pressures and currents to direct pressures and currents, &c." S. A. Stigant. April 11th.

10,614. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. April 11th. (United States, April 19th, 1920.)

10,619. "Speed accumulator for bicycles." P. S. Nixon. April 12th.

10,629. "Protective covering for electric refill batteries." G. P. Golden. April 12th.

10,638. "Cartridge fuse for electrical circuits." G. W. Humphry. April 12th.

10,639. "Earth connection devices for pipes, cables, sheaths, &c." G. W. Humphry. April 12th.

10,643. "Electrical signalling, &c., apparatus for use in trains, factories, mines, &c." L. G. A. C. D. Gaunt. April 12th.

10,651. "Electrically-illuminated hand mirror." C. E. Toms. April 12th.

10,663. "Electric lamp holders, &c." G. F. A. Stone. April 12th.

10,671. "Electric batteries." Hewittic Electric Co., Ltd., formerly Westinghouse Cooper Hewitt Co., Ltd. April 12th. (France, April 15th, 1920.)

10,680. "Automatic compressed-air brake for tramways, &c." E. Seguin. April 12th. (France, April 15th, 1920.)

10,681. "Pneumatic brakes for tramways, &c." E. Seguin. April 12th. (France, April 19th, 1920.)

10,687. "Motor for generating power." F. Macdonald. April 12th.

10,690. "Method for preventing disturbing induction between adjacent leads carrying approximately the same high-frequency waves." H. A. Gill (Deutsche Telephonwerke Ges.). April 12th.

10,700. "Control of alternating-current electric motors." Metropolitan-Vickers Electrical Co., Ltd. April 12th. (United States, July 30th, 1920.)

10,701. "Control of alternating current electric motors." Metropolitan-Vickers Electrical Co., Ltd. April 12th. (United States, July 19th, 1920.)

10,702. "Electro-magnetic switches." British Thomson-Houston Co., Ltd. (General Electric Co.). April 12th.

10,705. "Trolley pole safety appliance for electric trams, &c." P. M. de C. Ireland. April 12th.

10,730. "Switch arrangement sending and receiving electrical oscillations of low frequency." Dr. E. F. Huth Ges. April 12th. (Germany, April 12th, 1920.)

10,746. "Sparking plug shield." S. Sims. April 13th.

10,761. "Galvanic battery." J. Hossack. April 13th.

10,765. "Electric baling presses for loose materials." J. H. Hindle and T. Hindle. April 13th.

10,770. "Illuminated signs." Studien Ges. fur Elektrische Beleuchtung. April 13th.

10,776. "Chronometric electric switches, &c." L. Burn, W. W. Stainer, and C. J. Stewart. April 13th.

10,795. "Receivers for telephones." A. Humphrey and E. Kempner. April 13th.

10,798. "Dynamo-electric machines." M. Dewhurst. April 13th.

10,799. Electrical apparatus." E. L. W. Byrne. April 13th.

10,800. "Plug and socket connectors." A. P. Lundberg, G. C. Lundberg, P. A. Lundberg, and G. Pegg. April 13th.

10,802. "Contact breakers for electrical ignition for automobile internal combustion engines." A. Demont. April 13th.

10,803. "Telautography." H. G. Bartholomew. April 13th.

10,809. "Enclosed fuses." A. L. Eustice. . April 13th.

10,813. "Variable speed power transmitting devices." E. C. R. Marks (Marathon Electric Manufacturing Co.). April 13th.

10,822. "Retarding devices for relays." W. H. Petersen and Allmanna Svenska Elektriska Aktiebolaget. April 13th.

10,823. "Inverse time limit relays." W. H. Petersen and Allmanna Svenska Elektriska Aktiebolaget. April 13th.

10,849. "Telephone systems." H. H. Gelman." April 13th.

10,883. "Control devices for electric generators." R. Bosch Akt.-Ges. April 14th. (Germany, May 3rd, 1920.)

10,892. "Control of electric lifting magnets." H. E. Bowen, W. Brooke, E. Holme & Co., Ltd., Steel, Peech & Tozer, Ltd. April 14th.

10,903. "Combined switch and petrol tap for motor cars, &c." W. S. Brigham. April 14th.

10,923. "Apparatus for transmitting, receiving, or reproducing sound." A. F. R. Cotton and E. W. C. Russell. April 14th.

10,935. "Three electrode bulbs or valves." Soc. Anon. pour l'Exploitation des procedes M. Leblanc-Vickers, formerly Soc. Anon. pour l'Exploitation des procedes Westinghouse-Leblanc. April 14th. (France, April 15th, 1920.)

10,939. "Electric starters for internal combustion engines" Scintilla. (Switzerland, April 14th, 1920.)

10,958. "Electric lighting for motor cycles, &c." S. L. Price. April 14th.

10,959. "Dynamo-electric machines." S. L. Price. April 14th.

10,977. "Generators of electric current." P. Belyavin. April 15th.

10,987. "Non-glare head-light for motor cars, &c." A. A. Green. April 15th.

10,990. "Rheostats." S. T. Quilliam (Electric Railway Improvement Co.). April 15th.

11,007. "Transmission systems with electric diaphragms for sound boxes for talking machines." H. Hurm. April 15th. (Belgium, April 19th, 1920.)

11,026. "Means for suspension of electric contact wires." L. N. Reddie (Consorzio per Elettrotrazione). April 15th.

11,035. "Machines for slotting insulation between commotator bars of electric machines." J. Phillips. April 15th.

11,038. "Timing devices for ignition apparatus of internal combustion engines." R. S. Bowen. April 15th. (United States, April 17th, 1920.)

11,049. "Electro-metallurgy." British Thomson-Houston Co., Ltd. (General Electric Co.). April 15th.

11,061. "Signalling systems, particularly wireless modulation systems." J. Scott-Taggart (Radio Communication Co., Ltd.). April 15th.

11,065. "Gas producers, electric furnaces, crucible furnaces, &c." H. B. Clapp & Ferolite, Ltd. April 15th.

11,069. "High-frequency electrical apparatus." J. B. Bower. April 15th.

11,070. "Electric switch." A. H. Hunt. April 15th.

11,080. "Sparking plugs." H. Molla. April 16th. (France, May 10th, 1920.)

11,089. "Combined spark intensifier and sparking plug tester for internal combustion engines." E. Arden Pye, H. Singer, and E. Taylor. April 16th.

11,091. "Trolley head for electric tramcars, &c." C. Noble. April 16th.

11,120. "Means for reducing capacitative ground current in high-tension transmission systems." Allmanna Svenska Elektriska Aktiebolaget. April 16th. (Sweden, April 16th, 1920.)

11,121. "Arrangement for neutral point resistances for high-tension transmission systems." Allmanna Svenska Elektriska Aktiebolaget. April 16th. (Sweden, April 16th, 1920.)

11,125. "Electric switches." W. P. Gilbart and R. A. Griffiths. April 16th.

11,127. "Electric lighting and ignition systems for motor vehicles." E. A. Watson & C.L.I. Manufacturing Co., Ltd. April 16th.

11,128. "Safety fuses." A. L. Eustice. April 13th.

11,131. "Quick make and break electrical switches." F. Shergold and Edison Swan Electric Co., Ltd. April 16th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1914.

17,733. "Electric metallic filament incandescent lamp." Kende. July 27th, 1914.

1918.

12,266. "Electric heaters." J. R. Quain. July 27th, 1918. (Cognate application 13,733/18.) (160,844.)

1919.

6,749. "Unidirectional radio receiving systems." British Thomson-Houston Co., Ltd. (General Electric Co.). March 18th, 1919. (160,846.)

22,428. "Electrical and other wire or cord or flex adjusters." E. Westrup and O. F. Westrup. September 12th, 1919. (160,860.)

23,051. "Combined double pole electric switch and plug." W. E. Watson. September 19th, 1919. (160,863.)

23,955. "Electric insulators." V. Tedeschi. September 30th, 1919. (Italy, December 5th, 1918.) (136,142.)

23,956. "Electric insulators." V. Tedeschi. September 30th, 1919. (Italy, February 18th, 1919.) (Addition to 136,142.) (139,148.)

23,977. "Electric switches." A. Anzani. September 30th, 1919. (France, October 2nd, 1918.) (133,309.)

29,690. "Electric relays." Siemens Bros. & Co., Ltd., W. H Grinsted, and E. A. Petithory. November 28th, 1919. (160,888.)

29,783. "Insulating and anchoring device for electric lamp holders and other electric fittings." B. Deakin. November 29th, 1919. (160,890.)

29,980. "Induction motors." Colner Elektromotorenfabrik Johannes Bruncken. February 7th, 1918. (136,156.)

30,120 ".Induction motors." Colner Elektromotorenfabrik Johannes Bruncken. July 17th, 1919. (Addition to 136,156.) (160,894.)

32,454. "Telegraph printing systems." Automatic Telephone Manufacturing Co., Ltd., H. H. Harrison, and S. R. Smith. December 29th, 1919. (160,916.)

32,703. "Magneto-electric machines." R. B. North and A. M. Allen. December 30th, 1919. (160,931.)

32,707. "Audible and visible electric signalling systems for calling attendants." M. V. Ely and Foster Engineering Co., Ltd. December 30th, 1919. (160,932.)

32,719. "Burglar and like alarm apparatus." J. O. Attaque. December 30th, 1919. (160,934.)

32,830. "Radio receiving systems." British Thomson-Houston Co., Ltd. (General Electric Co.). December 31st, 1919. (160,941.)

1920.

549. "Electrodes for use in electric welding or fusion deposition of metals." Quasi-Arc Co., Ltd., and A. P. Strohmenger. January 7th, 1920. (160,957.)

879. "Electric heating device." Electric Heating & Hardware, Ltd., and F. J. Wineberg. January 10th, 1920. (160,971.)

1,101. "Wireless direction finding systems." F. Murphy. January 13th, 1920. (160,975.)

1,134. "Commutators for dynamo-electric machines." A. E. White (Toledo Standard Commutator Co.). January 13th, 1920. (160,978.)

1,249. "Portable radio telegraphic and telephonic apparatus." R. M. Radio, Ltd., and H. St. J. De A. Donisthorpe. January 14th, 1920. (160,981.)

2,688. "Electric resistances." British Thomson-Houston Co., Ltd. (General Electric Co.). January 28th, 1920. (161,011.)

3,650. "Incandescent electric lamps." H. J. Osborn. February 6th, 1920. (161,026.)

12,222. "Spark plugs." J. Iacono and S. E. Pace. November 27th, 1918. (142,811.)

15,791. "Spark plugs." W. Housman. November 26th, 1917. (144,713.)

16,911. "Electric starting device for internal combustion engines." R. Bosch Akt.-Ges. May 26th, 1919. (145,527.)

18,170. "Dynamo-electric machines." Locknitzer Eisenwerk Ges. December 2nd, 1919. (154,878.)

18,889. "Telemotor." R. Macgregor. July 6th, 1920. (Patent of addition not granted.) (161,102.)

19,350. "Conveyance and distribution of high-frequency electric currents." Ges. fur Drahtlose Telegraphie. May 28th, 1919. (147,447.)

19,504. "Manufacture of composite conductors for dynamo-electric machines and other electric apparatus." Siemens-Schuckertwerke Ges. December 14th, 1917. (147,571.)

19,533. "Electrically controlled valve gear of a hydraulic gun-laying mechanism." F. Krupp Akt.-Ges. November 10th, 1917. (147,596.)

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THE ELECTRICAL MANUFACTURING INDUSTRY.

AT annual meetings held during the last fortnight by two of the largest British electrical manufacturing companies, statements have been made which amply justify the optimistic views which have appeared in these pages recently respecting the electro-industrial situation.

It is important that we should remember the very special place occupied by the electrical industry in relation to all or most other trades, and the service which it is peculiarly designed to render them in their own progress toward more economical and efficient production. It is very easy to allow the heavy clouds which overhang most nations to-day to depress us unduly and lead us to hold our hand from even some of the most ordinary measures of enterprise if we forget that the essential service that it exists to provide places it in a unique position. If we can contrive means for passing through the present critical period with comparatively little damage to our manufacturing business we shall reach such a state of activity as the industry has never before known.

What Sir Charles Ellis said at the meeting of the English Electric Co., Ltd., with regard to railway electrification is equally applicable to much other work that will sooner or later fall for execution. The delay in proceeding with the electrification of railways in the United Kingdom—work which means so much to the future of the industry—is not due to any doubt as to the technical advantages that accrue from the adoption of electric traction; it is mainly due to difficulties of finance. The depression that affected other important national industries last autumn, began noticeably to affect the electrical trade a little later, but the company in question has a considerable volume of unexecuted orders, and, said Sir Charles, "it is not unreasonable to hope that in all except the smaller classes of our manufactures the flywheel action of this volume of orders will be sufficient to carry us over until trade revives." The speaker stated that one of the causes of the present trade depression was the loss of orders to foreign competitors consequent in part upon the wage rates now prevalent in British engineering and "even more" in the industries from which it draws its materials. He showed, as did Mr. Bryce at the meeting of the Metropolitan-Vickers Co., that if we are to extend or even fully to regain our pre-war business abroad, considerable reductions will be necessary in the prices of our products, "and therefore in the cost of the whole range of processes through which they are built up from the materials of coal and iron." Sir Charles has no doubt whatever that we shall be able to negotiate the present crisis safely if both employers and workers can be sure that the necessary sacrifices are distributed as fairly and equitably as is humanly possible over all those concerned.

That there will be a revival of trade sooner or later, notwithstanding the very exceptional causes of the prevailing depression, there is no room for doubt, and when it does come the electrical industry will assuredly contribute in a remarkable way to securing appropriate reward for all classes and all craftsmen. "The electrical industry has an assured future, because it is bound up with those improvements and economies in productive organisation which we all regard as a necessary element in the future prosperity of the world."

For the record of what the English Electric Co. has been doing during the past year by way of consolidating its organisation, and developing at its several factories the manufacturing operations for which they are each most suited—in other words, "the best possible utilisation of our five works"—we must refer readers to our "City Notes" pages to-day. Efficiency of equipment and organisation, "continuous team work by the staffs," discussion of labour problems through works committees, and economy in selling expenses at home and abroad—these are the outstanding features of the work that occupied the year that has gone.

The record of the Metropolitan-Vickers Co. printed in our last issue indicated that the orders received in 1920 were about 80 per cent. greater in value than those of the preceding year, and the orders completed were 50 per cent. greater. The actual tonnage of orders completed, which is perhaps more suggestive than value nowadays, represented an increase of about 30 per cent., and as Mr. Bryce pointed out, this was a remarkable improvement, seeing that electrical machinery is always becoming lighter in weight, owing to the increase of efficiency in the use of the materials of construction, and he justifiably mentioned it as reflecting very great credit on the efficiency of the organisation.

It is obvious that while neither of the two great electrical manufacturing concerns to which we refer can see any grounds for exultation as long as the home industrial and financial situation is so depressing, and the state of international questions causes general unsettlement, they are both, like probably many other electrical firms, living in anticipation of great times that may not be far off.

Mr. A. F. Berry, of the British Electric Transformer Manufacturing Co., Ltd., rightly said the other day that the next few years would test the capacity of even the best captains of industry, and he remarked that it would be most difficult to restart businesses that had stopped, or speed up those which had slowed down. There is undoubtedly a distinct danger in slowing down, and it should not be done without the fullest deliberation.

We are inclined to give a word of warning lest, due to the adverse conditions of the moment, there be a tendency to permit the instruments of electrical commerce to rust, to dispense with men essential to the best enterprise when the awakening comes, to defer the preparation of measures for securing efficient salesmanship. These are matters in connection with which the wheels cannot be set running efficiently again in a hurry if we have indulged in a little slacking off. We cannot afford to slow down in our efforts to keep in touch with buyers either at home or abroad. The prices of our product must come down sooner or later, and we shall be the better able to take advantage of reductions if our salesmanship, publicity, and general business-getting organisation be continuously maintained in a state of high efficiency.

Sale of Goods Under a Trade Mark.

A point of considerable importance to those who buy goods having a trade mark was decided in the Court of Appeal some time ago. The question was:—What is the effect of a sale of goods which bear a label which is an infringement of the trade mark of some third person? The defendants sold to the plaintiffs certain cases of condensed milk. Some of the tins were labelled with the "Nissly" brand. After the transaction was completed, the plaintiffs found that the label was an infringement of the trade mark of Nestlé Co. In these circumstances they were compelled to sell the tins at a loss, having first removed the offending labels. They sought to recover damages from the defendants. By Sec. 12 of the Sale of Goods Act, 1893, "In a contract of sale, unless the circumstances of the contract are such as to show a different intention, there is: (1) An implied condition on the part of the seller that in the case of a sale he has a right to sell the goods, and that in the case of an agreement to sell he will have a right to sell the goods at the time when the property is to pass. (2) An implied warranty that the buyer shall have and enjoy quiet possession of the goods. . . ." Mr. Justice Bailhache held that when without the knowledge of the buyer or of the seller goods are labelled in such a way that they cannot in their then condition be resold without infringing the trade mark of a third party, the above provisions do not entitle the buyer to reject the goods. In coming to this conclusion the learned judge followed the decision of Lord Russell of Killowen in Monforts *v.* Marsden, 12 R.P.C. 266. The Court of Appeal has now reversed this decision, holding that there was an implied condition on the part of the seller that the defendant would have the right to sell the goods, and that this condition had been broken. It is useful to note that this decision is not based upon Sec. 17 of the Merchandise Marks Act, 1887, under which on the sale or in the contract for the sale of any goods to which a trade mark or marks or trade description has been applied the vendor is deemed to warrant that the mark is genuine and not forged or falsely applied.

It was decided in an earlier case (by Mr. Justice Rowlatt), Scaliaris *v.* Ofverberg, 37 T.L.R. 307, that when goods are sold as being of a particular brand, the undertaking is that they will bear the label of the manufacturer which is put on the goods of that brand in the ordinary course of business, and there is no obligation on the purchaser to accept goods which do not bear the label, even though the goods of that brand have been made by that particular manufacturer.

The Electrification of Railways.

The recent decision of the Ministry of Transport to standardise the use of the high-pressure direct-current system for the electrification of our railways suggests the inference that the battle between a.c. and d.c. has terminated definitely in favour of the latter. This conclusion, however, is by no means so well established as might be thought. In an article published in the *Electrical World*, Herr E. C. Zehme, of Berlin, points out that the electrification of railways in Germany, Sweden, Norway, Holland, and Italy is "somewhat in suspense," on account of the lack of a definite decision as to the type of current to employ. Switzerland and Austria have officially adopted the single-phase system at 15,000 volts, with a frequency of 15 or $16\frac{2}{3}$ cycles per second, but in each country one-third of the existing mileage that is electrically operated is working on the d.c. system; in both cases the electrification of the railways is of extreme urgency, owing to the lack of native coal, and huge schemes with that end in view have been approved.

Sweden also has favoured the single-phase system, but has experienced considerable trouble due to inductive disturbances in telegraph and telephone lines, which constitute a grave objection to the use of alternating current. Holland has not yet decided upon the choice of system. In Italy all three systems—d.c., three-phase and single-phase—are widely used, in the order named, and a special ministry has been formed to consider a great extension of electrification, with a leaning towards three-phase, which has attained its greatest development in that country.

Germany has used single-phase on recent electrifications, but here again serious inductive troubles have been met with, as well as operating difficulties, and doubts have been expressed as to the wisdom of adopting alternating current. In the United States, direct current has been in the ascendant for some years.

It is clear, therefore, that the question is still by no means settled; the three-phase system, curiously enough, is not making much progress, and the fight is practically confined to the two great rivals, direct current and single-phase current, which so long disputed the supremacy for lighting purposes in this country.

SUBMARINE CABLE TELEGRAPHY.

Oscillatory Circuit Signal Conditions: *Some* Graphs, Tables, and Scales.

By EDWARD RAYMOND-BARKER.

1. The foregoing sub-title certainly is somewhat lengthy, and readers may opine that, at least, the collective term "some" might have been omitted. That this word is requisite is due to the fact that the following matter—once certain preliminary points shall have been dealt with —will relate to one sub-section, only, of the complex system of submarine cable station electrical adjustments and corrective devices of late years grown up owing to modern requirements with regard to high-speed cable-signal transmission and reception, auto-retransmission, and—whenever desirable—ultimate Creed record in Roman type.

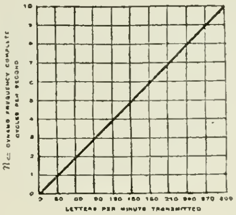

Fig. 1.

A	B	C	D	E.	F.
∩ p.m. ch.p.m.	l.p.m.	l.p.m./15 = ∩ per sec	15/l.p.m = sec. per ∩.	l.p.m./30 = ∿ per sec.	30/l.p.m. = sec. per ∿.
200	50	3.333	0·300	1.667	0·6000
300	75	5·000	0.200	2.500	0·4000
400	100	6·667	0·150	3·333	0·3000
500	125	8·144	0·123	4·167	0·2400
600	150	10.000	0·100	5·000	0·2000
700	175	11·667	0·0857	5·833	0·1714
800	200	13.333	0.0750	6·667	0·1500
900	225	15·000	0·0667	7·500	0·1333
1000	250	16·667	0·0600	8·333	0·1200
1100	275	18·333	0·0545	9·167	0·1066
1200	300	20·000	0·0500	10·000	0·1000
1300	325	21·667	0·0462	10·833	0·0923
1400	350	23.334	0·0429	11·667	0·0857
1500	375	25·000	0·0400	12·500	0·0800
1600	400	26.667	0·0375	13·333	0·0750
1700	425	28.334	0·0353	14·167	0·0706
1800	450	30·000	0·0333	15·000	0·0667
1900	475	31·667	0·0316	15.833	0·0631
2000	500	33.334	0·0300	16·667	0·0600
2100	525	35·000	0·0286	17·500	0·0571
2200	550	36·667	0·0273	18·333	0·0545
2300	575	36·334	0·0261	19·167.	0·0522
2400	600	40·000	0·0250	20.000	0·0500
2500	625	41·657	0·0240	20·833	0·0480
2600	650	43·333	0·0231	21·667	0·0462
2700	675	45.000	0·0222	22·500	0·0444
2800	700	46·667	0·0214	23·333	0·0429
2900	725	48·334	0·0207	24.167	0·0414
3000	750	50·000	0·0200	25·000	0·0400
					E.R-B.

Table I.

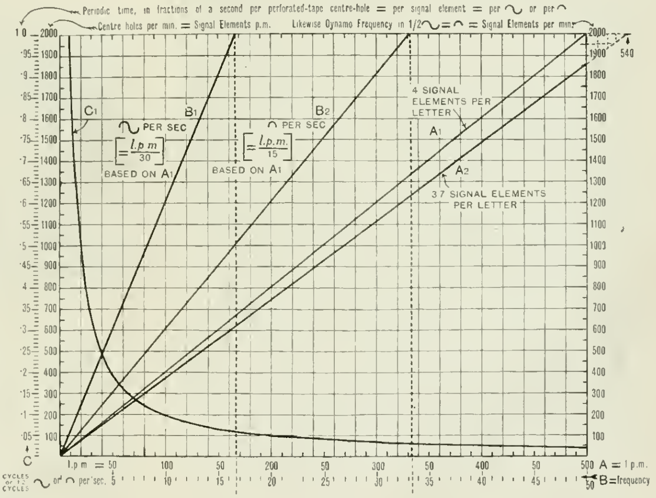

Fig. 2.

2. The said sub-section will be found to refer to the relationship or relativity desirable between capacity K (microfarads) of the receiving condenser, and inductance L (henries) of the receiving inductance shunt between cable and receiving apparatus (to be illustrated later), whenever permanent maintenance of any particular speed of effectively shaped-up signal impulses, or—expressed in another way—any particular frequency in complete cycles or waves transmitted and received per second, is desired. The circumstance, therefore, that this sub-section forms only a small portion of cable reception oscillatory circuit matter considered generally, clearly justifies the foregoing qualifying expression "*some* graphs."

3. In the presence, so to speak, of the scattered and widely-flung band of devoted and experienced men (what is mere geographical distance when mutual concern in an interesting subject unites all in one ?) who, at the present moment, dotted here and there over the world of land and ocean, under modern technical conditions of high tension not unattended by personal anxiety, keep the working of the world's great cables up to concert pitch, the present writer, notwithstanding his varied experience ashore and afloat, feels a mere neophyte.

4. However, some little time ago, having had his attention drawn to the afore-mentioned sub-section of what really is a big subject, he thereupon devised, and eventually found useful certain graphic methods and curves which indicate the mutual relativity of K and L at various speeds. These graphs have since proved of great use. It is a record of this little investigation, together with resulting *tables, curve sheets*, and *calibrated scales*, as best may suit the reader's preference, that the writer has much pleasure in submitting, through the columns of the Electrical Review, to all friends interested.

5. It will be, of course, clearly understood that the only novelty claimed by the writer—in which particular direction he is not aware that he has been anticipated—lies not in any new process of calculation, but in the presentation in tabulated, and more especially, *in graph form*, or by means of calibrated scales, of calculated values resulting from theories and methods already known to and used by cable staffs. These graphs, and any tables corresponding to the same, will remain—at least, so the writer ventures to hope —a permanency for quick and easy reference at any time, or as models for others at any particular speeds required, to the great simplification of the work of quickly estimating not a few electrical adjustments.

6. Already, reference has been made to the necessity, first of all, for dealing cursorily with certain preliminary matter. This covers mainly :—

7. (A.) The requisiteness, on any coherent submarine-cable electrical-signal transmitting and reception plants, of synchronic coincidence, between the several frequencies in terms of complete cycles (~) per second, of three separate, though co-operating, pulsatory systems, namely (*a*) : Frequency of signal beats in terms of complete waves or cycles per second ; (*b*) frequency pertaining to the natural period

of free electrical oscillations in the receiving oscillatory system, namely, that consisting of receiving condenser in series with actual receiver, these two instruments being shunted by a self-inductive resistance coil, inductance or magnetic shunt; (*c*) frequency pertaining to the natural period of vibration of the actual receiver, whether this be a direct-working recorder or other apparatus on local circuit. As a matter of fact, the last-mentioned of these frequencies, especially that of a local circuit instrument, may be, with advantage, somewhat of a higher order than in the case of the prior two, viz. (*a*) and (*b*).

8. (B.) Conversion of perforated-slip *centre holes per minute* (c.h.p.m.) into machine-transmitted *letters per minute*—hereafter to be referred to as l.p.m.—and thence into equivalent *complete cycles or waves per second.*

9. Let us, first of all, deal with (B). In former times, leading authorities, *e.g.*, the Eastern Telegraph Co.'s Electrical Department, took the average recorder code letter corrected for spacing as amounting to 3·7 contact elements per letter. In "Notes" in *The Electrician* of April 23rd, 1897, the following concise information is given:—

10. . . . "At stations where the automatic transmitter is used, the letter speed per minute can readily be arrived at by counting the number of centre-holes in the perforated slip which pass through the transmitter in one minute, and dividing that number by the constant 3·7 representing the number of spaces occupied by an average letter. This constant 3·7 has been arrived at by a careful examination of the traffic carried by the Eastern and other systems, and by calculating the actual number of electrical contacts which are made in the formation of an average letter, which is found to be within 3 per cent. of 2·6. To this figure must be added 1·0 for the space between each letter, and 0·1 for the proportion to be added to each letter on account of the extra space allowed between words—a word for this purpose being taken as 10 letters."

11. Of recent years the constant 3·7 contacts per letter has given place to the constant of *4 contacts per letter.* For instance, Colonel George O. Squier, Ph.D. (now Major-General, Signal Corps, U.S. Army), in the memorable paper "On an Unbroken Alternating Current for Cable Telegraphy," read by him on June 25th, 1915, before the Physical Society of London,* has given a graph, fig. 1 (General Squier's fig. 3), exhibiting the linear relation between *n*, the frequency of a transmitting single-phase alternator, and the letters per minute transmitted, based on the assumption that the average cable letter with its space is equivalent to *4 contact signals.*

12. In a very useful paper entitled "The Practical Problem of Telegraph Transmission from a New Angle of View," contributed to the Royal Engineers' *Journal* (October, 1915) by Major W. A. J. O'Meara, C.M.G., endorsing and supporting Colonel Squier's sine-wave alternating-current system of submarine-telegraph transmission and reception, Major O'Meara, on page 188, refers to 386 signals per minute as = 19 words per minute. This means that 386/19 = 20 signals per word, and 20/5 letters per word = *4 signals* per letter.

13. The British Post Office "Imperial Cable" Service, the Eastern Telegraph Co.,† the Compagnie Française des Câbles Télégraphiques, and, doubtless, other administrations, have adopted the standard of 4 contacts per letter, including space.

14. Thus, an average cable-code letter with its space
= 4 signal contact units.
= 4 centre-holes of perforated slip.
= 4 half cycles (⌒).
= 2 complete cycles (~).

15. Again, referring back to 8:—
l.p.m./60 = letters per second.

16. L.p.sec. × 4 = signal contact units per sec.
= ½ cycles (⌒) per sec.

17. ½ cycles per sec./2 = complete cycles (~) per sec.

18. So, in conversion of l.p.m. to complete cycles (~) per sec.—l.p.m. ÷ 60 × 4 ÷ 2 = ~ per sec.

19. But this is equivalent to—l.p.m. ÷ 30 × 2 ÷ 2 = ~ per sec.

20. Which is tantamount to—l.p.m. ÷ 30 = ~ per sec.
l.p.m. ÷ 15 = ⌒ per sec.

21. Table I will be found usefully comprehensive.
Column A gives transmission speeds in c.h.p.m. = ⌒ p.m.
" B equivalent l.p.m.
" C equivalent ⌒ per sec.
" D recip. of C = duration of ⌒.
" E true frequency of oscillations = ~ per sec.
" F recip. of E = periodic time of each ~.

22. Chart shown in fig. 2 embodies, in graph form, methods utilised for compilation of Table I.

Line A_1, using ordinate scale c.h.p.m., and abscissa scale A, converts c.h.p.m. into l.p.m., and *vice versa*, on the basis of four centre holes to one cable-code letter.

Line A_2 similarly, but on basis of Eastern Telegraph Co.'s former constant of 3·7 centre holes to one cable-code letter.

Line B_1, using ordinate scale c.h.p.m., and abscissa scale B, converts c.h.p.m. to frequency ~ per sec., and *vice versa*, on basis of four centre holes to one letter.

Line B_2 similarly converts c.h.p.m. into ⌒ per sec., and *vice versa.*

Reciprocal curve C_1, using ordinate scale C, and abscissa scale B, converts periodic time in fraction of a sec. per ~ to frequency ~ per sec., and *vice versa*, or, if required, sec. per ⌒ to ⌒ per sec., and *vice versa.*

Example:—(Using, on the chart, a pair of compasses) 1,700 c.h.p.m. = 425 l.p.m. = 14·2 ~ per sec. = 0·071 sec. per ~.

(To be continued.)

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* The Electrical Review, July 30th and August 6th, 1915.

† If the centre holes per "cable code" letter be taken as = 3·7, as formerly was done, the corresponding constant for Morse code will = 4·7. Considering, therefore, the present-day extension of ocean-cable Morse code, the now generally-adopted constant of 4 contact signals to the cable letter, would, after all, appear to be an excellent and practical compromise covering all likely requirements.—E.R.-B.

DETERMINATION OF EQUIVALENT RESISTANCE AND COPPER LOSSES IN A THREE-PHASE STATOR.

By A. Nash.

Although the method of determining the equivalent resistance and copper losses in a three-phase alternating-current stator connected either star or in mesh is fairly well known, the derivation is, even amongst fairly qualified electrical engineers, somewhat hazy, and the accompanying explanation may be appreciated by electrical students, both on the test bed and in technical schools. In the following it is assumed that each phase winding has the same resistance.

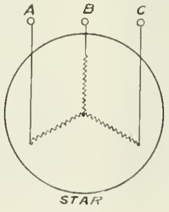

Fig. 1.

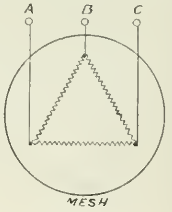

Fig. 2.

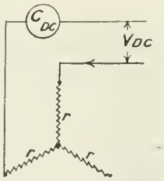

Fig. 3.

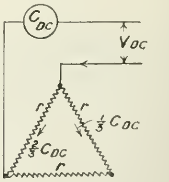

Fig. 4.

Let *r* represent the resistance of one phase winding.
" C_ϕ " current flowing through one phase winding.
" C_L " line current per phase.
For star connection $C_\phi = C_L$
" mesh " $C_\phi = C \div \sqrt{3}$.

To obtain the value of r in ohms, apply a constant voltage with an ammeter in circuit to any two terminals AB, BC, or CA. This should be done whilst the machine is hot.

For a star connection $r = \frac{1}{2} V_{DC}/C_{DC}$.

This can easily be seen from fig. (3), as there are two phase windings in series.

Now, copper loss per phase $= C_\phi^2 r$.

In the three phases total copper loss $= 3\ C_\phi^2\ r \quad \ldots \ (1)$

Now, substitute $r = (\frac{1}{2} V_{DC}/C_{DC})$ in (1), and we get copper loss for a star connection

$$= 3/2 \,.\, C^2 V_{DC}\, C_{DC}$$

but $C_\phi = C_L$ for star connection.

$\therefore$ Copper loss $= 3/2 \,.\, C_L^2 V_{DC}/C_{DC}$.

Mesh Connection.—Proceed in exactly the same manner, *i.e.*, apply a constant voltage to any two terminals. Fig. 4 shows plainly that the current divides up through two paths, one having resistance r and the other $2\,r$; consequently, two-thirds of the current will pass through the former, and from Ohm's law, voltage/current = resistance, the resistance r in ohms will be—

$$V_{DC}/\tfrac{2}{3}\, C_{DC} = 3\ V_{DC}\ 2\ C_{DC} \qquad \ldots \quad (2)$$

$$\begin{aligned} \text{Now copper loss per phase} &= C_\phi^2 \times r \\ \text{and total copper loss} &= 3\ C_\phi^2 \times r. \qquad (3) \end{aligned}$$

Substituting value of r given in (2) in expression (3) we get—

$$\text{Copper loss} = 3\ C_\phi^2 \times 3\ V_{DC}/2\ C_{DC} \qquad \ldots \qquad \ldots \quad (4)$$

but for mesh connection $C_\phi = C_L/\sqrt{3}$
and substituting in (4), we get—

$$\begin{aligned} \text{Total copper loss} &= 3\ (C_L/\sqrt{3})^2 \times \tfrac{3}{2} \,.\, V_{DC}/C_{DC} \\ &= 3\ C_L^2\ 3 \times \tfrac{3}{2} \,.\, V_{DC}/C_{DC} \\ &= \tfrac{3}{2} \,.\, C_L^2\ V_{DC}/C_{DC}. \end{aligned}$$

which is exactly similar to the star connection.

Summarising, all that is necessary to obtain the equivalent resistance for either a star or mesh connection is to apply a constant voltage with an ammeter in circuit to any two terminals of the machine, divide the voltage by the current, and multiply the result by $1\frac{1}{2}$. The total stator copper losses are then obtained by the product of this quantity and the square of the alternating current in the line for any particular load.

THE WORK OF THE ELECTRICITY COMMISSIONERS.

(Communicated.)

The electrical field is only one of those in which the optimism prevalent two years ago has proved to be misplaced. But perhaps in no other field did a rapid recovery then seem more feasible than in that of electricity supply. This arose largely from the fact that this subject had been investigated during the war by three separate committees connected with the industry, set up with different objects, and all of which had reported in much the same sense as regarded the supply part of the question. The establishment of the Electricity Commissioners would, it was hoped, clear the field, and by placing them under Sir Eric Geddes, at his own request, it was expected to obtain the necessary "push."

That the results to date are so disappointingly meagre and the actual achievements of the Commissioners so small, arises from several causes. These are not all the fault of the Commissioners, who were more or less bound by the Act to make some attempt to carry out a somewhat impracticable policy, before settling down to real constructive work. If perhaps they have taken rather longer than the electricity supply industry itself, to realise the real needs of the situation, it is not entirely their fault. The previous experience of the majority of the Commissioners naturally led them to attach more importance to forms of administration, composition of authorities, &c., and less importance than the business world does to the real question—the importance of getting some works started and the financial difficulties of so doing. Whatever the reason, the fact remains that to-day, two and a half years since the Armistice and longer still since the Board of Trade Report, not one important step has been actually taken towards building a "super station."

When the Commissioners were appointed some criticism arose in company circles that their sympathies would be too "municipal." The chairman, it was pointed out, had had comparatively little experience of private enterprise, Sir H. Haward had been a lifelong municipal servant, and Mr. Booth always a Government official.

In practice, however, it cannot be fairly said that the Commissioners, in such decisions as they have made, have shown any pronounced bias. Their postponement of the County of London project until the L.C.C. and other parties interested had had a final chance to agree upon a scheme was at least well intended. If it be said that at Nottingham they seemed a little inclined to one side, yet at Chester they have approved the other.

Where a municipal or joint authority is really certain to proceed at once, so much the better. But if private enterprise offers the best chance of an early start, let us by all means use it, only provided we get the big station erected.

The attitude of the public towards the company and municipality question began to change ten years ago, and has changed very rapidly since 1915. In former days the question was who was to be allowed the profitable right to sell electricity in any given area. Now it is a question of who, if anybody, can and will find the money to put up big stations to enable the existing supply undertakings to reduce their expenses. Ten years ago, most municipal authorities, broadly speaking, favoured extending municipal responsibilities. To day, while there are plenty of optimists on municipal Electricity Committees, they do not get the same support from their Finance Committees and Councils as formerly, as regards expansion; and there is no superabundance of private capital for this purpose.

The first duty of the Commissioners—and the second—is to get some of these big stations started. This is what they were largely appointed to do, and expected by the public to do. The form of control and questions of administrative machinery, while by no means negligible, are of tertiary importance, and the decision will usually be facilitated, if not inevitable, if only the main purpose—real progress—be kept to the front.

It has been said that the Commissioners are inclined to attach rather more importance to the question of forms of control than does the general public, and have not fully grasped the change in public opinion, which is now most concerned with getting cheaper electricity. Even if the Commissioners had been able to get half a dozen joint authorities established, we doubt whether it would have had as much real effect on the industry as the erection of one super-station. As it is, the difficulties in the way of joint authorities—difficulties of sharing financial responsibilities, &c., apart altogether from difficulties of agreeing to form an authority—make it impracticable to delay helping the industry till they are in being. The industry looks to the chairman, as a practical engineer, to keep this fact before his colleagues.

This natural desire of the Commissioners, to establish joint authorities, if it can possibly be done, has guided their policy as regards the London situation.

They have given the London authorities every chance and encouragement to produce an agreed scheme. If no such scheme is forthcoming, and the experience of the past 15 years indicates the unlikelihood, the London authorities can certainly not complain that the Commissioners have not given them an opportunity.

It is in the interests of London as a whole, and in our opinion, of the supply authorities themselves, that an agreed scheme should be arrived at. But it must be a really workable scheme with a definite assurance that it will proceed, and not a half-hearted affair, intended, or at any rate subsequently used, merely to block a really big advance. The Commissioners may be trusted to prevent this, and not to authorise a mere "paper" scheme, or even an agreed technical scheme, unless they are at the same time really convinced that the necessary administrative machinery is also ready and the necessary finance and honest determination to proceed is also present. If the next inquiry does not result in at least one super-station being really begun by one group or the other, public opinion will, indeed, begin to question the powers of the Commission. Incidentally, we believe that the starting of one up-to-date super-station in London, whether municipal or company, will do much more to bring about future agreement than the establishment to-day of an unwieldy Joint Authority without real unity of purpose.

ENGINEERING IN RUSSIA.

At the informal meeting of the Institution of Electrical Engineers on April 25th, Mr. J. F. Avila was in the chair, during the discussion, opened by Mr. C. L. Lipman, on "Engineering in Russia." The meeting was not as well attended as usual, and was the last of the session. The meetings will be resumed at the end of October. The chairman appealed for early notification of the subjects of papers offered for next session.

Mr. Lipman commenced by stating that for the time being the Soviet Government was the only possible Government capable of maintaining public order. The roots of Bolshevism had gone so deep that to extirpate the system hurriedly would only increase the industrial chaos. Now the Soviets had been able to turn from preparations for war, internal and external, to ambitious schemes for the mobilisation of town and village in the peaceful re-establishment of industry, and the engineering industry in particular.

A body called the Eighth All-Russian Congress of Soviets had planned this reconstruction. This Congress decided to start with the electrification of the most important industrial regions and, first, the coal mining and metallurgical industry of the Siberian, Ural, Moscow, and Donetz regions. It was anticipated that during 1921 the Donetz Basin alone would yield eight million tons of coal and 360,000 tons of pig iron.

The general destitution and the dearth of engineering materials had not permitted progress much beyond the excavating and lay-out stage, but considerable pioneer work had resulted. A hydro-electric scheme, the Kashir generating station, to supply Moscow and a number of adjacent counties was being rushed forward day and night, for it was decreed that all factories in Moscow should use electric power.

A temporary district station on the Shatour Marshes was helping the Bogorodsky transmission station to illuminate Moscow. The electric station at Sudakovsk works had been restored, and the works at Tula were receiving the required power. Seven industrial districts of the Moscow Basin were shortly to receive electricity from the Shatour and other stations with the object of obtaining 1,000,000 tons of coal per annum.

In the Petrograd district electrification was being carried out at a quickened pace; the Ontkin works were being reconstructed, and a new station had been commenced on the Viazen Marshes. On the river Svir (the Svir Volkhov station) a huge hydro-electric plant was in hand for the supply of the northern districts of the capital. Simultaneously dredging of the Svir was going on under the Mariinsky waterway project of connecting the Volga with the Baltic.

In the Donetz Basin the electricity works, reduced to a deplorable state in the fighting with Denikin, were already recovering, and at the end of February last 30 stations with a total capacity of 190,000 kW were working in three of the chief districts, while 3,000 motors of 122,240 h.p. had been repaired and put to use.

In the Kizelovsk coal district in the Ural great efforts were being made to finish the electricity works by 18 months hence. Nor was it only industrially that the electrification was going on. Thousands of cottages were receiving light, and in the Kieff district the workers' quarters were lighted free of charge.

Mr. Avila, in opening the discussion, admired Mr. Lipman's optimism in looking to a Russia stirring with electric transmission and transport while we in England had such difficulties with a dense population to justify the operations.

Mr. H. E. Crowcroft, who had spent some years in Russia, told of the German hold in pre-war days on the Russian engineering trade, especially in the Baltic Provinces, where the business correspondence was often conducted in German, and the rules and specifications were simply translations from German. He asked when might traders interest themselves in Russia, and what were the credit arrangements that the Soviet Government offered?

Mr. F. Pooley pointed out that all were concerned in the enormous demands for engineering goods that would result when a reliable Government could put Russia's materials into circulation. His transactions with Russian engineers had led him to think that their specifications were designed to hamper the English maker for the benefit of the German.

Major R. Grierson asked if there were now electricity Acts equivalent to our authorisations to supply, and any considered scheme for linking-up. He also wondered if after the Russian had done years of excavating with, say, two years more in which to erect and complete his stations, and had finally to light the areas free, he would show a profit by Bolshevist finance. He thought it desirable to get young Russians into English works, in order that they might return home with the correct bias.

Mr. Crowcroft, speaking a second time, said he did not think there was such an entire dearth of skilled labour in Russia as was held; he had seen thoroughly sound jobs carried out entirely by Russians. The Russian engineer was often extremely well trained, but frequently was too theoretical. There were no facilities at home for study, and he generally went to Germany, hence his bias towards German methods and standards. Still, he was convinced that our first-class materials would yet find a market in Russia.

Mr. Lipman, in reply, said that Germany by her proximity had received most students, and had naturally benefited. Further, the German was more complacent, and was ready to give long credits, but he did not believe the German influence would hold in the future. The trading agreement with Russia had been signed, and he appealed for sympathy with the only possible Government *pro tem.* He believed that things would right themselves, and that the Russian eventually would honestly meet all his obligations.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession*

Electricity Supply without Statutory Powers.

I am one of those supplying electricity with no statutory powers, and I should be very pleased to help or receive help or suggestions from anybody else supplying with no powers. I think if we could communicate with one another it would be to our mutual benefit. I have over six miles of overhead wires, supplying about 50 consumers.

Francis H. Grace.

West Sheen,
Thornbury, Glos.
April 28th, 1921.

Charging for Idle Current.

I read with much interest Mr. Carrothers's article in your issue No. 2,262 on a method of charging for idle current. In a letter published in your issue No. 2,265, written by Prof. Kapp, reference is made to the necessity for not only penalising a consumer for running with bad power factor, but giving a bonus when the power factor is leading. Although doubtless the number of cases of consumers running with leading power factor is comparatively few, a bonus for leading power factor is unquestionably desirable, and I shall be interested to know how Prof. Kapp would propose to arrange the sine meter which may run either forwards or backwards, so that a record is given in either direction. I take it that this would be possible with some sort of ratchet mechanism, such as is used when supplies may be given in either direction, as between two undertakings which are linked together. It seems to me that the underlying principle referred to by Prof. Kapp, viz., to charge on the basis of integrations of the meter, is not sound, as it will be obvious that at times of comparatively light load and poor power factor the sine meter will integrate a much heavier percentage, although the maximum demand is by no means as great as it would be at times of maximum load. I have always maintained that the only sound basis of charge is that of kVA demand, and am still of the opinion that the tariff should incorporate a charge based on kVA demand and a running charge per unit.

A sine and cosine meter fitted with the Merz maximum-demand attachment would give the desired result quite satisfactorily, as by simple trigonometry the actual demand in kVA can be derived from the readings of the two demand indicators, and the units integrated on the cosine meter would, of course, be charged for in the usual way.

If I read Prof. Kapp's letter aright, the supply bill would be increased or decreased from a datum line of 80 per cent. lagging, directly in proportion to the power factor, but, as is well known, this is not by any means proportional to the cost of the supply of electrical energy.

Taking as an example a 400-kW load at 80 per cent. power factor, viz., 500 kVA, we will assume the charge for this would be 1d. per unit. If the demand of 500 kVA remains the same but the power factor drops to 50 per cent., *i.e.*, 250 kW, under Prof. Kapp's proposal the charge for energy would be increased in the ratio of 8 : 5, viz., 60 per cent., *i.e.*, the charge per unit would be 1.6d. If this case be analysed it will be seen that the demand on the supply company remains the same, viz., 500 kVA, and I shall be glad to know what justification there would be on the part of the supply authority for increasing the charge from 1d. to 1.6d. per unit.

With a 2-part charge, which I have always maintained to be sound in principle, the kVA demand charge in either of the two examples quoted above would remain the same, and the bill would only alter in proportion to the total number of units consumed, which is perfectly sound and logical.

As there is a difference of 60 per cent. in the two methods I shall be glad to have a little further information from Prof. Kapp to show how his method of charging would be justified.

E. W. Dorey.

London.
May 2nd, 1921.

The Training of Kinema Operators.

With regard to Mr. L. H. Edwards's letter in this week's Review on the above subject, the name of the trade journal running these tests is the *Bioscope*, 85, Shaftesbury Avenue, W. 1; the course is conducted by "Crater," the technical editor.

I quite understand Mr. Edwards's experience in being unable to get a really good book on operating; the best two English books on the subject are at present out of print.

A lot of the trouble as regards learning operating is this: Some of the operators are not proficient enough to teach anyone, while others think that if you are taught the business thoroughly, thereby making you a proficient operator, you will do them out of their job. A lot of this sort of work has been done—yes, and worse; it came to this (it is a bit better now): If you could turn a handle, and carry a box of films, and work for a pound a week, you could have the job. Hence the duds you run up against. Every trade has its duds; I have met them in the electrical trade, and it is a great pity, for it is hard to improve them, and to show them what a great drawback they are to industrial progress.

Electrician Operator.

Bolton.
May 1st, 1921.

Transformers and Changed Frequency.

Amongst a group of electrical meter engineers, a somewhat curious problem recently "cropped up," and with the intention of seeing the views of others upon the subject, we are submitting it to the readers of the Electrical Review.

It is well known that in an alternating-current system, an increase or decrease in the rate of change of flux tends respectively to increase or decrease the voltage of that system. We also know that the converting properties of a transformer are directly controlled by the ratio of the numbers of turns of wire wound on that transformer.

From this it appears that a transformer wound for 25-cycle service would operate differently when used on a 50-cycle system—the ratio of the turns, however, decrees that it should operate just the same.

It is almost as complex as the old problem—"when an irresistible force comes into contact with an immovable body, &c. Can any reader explain?

Kilowatts.

May 2nd, 1921.

[The "problem" is really quite simple. When an alternating e.m.f. is applied to a coil, the current which flows produces a magnetic flux which cuts the turns of wire and generates a back pressure nearly equal to the applied pressure. Other conditions remaining the same, the back e.m.f. depends upon the product of the frequency and the magnetic flux (*i.e.*, the rate of change of flux). If the frequency is halved, the magnetic flux must be doubled to produce the same back e.m.f.—and, roughly speaking, that is what happens. As the secondary coil is cut by the same flux as the primary, the same reasoning applies to it; if the frequency is halved, the flux is doubled, and the voltage ratio remains practically unaltered.—Eds. Elec. Rev.]

Domestic Tariffs and Cheap Metering.

With reference to the interesting article under the above heading in your issue of the 22nd inst.

One advantage of the multi-part tariff system of charging lies in the ability, if desired, to allow for the meter rent in the fixed charge so that the consumer would on his account have two items only, the fixed charge and the single rate for the units consumed.

It is, of course, admitted that under a multi-part system metering accuracy is relatively less important in this connection; it was even pointed out in the early days of the rateable value and the telephone systems of charging that putting in one meter only for lighting, heating, and cooking meant putting in a comparatively large meter which might be slow on a very small lamp load—the answer to the objection was that in view of the system of charging any minor losses resulting from this would be unimportant.

Broadly speaking, however, it is permissible to doubt whether at the present time one should attempt to effect a small saving in the cost of meters by reducing their accuracy. For a long time past the old jest about the accuracy of the gas and electricity meter has died out, our own instruments are particularly accurate, and remain so over very long periods, and it seems a pity to destroy a reputation built up in this way, and also to take any action which might make it necessary to stock two brands of meter, one of the usual accuracy for supplies where the whole of the money is recovered as a charge per unit, and another of less accuracy where a multi-part tariff is in force.

J. W. Beauchamp,
Director and Secretary,
British Electrical Development Association, Inc.

London.
April 28th, 1921.

The Hackney Case.

Referring to an article in the "Legal" column of last week's Electrical Review *re* the Hackney Borough Council's refusal to connect the supply on account of the contractor not having a union ticket, I consider it out of all reason on the part of both Borough Council and the trade union, for in the first place I believe all electricity supply undertakings are bound by Act of Parliament to supply electricity wherever their mains are; in the second place, they supply the current to their clients, not to the contractors, who in the case of the Hackney Borough Council no doubt is a ratepayer, and therefore part and parcel of the concern; in the third place, what right has a trade union to force a master man into the union? They cannot find their unemployed work, and if a man starts in business for himself and does the work himself and finds the work himself, what right has any authority to demand money from a man in such a position? I call it almost highway robbery. Therefore I hope the Hackney Borough Council will lose the day, for if not it will mean the taking away of a man's living, for if he goes to join the union he may have to pay anything up to £25 to join. I should be pleased if you would publish this letter, and also to hear from anyone else on the matter.

E. J. Arnold.

London.
April 27th, 1921.

Nottingham's Electricity Supply.

Your contemporary, the *Electrical Times*, in its last issue, gives us the names of ten municipal undertakings (Stalybridge, Darlington, West Hartlepool, Sheffield, Bolton, St. Helens, Stockport, Bury, Leeds, and Coventry) which produce energy at less than one penny per unit, the average being 0.85d. In 1914 the average of the same undertakings was 0.52d., so that costs have increased by just about 50 per cent.

Now in my native city we have the wonderful record of 1.07d. in 1914 and 2.22d. in 1920, which is a very generous 100 per cent. rise. Here our most excellent engineer has reigned for over a quarter of a century, and during that time he has had the assistance of quite a large number of the most eminent electrical consultants of the day; we have hesitated to purchase even a kettle without the advice of perhaps two firms of consultants, albeit that our engineer has always merited and received the fullest confidence of his committee.

I am wondering what results Stalybridge would have been able to show to-day if only our excellent friend Mr. Blackmore had, during his term of office, called in, say, eight different consultants. Would Mr. Tough have transmogrified his undertaking as he has done if he had taken the advice of, say, six consultants?

We Nottingham folks are proud of our city, we are in all things consistent; our output of electricity per head of population in the year 1914 was 26 units, in 1920 the output was 34, whereas Wolverhampton sells 322 units per head, which, considering the present scarcity of coal, is scandalous.

Now, in Nottingham we probably have more private electricity plants to the square mile than any city in the country, so that our Corporation, when it has spent the prospective £2,000,000 on its new station, will always be able and justified in keeping the prices for electricity at the present comfortably high level.

Some few ratepayers here are foolish enough to ask for information as to the new station; the Corporation very rightly refuses even a printed copy of the latest consultant's report.

Now, Mr. Editor, on how many occasions during the past 25 years has your paper been used by the Nottingham Corporation for advertisements inviting tenders for machinery? We don't waste much cash in that silly way.

Veritas.

Nottingham.
April 30th, 1921.

The Transport of Coal by Suction.

Considerable attention has recently been drawn in the London Press to the coal suction plant now being installed at the City of London Electric Co.'s Bankside station. In all references it is stated to be novel, and in fairness to myself and other firms I consider it only right that attention should be drawn to the fact that a coal suction plant has been in operation at the works of Messrs. Boots, the chemists, Nottingham, for the last four years.

The writer installed this plant to lift coal from barges into overhead bunkers a vertical distance of nearly 90 ft., primarily to prevent dust and dirt in these works, where cleanliness is absolutely insisted on.

This plant has been intensely successful, and a duplicate plant has since been installed, and plants are in hand in various parts of the country for the handling of coal, chemicals, ores, barks, and all classes of granular materials. Plants are also in hand for several Corporations, including Brighton and Bristol. The coaling of ships from floating plants is now being perfected, and will prove a great advancement on present methods.

Messrs. Pitman & Sons, recognising the importance of this departure, are publishing a small book written by me, entitled "Pneumatic Conveying," in which the principles and methods and constructional details are dealt with.

I have now been working for some time in conjunction with three important firms who are manufacturing and installing these plants, and in fairness to these good people it cannot be said that the Bankside plant is "novel."

E. G. Phillips.

Nottingham.
April 27th, 1921.

BUSINESS NOTES.

Bankruptcy Proceedings.—W. Hedgecox, electrical engineer, Wolverhampton.—First meeting, May 7th; public examination, May 25th, both at Wolverhampton.

G. Sutcliffe, electrical engineer (G. Sutcliffe & Co.), Abertillery.—Application for discharge will be heard at the Town Hall, Tredegar, May 25th.

B. Pordes (United Electrical Manufacturers' Co.), 18-22, Christopher Street, E.C.—Last day for proofs for dividend, May 13th. Liquidator, Mr. E. Hawkins, 4, Charterhouse Square, E.C. 1.

S. Beckett, Jun., electrician, 50, Deane Road, Bolton.—Receiving order made April 30th, on debtor's own petition.

A. J. Harrison ("Xtra" Lighting Co.), electrical and gas engineer, 4, 5, and 6, Old Market, Sunderland.—Receiving order made April 29th on debtor's own petition.

H. Doyle (Accessories Supply Co.), factor in electrical accessories, 56, Hardman Street, Deansgate, Manchester.—First meeting, May 11th; public examination, June 17th.

E. Cloney, tramway divisional traffic superintendent, 5, St. Albans Road, Parliament Hill Fields, N.W.—Last day for proofs for dividend, May 20th. Trustee, Mr. W. P. Bowyer, Senior Official Receiver, Carey Street, W.C.

J. W. Layton, electrician, 5, Noble's Bank, Hendon, Sunderland.—Last day for proofs for dividend, May 18th. Trustee, Mr. W. A. Ellis, 3, Manor Place, Sunderland.

E. S. Elam and J. Walton, electricians, Kingston-upon-Hull.—First and final dividend of 7s. 5d. in the £, payable May 10th, at the Official Receiver's Offices, Hull.

Company Liquidations.—Stoffels Electric Switch Co., Ltd.—Winding up voluntarily. Liquidator, Mr. S. R. Rogers 41, Eastcheap, E.C. 3. Meeting of creditors, May 9th.

Cowper-Coles Engineering Co., Ltd.—Meeting of members called for May 30th, at 11, Ironmonger Lane, E.C., to hear an account of the winding-up from the liquidator, Sir W. B. Peat.

Electrolytic Co. (Spain and Portugal), Ltd.—A meeting of members is called for June 14th, at 5, Moorgate Street Buildings, E.C., to hear an account of the winding-up from the liquidator, Mr. R. I. Marsden.

Ampere Electrical Engineering and Plating Co., Ltd.—Winding up voluntarily. Liquidator, Mr. T. L. Hammond. Meeting of creditors, May 11th.

Tyne Electric Steel Foundries, Ltd.—Winding up voluntarily. Liquidator, Mr. J. G. Swan, 31, Mosley Street, Newcastle-on-Tyne. Meeting of creditors, May 2nd.

Harman Electric Co., Ltd.—A meeting of members is called for June 16th, at 9, Walbrook, E.C., to hear an account of the winding-up from the liquidator, Mr. F. M. Jeboult.

Inquiries.—Maker's name and address are asked for in respect of the "Ackerman-Johnson Anchor" for plugging slate switchboards, &c.

Dissolution of Partnership.—Balmford & Salt, manufacturers and wholesale factors to the electrical and allied industries, Electric House, Whittall Street, Birmingham.—The partnership between Walter Balmford and Francis Albert Salt has been dissolved. Debts will be attended to by Mr. Walter Balmford, who will continue the business in his own name.

Trade Announcements.—Messrs. W. H. Pease & Co., of Southampton Row, W.C. 1, have taken into partnership Mr. F. E. Pratten, formerly a director of Messrs. J. and E. Hall, Ltd., of Dartford. The name of the firm has been altered to W. H. Pease, Pratten & Co.

Messrs. Pettigrew & Merriman, Ltd, have removed to 122 and 124, Tooley Street, S.E. 1; telephone, "Hop 134"; telegrams, "Merrigrew, Tooley, London."

The Mullard Radio Valve Co., Ltd., have removed to 35a, Claybrook Road, Hammersmith, W. 6. Telephone number, "Hammersmith 312."

The Jackson Electric Stove Co., Ltd., have appointed Mr. W. Blogg, of the Sterling Telephone Co., of 8, Park Place, Cardiff, as their agent for the whole of Wales for their electrical cooking and heating apparatus. He will carry a stock at the address named.

The Midland Supply Co., of Birmingham, have appointed Messrs. E. L. Price, of 34, Fenchurch Street, London, E.C. 3, as their representatives for London and district in connection with the Robinson electric lifting appliances.

The E.M.F. Winding Co., who have commenced business at 75-76, Wells Street, Oxford Street, London, W.C. 1, as specialists in the repair and rewinding of small motors, wish to receive catalogues and price-lists.

Owing to the growth of their business in Ireland, the Sun Electrical Co., Ltd., have moved to larger premises, and opened new showrooms at Gibson's Building, Mill Street, Belfast, where a large stock of electric light fittings and material is available. The branch is under the management of Mr. E. P. Prior, as heretofore.

Catalogues and Lists.—Messrs. Chipperfield, Ltd., Oulton Broad, Lowestoft.—Four illustrated and priced leaflets—C/21, round pattern ignition coil; C/22, rectangular pattern ignition coils; S/23 and S/24, automatic battery cut-in and cut-out.

Mr. A. B. Cartland, A.M.I.E.E., manufacturers' representative, 3, Creechurch Lane, Leadenhall Street, E.C. 3.—Two illustrated brochures on the "Zenith" patent furnace made by Wm. Whittaker, Burnley, and an illustrated description of the "Premier" Appliances, Ltd.'s system of boiler setting for reducing coal consumption.

Metropolitan-Vickers Electrical Co, Ltd., 20, Brazennose Street, Manchester.—Circular No. 1,426, giving illustrations and exhaustive descriptions of Metropolitan-Vickers turbo-alternators. Photographic reproductions of actual installations at Glasgow, Manchester, and Cardiff are given.

Messrs. Baxter & Caunter, Ltd., 219, Tottenham Court Road, W. 1.—An illustrated and fully-detailed price-list of "Alden" oil engines and electric lighting plants made by the Alden Engine Co., Ltd.

The General Electric Co., Ltd., Magnet House, Kingsway, W.C. 2.—Bulletin No. 10, "The Condenser System of Protection against Surges." This is a valuable pamphlet explaining the nature of high-voltage and high-frequency surges and their effects. Various methods of dealing with these surges are treated of, and, finally, a full description of the condenser method is given. Many illustrations of component parts of the apparatus and of actual installations are included in the publication.

The Electrical Apparatus Co., Ltd., Vauxhall Works, South Lambeth Road, S.W. 8.—Leaflet H 29, illustrating and describing "E.A.C." float switches for a.c. and d.c. motors. Fully dimensioned and priced.

Messrs. Berry's Electric, Ltd., "The Switch House," 85, Newman Street, Oxford Street, W. 1.—A priced and illustrated pamphlet dealing with the "Midget Masta" fuse switch (*vide* Electrical Review, April 22nd, 1921, p. 509).

Messrs. Herbert Morris, Ltd., Loughborough, Leicestershire.—Book 90, giving illustrations, full details, and prices of worm-and-spur-gear pulley blocks, triple-gear pulley blocks, electric hoists, travelling trolleys, &c.

Messrs. George Ellison, Perry Bar, Birmingham.—Three lists giving exhaustive particulars, prices, and illustrations of switchgear, &c. No. 76 deals with oil-cooled rotor starters, No. 327 with totally-enclosed brake solenoids or power magnets, and No. 431 describes cable fittings, pipe flanges, sealing and dividing boxes, armour clamps, &c.

Messrs. Donovan & Co., 47, Cornwall Street, Birmingham.—An illustrated price-sheet of electrical accessories, including wall plugs, dry cells, reflectors, wire guards, fuses, Morse keys, switchgear, &c.

Messrs. Higgs Bros, Sand Pits, Birmingham.—"Monthly Magazine" (Vol. III, No. 3; May, 1921), giving details and prices of d.c. and a.c. motors, notes on insulation, and humorous items.

Messrs. Daysohms, Ltd., 14-16, Cockspur Street, S.W. 1.—Bulletin No. 6, giving a number of illustrations and a description of the principles and working of the "Daysohms" low-pressure a.c. welder.

Wage Reductions in Sweden.—The dispute with the workers in the Finsoongs Metallverksaktiebolag (Metal Works), which resulted in a strike at the beginning of March on the question of wage reductions has now been settled. The terms agreed upon are a general reduction of 20 per cent. in piecework rates, and of 15 per cent. in time rates.—*Reuter's Trade Service* (Stockholm).

New French Company.—A new company has lately been formed in Paris (16, Rue de la Pepinière) with a capital of 10,000,000 fr. and the title La Société des Forces Motrices de la Vallée d'Aspe.

Book Notices.—"The Mining Electrical Engineer." Vol. I, No. 7, April, 1921. Price 1s. net.—Among the articles included in this issue of the journal are "Surface Electrical Equipment at Mines as affected by the Regulations of July 30th, 1920," by Mr. J. A. B. Horsley (H.M. Electrical Inspector of Mines); "The 'Kingsway' No. 2 Miners' Electric Hand Lamp," by Mr. A. E. Angold; "The Electrician and the Management," by Mr. W. Cairns, &c.

"Electro Annuaire de l'Electricité et Industries s'y rattachant," for 1921. Paris: 47, Boul' de Sébastopol. Price 12 fr., post free 14 fr.—This is a most comprehensive directory of the French electrical industry. The first part of the volume gives the names, addresses, and the nature of firms carrying on electrical businesses. The arrangement is alphabetically by *départements* and towns, Paris being given the first place. A classified section follows, this being split up under various heads, such as measuring instruments, cables, heating, &c. This is followed by a trade-mark section occupying several pages. The remainder of the volume is devoted to an alphabetical list of electricity supply stations; this list appears to give even the smallest undertakings. The nature of the motive power, type of current and voltages are given in most cases. Probably the advertisements, of which there is a large number, will also prove of use. A small booklet accompanying the volume gives the names and businesses of firms in Paris by *arrondissements* and thoroughfares.

"Reid's Handy Colliery Guide and Directory for the Counties of Northumberland, Durham, Yorkshire, Cumberland, and Westmoreland." Newcastle-on-Tyne: A. Reid & Co., Ltd. Price 3s. 6d. net.—This is a new issue of a very useful handbook to the colliery industry. The usual features have been retained and revised, including the 1911 Coal Mines Act, a map giving the position of collieries, and the railway systems of Northumberland, Durham and Yorkshire, regulations for the use of electricity in mines, lists of colliery owners and managers, &c.

"Practical Testing of Electrical Machines." By L. Oulton and N. J. Wilson. Pp. 258. London: Sir I. Pitman & Sons. Price 6s. net.

"The Electrical Transmission of Photographs." By M. J. Martin. Pp. xii + 136; 73 figs. London: Sir I. Pitman & Sons. Price 6s. net.

"Is Trade Unionism Sound?" By J. H. Bunting. Pp. x + 98. London: Benn Bros., Ltd. Price 6s. net.

"Kinema Operator's Handbook." By W. S. Ibbetson. Pp. 160, 37 figs. London: E. & F. N. Spon, Ltd. Price 4s. 6d. net.

"Lichttechnik." By Dr. W. Bertelsmann, and others. (591 pp. and figs.) Munich: R. Oldenbourg. Price M. 118 unbound and M. 126 bound.

"Dynamo and Motor Erection and Management." By A. Havery. (152 pp.; 91 figs.) London: Cassell & Co., Ltd. Price 1s. 6d. net.

Lead.—Messrs. James Forster & Co. report (April 30th):—"The general position is unchanged. Apart from the effect of the strike on the domestic trade, consumption is not good, and the electrical trade, although fairly well employed on old orders, is not booking anything ahead to speak of. On the other hand, supplies are decidedly short, and are the dominating feature. Only about 2,000 tons of soft pig-lead has arrived in the Thames this month in three steamers, all from Spain, and there is urgent want of ex ship lead of suitable brands, particularly for electrical work. consumers, of course, being averse to paying prices asked for wharf lead."

New Indian Company.—With reference to the statement appearing under this heading in our issue of March 11th, page 310, we learn from Mr. H. Nimmo, of Rangoon, Electrical Inspector to the Government of Burma, that the company called the Maymyo Electric Power Station Co., Ltd., was formed recently by a Belgian subject, but he understands that that company is now defunct. He adds: "No licence has yet been issued for the supply of energy in Maymyo, but there is every reason to believe that a licence for that purpose will shortly be granted to Messrs. Van Someren & Hamid, of Rangoon, whose application is now under consideration."

The King's Roll.—In the course of a recent speech, Dr. Macnamara announced that from the close of this month all firms tendering for Government contracts, to which the conditions of membership of the King's Roll were applicable, would, unless under exceptional circumstances, require to be on the roll or they would not get the contracts. "It is high time we laid down that condition, and I think everyone will agree it is an entirely reasonable one."

West Midlands Industrial Council Meeting.—The first annual meeting of the District Industrial Council for the West Midlands Area, which comprises the counties of Shropshire, Staffordshire, Warwickshire, and Worcestershire, was held in Birmingham, on April 30th. The meeting, which was preceded by a luncheon to celebrate a successful year's work, was attended by 40 members and delegates representative of the electricity undertakings of local authorities and companies within the area, and of the Trade Unions interested in the employés of such undertakings. Mr. R. A. Chattock (city electrical engineer of Birmingham), the Chairman of the Council, presided. Steps were taken for the election of members of the Council for the ensuing year. Votes of thanks, on the motion of the vice-chairman (Mr. Alderman Gregory), to the chairman for his services during the year, and to Mr. E. J. Jennings (Birmingham), the secretary and treasurer, terminated the proceedings.

The Coal Dispute.—Reports received from various parts of the country indicate the progress of the evil effects of the stoppage of coal production. Electricity undertakings are still carrying on, but supplies for the most part have been severely curtailed. The most drastic restrictions have been imposed at Accrington, where the electricity supply has been stopped entirely between the hours of 6 a.m. and 5 p.m., except on Saturday. The tramway service is also suspended after 10 p.m. On the other hand, Salford, owing to the prevalent trade depression, has found it unnecessary to restrict power supplies or go beyond the regulations regarding lighting issued by the Board of Trade. These regulations were published on April 25th, and direct that all public lighting shall be reduced by at least 50 per cent.

In Leicester many firms have had to shut down, and Wolverhampton has been severely affected, the iron and steel industry being practically at a standstill. Sunderland Corporation has been compelled to announce that manufacturers can only be supplied with electricity for three days a week, and the Newcastle Electric Supply Co. has also imposed many restrictions. Elsewhere on the Tyne, industry is gradually coming to a stop, although efforts are being made to keep as many men employed as possible. The Leeds Corporation is also unable to supply power for more than three days a week, except in very special cases. The Leeds tramway services, in common with those of most other towns, have been reduced considerably, and many routes have been suspended for a time. The Cambridge Electric Supply Co. now entirely suspends its supply for six hours a day. Owing to the low stocks of the Southend Corporation, all tramdrivers, conductors, and semi-skilled men (numbering about 200) were given a week's notice, which was to have expired on Wednesday last. Heavy "cuts" have been arranged in the London County Council tramway services, but so far it has not been found necessary to put them into operation.

The unemployment list continues to expand, and every day another thousand is added to it. Conferences between the owners and miners, with the Government standing between, have been unsuccessful, and reports from the various centres of the industry indicate that the miners are holding out, and are prepared to starve rather than give way an inch upon their terms.

Efforts to import coal from abroad have been unsuccessful in some cases, owing to the refusal of dockers and railwaymen to handle it, but it is reported that fairly large supplies have entered the country.

A Reuter message, dated May 2nd, stated that the French Government had authorised the export of coal to this country, and that a British firm desired to purchase 10,000 or 15,000 tons daily.

Swedish Electrical Preference.—The Swedish Electrical Industry Association is asking the Government to urge the municipalities when making purchases to give preference to Swedish goods.—*Reuter's Trade Service* (Stockholm).

Applications for British Trade-Marks.—Appended is a summary of the recent applications for British trade-marks in respect of goods and productions associated with the electrical trades and industries:—

Designs comprising a triangle and bars, Nos. 412,520 and 412,521, Class 13.—Electrical Appliances.—Hotpoint Electric Appliances Co., Ltd., 33, Cannon Street, London, E.C., February 15th, 1921.

Dictograph, No. 409,021, Class 8.—Telephone Instruments and Apparatus.—Dictograph Telephones, Ltd., Dictograph House, Denman Street, London, S.E., October 22nd, 1920.

Design, No. 404,243, Class 50.—Electric Insulating Preparations. —Koln - Rottweil Gesellschaft, 36, Dorotheenstrasse, Berlin, Germany, May 18th, 1920.

Acousticon, No. 409,022, Class 11.—Telephone Instruments and Apparatus for the Aid of Deaf Persons.—Dictograph Telephones, Ltd., Dictograph House, Denman Street, London, S.E., October 22nd, 1920.

Syncela, No. 410,334, Class 50.—Artificial Filaments, made wholly, or principally, of cellulose derivatives, electric insulating materials, &c.—British Cellulose and Chemical Manufacturing Co., Ltd., 8, Waterloo Place, London, S.W., December 2nd, 1920.

Celanese, No. 411,818, Class 50.—Artificial Filaments, made wholly, or principally, of cellulose derivatives, electric insulating materials, &c.—British Cellulose and Chemical Manufacturing Co., Ltd., 8, Waterloo Place, London, S.W., January 24th, 1921.

Fibrestos, No. 412,509, Class 50.—Sheets and Blocks of Cement and Asbestos, to be used as Electrical Insulators.—Siluminite Insulator Co., Ltd., The Green, Southall, Middlesex, February 15th, 1921.

Fiprallee, No. 412,289, Class 50.—Electrical Accessories made from asbestos.—Albert Lee & Co., Ltd., 8-9, New Zealand Avenue, London, E.C., February 8th, 1921.

Printing and Allied Trades Exhibition.—On Saturday, April 30th, Dr. Macnamara, Minister of Labour, formally opened the sixth International Printing, Stationery, and Allied Trades Exhibition, at the Agricultural Hall. Afterwards a luncheon was held, when the speakers included Mr. E. W. Humphries, President of the Master Printers of Great Britain and Ireland; Mr. G. H. Roberts, M.P., and Mr. C. W. Bowerman, M.P., President of the Printing and Kindred Trades' Federation. Former enemy countries have been excluded from the exhibition, but, in spite of this, it is larger than any of its predecessors. In our next issue we propose to give a description of some of the exhibits which, naturally, include a large amount of electrical apparatus. The show remains open until May 14th.

High Wages and Industrial Depression.—Mr. W. L. Hichens, chairman of Cammell, Laird & Co., Ltd., in a statement issued a few days ago, says:—

"The question that is exercising the mind of everyone in the industrial world to-day is 'How are we to get back our trade?' How is the present depression to be overcome and unemployment to be banished? And there can only be one answer—by lowering prices. If we want to widen the field of those who purchase our goods it can only be done by selling cheaper. In fact if we wish to maintain our position as a great manufacturing nation we shall be obliged to cut down our prices. For in the world markets success comes, other things being equal, to those who can quote the lowest price, and it is idle to suppose that the world will buy from us if Germany or America or some other manufacturing nation offers to supply the same goods at a cheaper rate. It is well known that in the iron and steel industries German, Belgian, and American prices are very considerably below ours, whilst even our shipbuilding supremacy is threatened by German competition. For a short time possibly we may obtain orders in overseas markets owing to goodwill, but inevitably the time must come when our foreign clients will be obliged to buy in the cheapest market. Hence, it is essential that we should set our house in order and make up our minds to adjust our prices to those of our foreign competitors. This must be done in a number of ways; every form of economy must be exercised. The Government must set the example, and municipalities must follow suit, for the cost of Government and municipal taxation presses on industry with terrible weight, and is a severe handicap in world competition.

"Again, up-to-date and efficient machinery must be installed wherever it is lacking if we are to keep our heads above water, and economies of management must be carefully studied. Profits, too, must suffer, and in point of fact the ordinary shareholder is always the first to feel the pinch of bad times. Many firms at the present time are making quotations which include no profit at all, and often work is taken at a loss merely for the sake of keeping the place going and preventing unemployment.

"But however great the economies that are effected in these directions, they will not suffice to reduce our prices to a level with those of some of our foreign competitors. It is inevitable that there should also be a reduction in wages and salaries. Nobody wants to reduce wages; the higher they are the better, so long as the consumer is able and willing to pay the price. Everyone desires to see a civilised wage assured to all the workers in this country. But, if, after making every possible economy in other directions, British prices are still too high, then wages must either be reduced or cease altogether.

"In the iron and steel industry to-day German and Belgian prices for finished articles do not cover the bare cost of labour and material in this country, leaving nothing for overhead charges and profit. Nor would any reasonable reduction in the wages of the iron and steel industry alone suffice. There must be a big reduction in the price of all raw materials, in the price of pig iron and of coal. And this involves a reduction of wages in these trades, for wages are by far the biggest item in the costs of production. If it cannot be secured the iron and steel industry will lose its world market, and as a result will consume but little coal, so that large numbers of miners will be thrown out of employment, and instead of half a loaf will get no bread.

"The interests of all the big industries are closely related, and the misfortunes of one are bound to react on others. No industry can, in the long run, pursue a selfish policy without suffering for it. If, for example, the miners are strong enough to insist on keeping up the price of coal by maintaining high wages, they will ruin the other industries of the country, but they will also be dragged down themselves in the catastrophe. In their own interests, and in those of the community, the only sound course for the miners is to aim at supplying coal to the consuming public at the cheapest possible rates.

"The dominant factor in the industrial situation to-day is that our prices are too high in relation to those of our foreign competitors, and they can only be brought down to an effective level if every section of the community is prepared first of all to recognise the facts and then to bear its share in the sacrifices that are involved."

Electric Vehicle Licences.—Statements have recently been made to the effect that owners of electric commercial vehicles can claim to have their vehicles licensed under paragraph 6 of the Second Schedule to the Finance Act of 1920. Paragraph 6 referred to reads as follows:—"6. Any vehicles other than those charged with duty under the foregoing provisions of this schedule: Not exceeding 6 horse power or electrically propelled, £6; exceeding 6 horse power, £1 for each unit or part of a unit of horse power."

On such a statement it might be difficult for any owner of a commercial electric vehicle to convince the licensing authority that he was entitled to claim a licence under this paragraph for a commercial vehicle. This difficulty is now removed by a letter which Mr. F. Ayton, the honorary secretary of the Electric Vehicle Committee of Great Britain, has received from the Roads Department of the Ministry of Transport:—"I am directed by the Minister of Transport to state that a vehicle, whether electrically or otherwise propelled, weighing more than 8 cwt. unladen, which is constructed or adapted for use and used solely for the conveyance of goods in the course of trade, is chargeable with duty based on its unladen weight in accordance with paragraph 5 of the Second Schedule to the Finance Act. The Minister has, however, been advised that where a vehicle which is constructed and adapted for use for the conveyance of goods is used for other purposes, in addition to the conveyance of goods in the course of trade, the owner is entitled to obtain a licence under paragraph 6 of the Second Schedule to the Finance Act, 1920, as the vehicle is not used *solely* for the purposes mentioned in paragraph 5 of that schedule."

Accordingly owners of commercial electric vehicles, irrespective of the unladen weight, are advised, when applying for a licence, to make the application under A1 (B) of form R.F. (1) (they should decline to make it on form R.F.4 A) stating that they intend to use the vehicle or vehicles for other than solely trade purposes.

Forthcoming Exhibitions.—The following exhibitions are being organised:—

London.—June 3rd to 17th, Rubber Trades' Exhibition; July 4th to 15th, London Fair and Market; September 7th to 28th, Shipping, Engineering, and Machinery Exhibition; October, Society of Motor Manufacturers and Traders; November 17th to 25th, Public Works, Roads, and Transport Exhibition. 1923—British Empire Exhibition.

Folkestone.—June 20th to 29th, Health Exhibition.

Leeds.—July 21st, Yorkshire Agricultural Show.

Manchester.—May 31st to June 11th, Efficiency Exhibition.

Cardiff.—1922—Welsh National Exhibition.

British Dominions.—June, 1921, Dominions Touring Exhibition (*South Africa, Canada, Australia, and New Zealand*).

France.—(*Bordeaux*) June 15th to 30th, International Samples Exhibition.

Switzerland.—(*Basle*) May 28th to June 8th, International Automobile Exhibition.

Holland.—(*Utrecht*) September 6th to 16th, International Industrial Fair.

Iceland.—(*Reykjavik*) June, World's Fair.

Peru.—(*Lima*) June 1st to October 31st, International Industrial Exhibition.

Argentina.—(*Buenos Ayres*), 1922, International Exhibition.

Brazil.—(*Rio de Janeiro*), 1922, International Centenary Exhibition.

Mexico.—September, Commercial and Industrial Fair.

Java.—(*Bandoeng*) September 19th to October 9th, Netherlands East Indies Fair.

Czecho-Slovakia.—(*Prague*) May 28th to June 5th, Automobile Exhibition. (*Reichenberg*), August 13th to 21st, International Fair.

Poland.—(*Warsaw*) May, Building and Fire Protection Exhibition. (*Posen*), May 28th to June 5th, Fair.

Sweden.—(*Gothenburg*), July 4th to 10th, Fair.

Italy.—(*Padua*), June 1st to 15th, Samples Fair.

Spanish-American Electricity Co.—As may be remembered, a company was formed in Madrid last June under the title of the Compania Hispano-Americana de Electricidad to acquire the undertaking of the German Transmarine Electricity Co., of Berlin and Buenos Ayres, which was taken over as from January 1st, 1920. Although the accounts have not yet been published for the first year's activity of the new company, a Spanish newspaper devotes nearly three columns to recording the progress made by the great supply system in Buenos Ayres in 1920 and of the other supply and tramway systems in other parts of South America which also formerly constituted part of the German company's properties either directly or by shareholding. Statistics are given of the production and sales from the pre-war year of 1913 to the end of 1920, and it is shown that in the case of the Buenos Ayres works the consumption rose from 216,365,000 kW-hours in 1919 to 248,868,000 kW-hours last year, while the receipts advanced from 33,811,000 paper pesos to 36,910,000 paper pesos in the two years respectively. It is further mentioned that as a result of the fall in the prices of coal last year, the company entered into contracts for the delivery of 180,000 tons of coal and 100,000 tons of petroleum.

Parliamentary.—Last week a Select Committee of the House of Lords, under the chairmanship of the Marquis of Bristol, considered a Bill promoted by the County of London Electric Supply Co. to enable the company to erect a generating station at Barking, subject to the sanction of the Electricity Commissioners, and to raise the necessary capital for that purpose. The Bill was amended and ordered to be reported.

The Lochaber Water Power (Substitute) Bill was before a Committee of the House of Commons, Sir Harry Samuel presiding.

Brown-Boveri in Poland.—The Polish Electricity Works Co. (Brown-Boveri) is being formed at Warsaw by Brown, Boveri & Co., of Baden, and a Polish bank, to supply installation material made by the Swiss works. Manufacturing is also to be undertaken, and workshops for this purpose are reported to have already been acquired at Lemberg.

Patents, Designs, and Trade Marks.—The annual report of the Comptroller-General of Patents, Designs, and Trade Marks shows that the total number of applications filed during the year 1920 was 36,672, by far the largest number on record; the increase was largely due to the filing of applications from abroad under the Peace Treaties. Complete specifications numbered 21,796, an increase of 2,874 over the previous year. Applications communicated from abroad numbered 1,265, and applications under the International Convention for the Protection of Industrial Property numbered 6,797, compared with 2,661 in the previous year. Applications to register designs numbered 13,669, and there were 14,064 applications to register trade marks.

The receipts from fees for patents amounted to £420,472; for designs, £8,691; and for trade marks, £39,295, making, with other items, a total of £487,542, an increase of £83,067 over 1919. Salaries amounted to £274,654, an increase of £72,119, due to the Civil Service war bonus. The receipts exceeded the expenditure by £86,507.

Electrical Wages: Agreed Reduction.—We learn that at a conference of the National Executives of the National Federated Electrical Association and the Electrical Trades Union, held at York on April 20th last, the two sides agreed jointly to recommend a reduction of 10 per cent. in the present rate of wages in two instalments—namely, 5 per cent. to come into force on the first pay day following May 9th for the pay period covered by that pay day, and a further 5 per cent. to come into effect on the first pay day following July 9th for the pay period covered by that pay day.

German Exports for East Africa.—The High Commissioner of Mozambique has telegraphed to the Portuguese Government that there is no objection to qualified German experts working for Portuguese companies in East Africa.—*Financial Times.*

Directors' Fees.—The point has arisen whether a director of a public company who has served in that capacity for less than a year is legally entitled to any remuneration for his services rendered during that time. In a case recently before the Courts, the plaintiff had acted as director of the defendant concern for about six months, when, owing to a dispute with his colleagues, he retired. He claimed the whole or part of his annual fee. The County Court Judge held that as he had not served for the full 12 months he was entitled to nothing. The Divisional Court has now reversed this decision, ruling that it was an implied term in the contract that a part of the plaintiff's salary was payable in proportion to his period of service. So far so good. The matter has a further interest for business men, however, because in the case of some companies, a certain sum is annually set aside as directors' fees, to be divided in such proportions among the parties as may be agreed. We are able to state that the Divisional Court's decision does not here apply, for the standing judgment is that under any arrangement for "bulk remuneration" no director is entitled to take anything out of the pool until he has completed a full year of office.

Coke for Steam Raising.—In a test made by the Gas Light & Coke Co., at Beckton Gas Works, to determine the best efficiency which could be obtained with a Lancashire boiler fired with large coke and fitted with "turbine" furnaces, made by the Turbine Furnace Co., Ltd., the draught produced by the chimney was 0.1 in. in the side flues, while the steam jets under the bars provided a pressure of 0.45 in.; the fuel was large coke, containing about 10.5 per cent. of ash. The test was carried on for six hours, during which 3,900 lb. of coke was consumed and 39,725 lb. of water evaporated. The average steam pressure was 77.6 lb. per sq. in., the feed temperature 50 deg. F., and the flue gas temperature 972 deg. F., the gases containing 18.3 per cent. of carbon dioxide. The fuel consumption worked out at 8.14 lb. of water per pound of coke, as fired, or at 9.8 lb. of water from and at 212 deg. F.

Cost of Living in China.—Writing in the *British Chamber of Commerce Journal*, Shanghai, for March, a correspondent says:—

"It should be clearly understood by engineers thinking of coming to China, that, the cost of living having risen to such a height, unless the allowances in addition to salary include housing, passages for the family both ways, allowance for increased cost of living (20 per cent.), hospital expenses, the admission to a pension or provident fund, and payment of salary (if in sterling) in 2s. dollars, the salary alone is quite inadequate for married people. All first-class foreign institutions give most, or all, the allowances named, and many of them a bonus as well, but the Chinese Government services allowances are in many cases inadequate and below the standard of the foreign firms."

Trade with Germany.—Mr. J. W. F. Thelwall, Commercial Secretary for Germany, will be working from May 2nd to May 14th in the Department of Overseas Trade, where he will be pleased to interview British firms interested in trade with Germany. Applications for such interviews should be addressed to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, S.W.1, and should bear the reference number F.W. 97231.

A French Amalgamation.—It is stated that a new company is to be formed to combine the Ateliers de Constructions Electriques du Nord et de l'Est (Jeumont) and the Forges et Ateliers de La Longueville.

The Electricity Supply Bill.—The Special Committee of the London County Council on London Electricity Supply recommends the passing of the following resolution:—"That the Council welcomes the introduction by H.M. Government of the Electricity (Supply) Bill, 1921, supplementary to the Electricity (Supply) Act passed in 1919, and urges upon the Government that in the public interest it should take every step in its power to ensure this measure becoming law during the present session of Parliament."

For Sale.—Burnley Corporation Electricity Department invites offers for one 250-kW triple-expansion Belliss-Dick, Kerr generating set, with condensing plant; also for one Lancashire boiler. See our advertisement pages to-day.

The B.E.A.M.A. New Members.—We are informed that the following firms have been recently elected members of the British Electrical and Allied Manufacturers' Association:—Babcock & Wilcox, Ltd.; Bonnella Bros; Clark, Robt., Ingham and Co., Ltd.; De la Rue, Thos., & Co., Ltd.; General Accessories Co., Ltd.; Power Plant Co., Ltd.; Sutcliffe (of Crumpsall), Ltd.; Venner Time Switches, Ltd.; Widdop Engine Co., Ltd.; Wilson, Hartnell & Co., Ltd.

Welsh Engineers' Wages.—It was officially announced at Swansea, last week, that, as a result of a ballot in the Welsh engineers' and founders' trades, the wages of fitters and moulders were to be reduced from £5 10s. to £5 per week, and labourers from £4 to £3 15s., on and from May 1st. The salaries of draughtsmen and clerks and the wages of firemen were to be reduced *pro rata* to the reduction on skilled workers' rates.—*The Times.*

Patent Restoration.—An order has been made restoring Letters Patent No. 2,045, of 1915, granted to J. P. Haworth, for "Improvements in electric accumulators."

LIGHTING AND POWER NOTES.

Accrington.—Supply from Blackburn.—Recently the Accrington Corporation, acting on the advice of the Electricity Commissioners, approached Blackburn for a bulk supply from the new station, in preference to extending the generating station at Accrington. The town clerk now reports that no offers or terms have come to hand, and he has been instructed to inform the Electricity Commission accordingly. Blackburn's contention is that the matter should not be pressed until the new station at Whitebirk is completed.

Aldershot.—Military Bulk Supply.—The Urban District Council has completed arrangements with the War Office for a supply of electricity in bulk from the Camp generating station. The estimated cost of the necessary feeders, converting machinery, switchboards, &c., is £18,000; the extension of the Council's own plant would cost about £25,000.

Aylesbury.—Inquiry.—On April 19th, Mr. M. K. North, Ministry of Health inspector, held an inquiry into the application of the Town Council to borrow £3,500 for the provision of electrical pumping plant at the sewage works, and also £1,144 for the laying of mains from the Council's power station to the works. It was explained that hitherto the works had been carried on by means of gas engines, but these were now worn out, and it was calculated that by the installation of electric motors a saving of £163 per annum could be effected.

Bath.—Loan.—The Electricity Committee has decided to apply to the Electricity Commissioners for sanction to borrow £30,000 for mains, &c.

Blackpool.—Increased Demand.—The electrical engineer states in his annual report that the withdrawal of restrictions on the purchase of materials for mains and service extensions has resulted in an abnormal number of applications for an electricity supply. The department has, for the first time, been compelled to institute a waiting list of consumers. The estimated profit on the year's working was £6,000, compared with £5,269 in the previous year. The units generated were 8,568,523, an increase of 1,379,369, equivalent to about 20 per cent. There was an increase of nearly 400,000 units for tramway purposes.

Bolton.—Effect of Trade Depression.—The Electricity Committee, on April 29th, considered a report from the electrical engineer making suggestions for counteracting the possible reduced demand for energy on the finances for the year ending March 31st next. Through trade depression there has been a considerable falling-off in the demand, and the engineer suggested that, in order to reduce expenditure, the extensions in progress at the Back-o'-th'-Bank works should be slowed down temporarily. This was agreed to.

Bridlington.—Price Increase.—At a meeting of the Electricity Committee the town clerk reported that the Minister of Transport had made an order authorising an increased charge for electricity not exceeding the sum of 11d. per unit, and also authorising the following minimum charges for electricity:—(*a*) In respect of each of the quarters ending March 31st and December 31st, for any amount up to 15 units, 13s. 9d.; (*b*) in respect of each of the quarters ending June 30th and September 30th for any amount up to 10 units, 9s. 2d. The Committee considered the advisability of increasing the minimum charge for electricity, which at the present time is 7s. 6d. per quarter, and decided to defer the further consideration of the matter for the present.

Continental.—Finland.—The Finnish Diet has voted F.Mk. 10,500,000 for the preliminaries to the canalisation of the Imatra and Anjala Falls, with a view to the establishment of power-stations there.—*Economic Review.*

Germany.—Herr Hugo Stinnes has been asked to take in hand the project for water-power development in East Prussia. The waters which it is proposed to harness are those of the Masurian Lakes, which supply the Aller, upon which the necessary dams and works will be constructed.

Portugal.—A commission has been appointed by the Portuguese Government to consider the advisability of establishing plant for the generation of electric power.—*Times Trade Supplement.*

Durham.—Agreement with Company.—The County Education Committee has concluded an agreement for a supply of electricity with the County of Durham E.P.D. Co. The terms of the agreement include the erection of a sub-station and purchase of plant by the Education Committee; the plant is to be installed by the company at a cost of £680. Special prices have been arranged.

Ealing.—Loan Sanctioned.—The Council has received the sanction of the Electricity Commissioners to a loan of £28,895, to be utilised as follows:—Mains (specific extensions), £12 500; mains and services (prospective expenditure), £8,000; total, £20,500; transformers (prospective expenditure), £2,500; meters (prospective expenditure), £3,500; expenditure prior to March 31st, 1920—mains, £1,350, and meters, £1,045. The Council's application was for £30,000.

Electricity Districts.—London and Home Counties.—The Electricity Commissioners have given notice that they will hold a local inquiry at the Institution of Electrical Engineers, Victoria Embankment, London, W.C., on Tuesday, June 14th, 1921, at 10.30 a.m. and the following days with reference to the area to be included in the proposed district and the objections and representations which have been made, and to consider schemes which have been submitted respectively by (*a*) The London County Council; (*b*) The Conference of Local Authorities Owning Electricity Undertakings in Greater London; (*c*) The London Electricity Joint Committee, 1920, Ltd.; [in each case for improving the existing supply of electricity, and for the formation of a Joint Electricity Authority]; (*d*) The Metropolitan Borough Council of Poplar [for improving the existing supply of electricity in "East London and District," and for the formation of a Joint Electricity Authority for such district]; (*e*) The Great Eastern Railway Co.; and (*f*) The London, Brighton and South Coast Railway Co. [in both cases for improving the existing supply of electricity]. Copies of the respective schemes may be obtained from the authorities concerned.

Aire and Calder.—The Bradford Corporation has asked for a further postponement of the Leeds inquiry from May 18th, but the Electricity Commissioners, last week, refused it. There are, of course, possibilities of its further postponement if the miners' strike continues. It is expected that the inquiry might extend over 10 days, but efforts are to be made to bring it within a week if possible. Points of policy, rather than technicalities, are the main theme of dispute.

Glasgow.—Mercury Rectifiers.—At a meeting of the Electricity Committee, relative to the acceptance of an offer by Messrs. Brown, Boveri & Co., Ltd., for the supply of mercury vapour rectifiers, which are being manufactured in Switzerland, the manager reported that considerable delay had taken place in the delivery of the rectifiers, and the Committee, after consideration, authorised him to visit the works of the contractors, with the view of ascertaining the cause of the delay and the progress which had been made with the manufacture of the rectifiers.

Protection Against Floods.—The engineer and manager of the Corporation electricity department proposes to install a floating boom or fender on the river Clyde, with the view of obviating trouble which has arisen in times of flooding on the river, when heavy floating *debris* chokes the circulating water inlet in connection with the new Dalmarnock works.

Great Harwood.—Electricity Supply.—The Council on April 20th received a letter from the town clerk of Blackburn, stating that the electrical engineer had informed him it was difficult, under present circumstances, to fix a date on which electricity would be supplied to Great Harwood, but he might safely say the supply would be available in parts of Great Harwood for next winter.

Guisborough.—Proposed Electricity Supply.—At a recent meeting of the Council a report on the question of the electric lighting of the town was referred to a meeting of the Council and representatives of the Cleveland and South Durham Electric Supply Co., Ltd.

Hawarden.—Electricity Supply.—A special meeting of the District Council has been held to consider the question of electricity supply, and the report of Mr. J. W. Speight, M.I.E.E., A.M.I.Mech.E., on the proposed scheme for the supply of electricity to the district. The report stated that Mr. Speight had gone fully into the draft agreement with the Secretary of the War Office and the Joint Committee, and it was estimated that the capital expenditure required to obtain a supply from H.M. Factory at Queensferry would be roughly £50,300, to be divided amongst the various authorities according to their rateable values. The apportionment of the Hawarden Rural District Council would, therefore, be £12,490. According to the estimate of Mr. Britton (electrical engineer of Chester), the cost of generating at Queensferry was roughly 9d. per unit, and he understood that the Chester Corporation was prepared to give a supply of electricity to the Hawarden Council in bulk at a price, including all charges, of 6.26d. per unit. His estimate of the electricity required for light and power was 81,406 units. Mr. Speight was of opinion that the amount of capital the Council would have to subscribe if it were part of the Joint Committee, would be a serious obstacle to the undertaking at the commencement, but by arranging to take the supplies from Chester in bulk, it would not be burdened with a large capital expenditure in high-pressure transmission lines.

Haywards Heath.—Electricity Supply.—Application has been made to the Electricity Commissioners by Mr. E. A. Bridge and others, for authority to generate and distribute electricity for public and private purposes within the urban districts of Haywards Heath and Cuckfield.

Hebden Bridge.—Water-Power Scheme.—The generation of electricity by water power from the River Hebden, flowing through the woods of Hardcastle Crags and the Hebden Bridge Valley, is contemplated by Mr. John C. Mitchell, worsted manufacturer, Old Town Mills, for the driving of his machinery. He has taken the necessary initial steps.

Heysham.—Electricity Canvass.—In response to an inquiry with regard to the North Lancashire and South Cumberland Electricity Supply District, the District Council has agreed to take a canvass of the district to obtain an estimate of the probable consumption of electricity in the area.

Leicester.—Loan.—At a meeting of the Leicester Town Council, on Tuesday, a report submitted by the Tramways and Electricity Committee was adopted, deciding to make application to the Electricity Commissioners for sanction to borrow £723,000 for the first section of the new power station to be erected on the Freemen's Meadow. Ald. Flint, the chairman of the committee, explained that the Commissioners had sanctioned £450,000 on account, stating that before they could deal with the balance, details would be required of the various items of expenditure. The Committee, therefore, had decided to arrange for the installation of one 10,000-kW generator at the present time, instead of two as originally provided for.

London.—Stepney.—The Finance and Parliamentary Committee recently had under consideration a claim from a biscuit manufacturing firm in the district for a sum of £175, the value of five tons of biscuits which, it was alleged, were destroyed by a stoppage of electric power. The claim was repudiated.

Lowestoft.—Loan.—The Town Council is applying for sanction to borrow the sum of £1,385, which represents the expenditure incurred in purchasing the assets of the Oulton Broad Electricity Co., acquired under the Provisional Order for the extension of the borough.

Morecambe.—Price Increase.—The Town Council last week approved a recommendation of the Electricity Committee that the price of electricity for lighting be increased from 8d. to 9d. per unit. A proposed increase from 4½d. to 5d. per unit for power was defeated. In the annual finance statement, last week, Alderman Jos. Snowdon said the street lighting department required £3,740 for the coming year, including £800 to be taken by the Gas Committee, and £1,330 by the Electricity Committee. The Electricity Committee estimated its deficiency at £2,124, including £1,650 special repairs to mains and batteries. The Electricity Committee was now having to pay 42s. per ton for coal, as against 8s. 6d. per ton before the war, and the wages bill had increased four-fold.

Preston.—Report on Electricity Supply.—Mr. J. A. Robertson, M.I.E.E., in a report to the Corporation on electricity supply, says that the capital necessary for development can be raised more quickly by the Corporation which will have direct representation on a joint authority. "The Corporation," he adds, "is in the fortunate position of having a site close to the borough, upon which a modern station could be erected capable of producing electricity at a minimum cost and sufficient for all future demands. The extent of Preston's requirements can be gauged by a reference to other towns with similar industrial conditions. In some towns the consumption of electricity per head of population exceeds 200 units; the averages of nine Lancashire towns depending chiefly on the cotton industry is 127 units per head. In Preston the average is only 22, this being about the lowest consumption of any industrial town in the country. Immediate steps should be taken to construct a new station on the site already acquired on the south side of the Ribble. Allowing a period of two years for construction, the station would be completed to meet the winter load of 1923-4. In the meantime the plant at Crown Street Station should be used to its fullest capacity. The new station would be designed to generate high-pressure three-phase current, which would be delivered by duplicate cables at 11,000-V pressure to Crown Street. The Ribble site is directly open to the coal-fields of South and East Lancashire and West Yorkshire. Coal should be conveyed by aerial transporters from the dock railway system, and deposited direct in overhead bunkers in the boiler house. The estimated capital expenditure for the new works is £379,000."

Newark. — Proposed Extensions. — At a meeting of the Town Council on April 25th, it was proposed to postpone the scheme of extensions for a period of two years owing to opposition on the part of several large firms in the district. The proposal was eventually defeated, and it was resolved to apply for a provisional order for powers to carry out the extensions.

Rhymney. — Proposed Electricity Supply. — The Urban District Council has decided to consult Mr. Ellis. of Cardiff, on the question of securing a supply of electricity for the town.

York. — Hydro-Electric Scheme. — The York City Council has been informed that the Electricity Commissioners do not approve at the present time of the Corporation's proceeding further with the Stamford Bridge hydro-electric scheme.

The Grampian Schemes.—Settlement of Differences.—The *Scotsman* states that the differences between the Grampian Electricity Co. and the Lochaber Water Power Co. with regard to their respective schemes have been settled. The Grampian Co. has agreed to withdraw its application for the use of the Pattack waters in Laggan, thus leaving them free for the Lochaber scheme should it receive Parliamentary sanction. Upon this understanding the Lochaber Co. has also withdrawn its opposition, so that the two schemes are no longer competitive. The promoters of the Inverness-shire scheme have come to a friendly understanding with riparian proprietors and other individuals who lodged objections. The chief opposition that now remains is that of fishery and other interests on the lower reaches of the River Spey.

The Convener of Dundee Corporation Electricity Committee states that there is every possibility of the scheme being abandoned. The Corporation engineer had had some conversations with the syndicate during last week, and the culmination was a letter stating that they had decided to abandon the Bill for the session.

Wye (Kent).—Electricity Supply.—The Wye Lighting, Heating and Power Co , Ltd., is applying to the Electricity Commissioners for authority to provide and distribute electrical energy for lighting and heating for public and private purposes within a certain portion of the parish or township of Wye.

TRAMWAY AND RAILWAY NOTES.

Barrow-in-Furness. — New Depôt.—Operations have been commenced on the building of the new tramway depôt, giving work to a number of unemployed men in the task of excavation. The new depôt will provide a substantial enlargement of the present accommodation, and also mess and recreation-rooms for the tramway employés.

Electric Vehicles.—At a meeting of the Town Council, on May 2nd, the Health Committee reported the receipt of a letter from the Ministry of Health, stating that it was not prepared at the present time to sanction a loan for the purchase of four electric vehicles, but in view of the necessity for increased apparatus to carry house refuse to the new Cocken Bridge Tip, and in order to avoid any relaxation in the present refuse collection service, it had been decided to sanction a loan of £3,520 for the purchase of two vehicles, and the Minister would be prepared to issue sanction to a loan of £800 for the provision of charging plant on being furnished with a copy of a resolution of the Council, authorising application for sanction to borrow for that purpose. It was decided by the Council to approve a recommendation to defer consideration of the matter until the next meeting of the Health Committee.

Birmingham.—Electric Vehicles.—The Salvage and Stables Department of the Birmingham Corporation is making increasing use of electric vehicles for refuse collection. It reported this week to the City Council that deliveries under the contract with Edison's, Ltd., for 25 electric vehicles at £1,280 each had been completed. Three further vehicles had also been delivered for the sum of £1,804 each, and a fourth was to be purchased. The system of refuse collection had been wonderfully speeded up by the use of electric vehicles. The lighting of the depôt was effected by an existing generator. The amount paid to the electricity supply department for power was approximately £3,000 per annum, and it was estimated that there would be a total saving of approximately £2,000 per annum.

Bradford. — New Cars. — The Tramways Committee recommends the expenditure of £13,000 on the building of seven railless trolley-cars—six of a type to be driven and conducted by one man, and one experimental double-deck car with six wheels. It is proposed to build the cars at the Thornbury depôt of the Corporation, where the double-deck railless car at present in use was built. and from plans by the general manager. The advantages urged are economy in running cost and smoothness in travel. It is claimed that the one-man cars will save 4d. per mile. They will seat 30. one passenger more than the present single-deck railless cars. and they will have a smoking compartment. Mr. Wilkinson holds that the present cars are too frail for their work, and the new cars proposed will be much more substantial. The six-wheel experiment has been sanctioned by the Ministry of Transport. the contention being that the third axle will ensure smooth running and avoid wear and tear. The double-deck car is estimated to cost £2,200, as against £1,800 for each of the others.

Collision.—A collision occurred, last week, between a Corporation electric tramcar on the Lidget Green route and a steam wagon belonging to Messrs. Mercer & Co., haulage contractors. All the windows on one side of the lower saloon of the car were smashed, and the passengers were greatly alarmed, but there was no personal injury.

Tire Contract.—Despite repeated criticism, the Tramways Committee has decided to reaffirm its original decision to place with the Anglo-Belgian Improvements Corporation, the order for 100 steel tires. An error in tendering had been made, in respect of the class of steel, and critics contended that the Committee had not subsequently given English tenderers proper opportunity.

Chesterfield.—Time Extension.—The Minister of Transport has extended the time until July, 1922, of the Chesterfield Corporation Act, 1914, for the completion of the tramways and railless system.

Continental.—Spain.—In their report for last year, the Société des Tramways de Barcelona state that they are making preparations for various extensions and improvements in the electric tramways in Barcelona. In addition to extra rolling stock, much work requires to be done in connection with the track, especially at the crossings and points which were neglected during the war. The feeder system requires development. and in this connection three more 750-kW converters have been ordered for converting high-pressure alternating to continuous current. Already about 30 km. of new rails and a quantity of crossings and points have arrived in Barcelona.

Belgium.—The Labour demonstration of May 1st left Brussels without a tramway service, and motor-omnibuses were extensively employed. The company running the Antwerp cars pointed out to the employés that a cessation of work would constitute a breach of agreement, and it was decided, therefore, to run the cars on May 1st.

Edinburgh.—Tramway Electrification.—The Corporation Tramway Committee has agreed to the electrification of the Broughton route, in addition to the Liberton section of the tramways.

Guiseley.—Protest Against Fare Increase.—The Urban District Council last week decided to enter a formal protest against the Leeds tramway department's proposal to apply for powers to advance the statutory maximum fares from 1d. to 2d. per mile, and workmen's fares from ½d. to 1d. per mile.

Halifax.—Track Renewals.—The Tramways and Electricity Committee has recommended the relaying, &c., of certain portions of the tramway track on the Causeway Foot section at an estimated cost of £36,050, and the relaying of the track on the Pellon section at an estimated cost of £19,500.

Huddersfield.—Collision.—A Corporation tramcar and a heavily-loaded motor wagon collided in the Huddersfield Market Place on Friday night last, and the driver of the wagon, Charles H. Terry, of Bradford, had to be taken to the Infirmary with severe injuries. The driver of the tramcar and another man on the wagon were slightly hurt.

Hull.—Decorated Cars.—In an endeavour to beautify and brighten up the city, the Hull Corporation has put two gaily-painted tramcars into commission. Owing to their success it is intended to paint several more. The decorations consist of coats-of-arms and artistic designs.

London. — Traffic Co-ordination. — The London County Council is recommended by the Special Committee of Inquiry on Tramways to ask for the introduction by the Government of legislation to make provision for the unified operation of local passenger transport undertakings in Greater London. and for the setting up for such area of a municipal traffic control authority, to be appointed by the local authorities affected. The report points out that in Greater London there are some 122 road authorities exercising various powers of control. There are now being operated in this area about 17 systems of tramways and a large number of motor-omnibus undertakings, with numerous local railway systems in addition. The opinion is expressed that if the undertakings were worked in co-ordination, very great benefits could at once be secured for the public, while considerable financial advantages would accrue to the individual undertakings.—*Morning Post.*

Rawtenstall.—Loss in Working.—There was a loss of £1,746 on the tramways and £5,154 on electricity during the past year.

Sunderland.—Abolition of Workmen's Fares.—The Tramways Committee has received the sanction of the Ministry of Transport to the abolition of workmen's fares. Artisans, mechanics and labourers are now being charged the full fare when going to or returning from work.

Loan.—Permission is to be sought to borrow the necessary money for doubling the track from Spelter Works Road to the Grangetown terminus, to effect an improvement in the Barley Mow Bank, Ryhope Road, and to construct an additional entrance into the Wheatsheaf depôt *via* Dundas Street.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—Imperial Wireless.—Mr. Wise, the Australian Postmaster-General, states that preliminary action was taken early this year for the selection of a site in Western Australia, on which to erect a wireless station in connection with the Imperial chain.

The Telephone Service.—Mr. Pike Pease (Assistant Postmaster-General), in reply to questions in the House of Commons, said that about 9,800 telephone subscribers had given notice to terminate their agreements during the four months ended March, 1921. As nearly as could be ascertained, about 3,000 of those notices were the result of the increased charges. The total number of telephones in service at December 31st, 1920, in the United Kingdom was 988,500, and in the United States approximately 13,500,000. The ratio of telephones to population was one telephone to every 47 inhabitants in the United Kingdom, and one to every eight inhabitants in the United States.

According to Sir W. Noble, engineer-in-chief to the Post Office, about £10,000 per annum is spent on telephone research work, but in America the telegraph and telephone companies spent £1,000,000 a year on such work. Automatic stations were working satisfactorily; at present they had 15 such stations established in which four different systems were working, and a fifth would be tried shortly. Of the four systems, one was less satisfactory than the others, and would not be used again. Up to the outbreak of the war the automatic system had not proved more economical than the manual system, but with the increase in operators' wages it would prove more economical.

"Bookmakers are apparently the only people who appreciate the facilities offered by the Post Office for letters to be dictated by telephone," said Mr. J. Scott, the Birmingham Postmaster, addressing the local Rotary Club recently.

Thirty words could be taken down at the head office, the Government providing the paper, and the caller only had to pay for the stamp.

United States.—Electrical Storm.—On March 5th, during an ordinary electrical storm, a violent electrical aerial discharge occurred at Kendalls, Wisconsin. It had the results and characteristics of an explosion of dynamite, but upon investigation it was found that it was entirely an electrical phenomenon, although it was not concentrated at any point, but was distributed over an appreciable area. The concussion was so severe that in nearly every business building window panes were shattered. Overhead wires, such as those of telephone, telegraph and power circuits, were mostly affected. The telegraph circuits along the Chicago and North-western right of way were all earthed through air gap protectors in the North-western station. The insulated copper earth wire between the protectors and the earth connections was fused, several holes were blown through the insulation, and the molten copper metal was completely blown out of the insulating covering. Isolated parts of the telephone equipment used for train dispatching were burned and destroyed. The bottom of the cable box at the open wire terminal, which is about 150 ft. from the station, was completely blown out, but otherwise box and equipment were uninjured. Practically all telephone circuits at Kendalls and in the immediate vicinity were out of service due to this storm. The relays controlling the crossing bells on the Chicago and North-western Railway were burned so that the bells rang continuously, which added more to the confusion. In the power house supplying the electrical energy for the city of Kendalls the switches on the power board were twisted into irregular shapes—*T. and T. Age.*

Cable Landings.—Senator Kellog's Bill authorising the United States President to regulate the landings of submarine cables has passed the Senate. The measure now goes to the House of Representatives, says *The Times*.

United States Indo-China Wireless.—A commercial service was inaugurated, on May 1st, by the naval wireless system between the United States and Indo-China *via* Hawaii and the Philippines.—*Reuter's Trade Service* (Washington).

Wireless Telegraphy.—Elwell-Poulsen Arcs on Board Ship.—The Cunard Co. has installed Elwell-Poulsen arc equipments on some of its larger liners, and some very satisfactory results are being obtained. The first ship to be fitted was the *Caronia*, and the results of several trips which she has made are now available. On the Atlantic route, communication is maintained direct with the shore stations throughout the passage. Very good ranges are also obtained with the "Polar" spark equipment with which the *Caronia* is fitted in addition to the arc. At certain places on the route, however, spark jamming and atmospherics are particularly bad, and it is then that the arc is particularly valuable in getting messages through.

The s.s. *Caronia* has recently completed a cruise in the Mediterranean, and the operator reports that the greatest range obtained with the arc was with Bar Harbour, on February 25th, at 6.12 a.m., at a distance of about 2,423 miles, when continuous communication was maintained with New York.

Bar Harbour also received signals on February 22nd, at 9.30 p.m, while working to Devizes, this distance being about 3,500 miles, and while the s.s. *Caronia* was still in the Mediterranean. At 7.35 a.m. on February 25th communication was established with Norfolk, Va, at approximately 2 815 miles. Devizes was also communicated with on January 19th, at 6.50 a.m, at approximately 2 000 miles.

During the Mediterranean cruise, communication was kept up practically throughout with Devizes, despite bad jamming from spark and arc stations in the vicinity.

Although the main portions of the *Caronia's* arc equipment are those of a standard land station, there are several points of interest. A special method of keying is employed so that no spacing wave is radiated, and the power taken by the arc during the spacing period is considerably less than that during marking. Easy starting and a clear note are helped by the use of a separate alcohol vaporiser in the place of the usual drip-feed arrangement.

New Message Recorder.—The feat of recording autographically wireless signals from great distances has been accomplished by two Bureau of Standards physicists, at Washington, D.C.—Drs. B. A. Eckhardt and J. C. Karcher—who have demonstrated that their apparatus can pick up signals sent out from Lyons, France, 4,000 miles away, and automatically transform them into ink lines on a chart that can be read easily. They also have been able to place in the same circuit and record with the same pen the ticks of a chronometer and the Naval Observatory time signals that are sent out regularly by Annapolis.

The new device is hailed as the leading apparatus of the day from the standpoint of the astronomer, geographer, and surveyor. Scientists have been striving to invent it for the last 10 years. With it the longitude of any spot far away from cables and wires can be determined to within two-hundredths second of time or 35 ft., it is said. It was to fill that need of an autographic wireless time-recording apparatus to replace the present wire telegraphic ear-recorded methods of making scientific time observations that the Bureau of Standards began its work at the request of the Coast Geodetic Survey. Because of the relative simplicity and compactness of the apparatus and its ease of operation, it is expected it will find numerous commercial applications, especially in stations that cannot afford a highly-trained operator.

Briefly, the signal comes in and starts oscillations in a local circuit, which releases enough local steady current to operate a relay, which in turn through another local circuit operates the chronograph pen. The chronograph drum moves a sheet of paper past the pen at a uniform rate, and the signals are recorded as sums in the line, short humps for dots and long ones for dashes. By means of winding the actuating magnets in different directions, it is possible to record simultaneously with the same pen the seconds of local time as furnished by the local standard chronometer and compare them with standard wireless observatory time without the errors of "lag" of the instruments.

The chronographic recording drum used is that developed and in use by the Coast Geodetic Survey. A single electron tube operating at a low voltage furnished by a portable battery is sufficient to receive far-off Lyons, even when a poorly located temporary antennæ is used.

The new apparatus is compact and not highly complicated, and the Coast Survey will use it in its field work during the coming summer. Captain G. D. Cowie, of the Survey, is now working with Drs. Eckhardt and Karcher at the Bureau of Standards on the new field sets being made.—*T. & T. Age.*

Continental Service.—Mr. Pike Pease, during the Parliamentary debates, last week, stated that, under present conditions, the Anglo-Continental telegraph service is doubtfully remunerative. In the opinion of the Government it is not expedient to debar private wireless companies from conducting services with Continental countries, provided they are willing to submit to the conditions which the Government thinks it necessary to impose.

Wireless Interference.—Mr. F. King Vreeland, the well-known wireless telegraph engineer, is perfecting a device that it is stated will prevent interference in wireless signals. He is conducting his experiments at the Stephens Institute of Technology, Hoboken, N.J.—*T. and T. Age.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Argentina.—June 13th. The Department of Overseas Trade has been informed by telegram that the Department of Sanitary Works is calling for tenders for the supply and erection of electric power batteries and lighting plant at Mar del Plata. Local representation is essential. When a copy of the specification is received by the Department of Overseas Trade it will be made available for consultation.

Buenos Aires.—June 3rd. Board of Sanitary Works. Supply and erection of the plant and accessories for a new generating station, previous tenders having been called for in 1919 and 1920. The plant comprises three four-cycle Diesel engines of 375-h.p., and adapted to run on crude petroleum from Comodoro Rivadavia, and three three-phase alternators, each of 250-kW, 2,200 volts between phases, 50 cycles and a power factor of ·8.*

Port Authorities. Supply of 19 electric cranes.—*Reuter's Trade Service* (Buenos Ayres).

Australia.—Melbourne.—Postmaster-General's Department May 31st. Telephone switchboards (Schedule No 1,670.) 29,500 porous cells, No. 1 size to specification (Schedule No. 1,685); 20½ tons ammonium chloride (Schedule No. 1,683).*

June 15th. Victorian Government Railways. 50 oil-immersed single-phase track and signal transformers for power signalling (Contract No. 33,901).*

June 22nd. One electric lifting magnet (capacity ½ ton), one 440-V motor generator.

June 29th. Supply of 1-ton platform type industrial storage battery trucks, also battery-charging equipment.—*Reuter's Trade Service* (Melbourne).

August 10th. 250 core-type impedance bonds for power signalling, with a capacity of 1,000 amperes per rail; also 50 miles of solid insulated copper wire, No. 14 Brown & Sharpe gauge, and 50 miles of solid insulated copper wire, 16 standard gauge.

August 17th. 3,000 sets of renewals for caustic soda primary cells.—*Reuter's Trade Service* (Melbourne).

August 30th. Board of Works. Four electrical centrifugal pumps, each with a capacity of twelve million gallons daily.—*Reuter's Trade Service* (Melbourne).

Perth.—May 25th. Postmaster-General's Department. Ironwork, as per Schedule 704. (April 22nd).

Belgium.—May 27th. The Service d'Etudes et de Controle des Applications de l'Electricité, 52, Boulevard du Regent, Brussels. For the supply and installation of ten electrically-operated capstans in connection with the locks on the Upper Scheldt.

Brussels.—May 11th. Belgian Post and Telegraph authorities at La Salle de la Madeleine, Brussels. Supply of a quantity of telegraphic and telephonic apparatus, including 600 Morse manipulators and 250 milli-amperemeters.

Municipal authorities of Gistoux, Province of Brabant. Tenders for the establishment of an electric-lighting system in the town.

Edinburgh.—May 26th. Electricity Department. E.h.p. and l.p. switchgear for sub-station. (April 29th.)

Fiji Islands.—The municipality of Suva invites tenders, closing June 30th, for the supply and erection of a 200-kW, 480/520-V, three-wire, d.c. generator, directly coupled to a 300-h.p. vertical Diesel oil engine, together with accessories for generator and panel.—*Reuter's Trade Service* (Melbourne).

Glasgow.—May 31st. Electricity Department. Cables (including small i.r. cables and flexibles) and meters for twelve months. (See this issue.)

London.—Paddington.—May 12th. G.W.R. Three months' supply of stores, including telegraph instruments and apparatus, electrical wire and cables, &c. (See this issue.)

L.C.C.—The Highways Committee is inviting tenders for feeder pillar earth panels and switch boxes required at sub-stations.

Manchester.—May 10th. Electricity Department. Weldless steel lamp columns. (See this issue.)

May 10th. Tramways Committee. Electrolytic copper and bronze trolley wire. Mr. J. M. McElroy, general manager, 55, Piccadilly.

Mexborough.—May 21st. Urban District Council. Electricity Department. One 750-kW rotary converter with transformer. (See this issue.)

Newcastle-on-Tyne.—May 17th. Electricity Supply Department. Half-a-mile single, l.p., lead-covered, steel-armoured main cable. (See this issue.)

New Zealand.—June 28th. Public Works Department. Ten s.p. oil-filled transformers for the conversion of three-phase current at 50 cycles, the voltage ratio being 50,000/11,000, for Waikato power scheme.*

June 28th. Supply and delivery at Lyttelton of two 50-kVA, two 100-kVA and two 200-kVA condensers in connection with the Lake Coleridge electric power supply (Section 116).*

Sale.—Urban District Council. Electricity Department. Converting plant, complete with e.h.p. and l.p., d.c. switchboards. (See this issue.)

South Africa.—Electrification of Capetown-Simonstown and Durban-Maritzburg lines. The date for the receipt of tenders has been extended to July 5th. (See this issue.)

Southampton.—May 14th. Electricity Department. 3-phase, 6,000-V cable. (See this issue.)

Uruguay.—June 28th. Ministry of Public Works. Three electric gantry cranes and a "Temperley" type aerial transporter for the Port of Paysandu. Tenders in Spanish and framed in accordance with the model to the Ministry of Public Works.*

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* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Barnstaple.—Town Council:—

Induced draught fan, £87.—Messrs. Bryant.

Birmingham.—Salvage and Stables Department. Accepted:—

Charging plant for electric vehicles, &c., £7,300.—Brightside Foundry and Engineering Co., Ltd.

Belgium.—The Belgian Post and Telegraph authorities in Brussels recently invited tenders for the establishment of a high-power post at the Government wireless telegraph station at Ruysselede. Four tenders were received, the lowest being that of the Federal Telegraph Co., San Francisco, U.S.A., which quoted $575,000, c.i.f. Antwerp.

Glasgow.—Corporation. Electricity Committee. Recommended:—

Switchboards for the Buchanan Street and Cadogan Street sub-stations, £7,444.—Messrs. Ferguson, Pailin, Ltd.

Leicester.—Town Council. Accepted:—

One 10,000-kW turbo-generator set, with condenser by W. H. Allen, Son, and Co., £91,394.—English Electric Co., Ltd.

Delivery within seven months is guaranteed. Ten British firms and three Swiss firms submitted tenders. The tender accepted was the lowest of the British. The highest was £102,169. The foreign quotations were lower than the English, but contained stipulations and refusal to submit to penalties for the non-fulfilment of the contract. The English Electric Co. has also prepared plans for the necessary buildings, and its tender for this part of the work amounts to £187,300. The company is also prepared to undertake to have the buildings erected and the plant running within twelve months of the date of the contract. The estimated cost of the boiler is £125,000.

London.—Stepney.—Electricity Supply Committee. Accepted:—

150/160 tons Northumberland D.C.B. slack, 28s. 1d. per ton.—Charrington Dale & Co.

One cargo Cowpen Northumberland ½-in. to 1¼-in. nuts, 36s. 6d. ton 200 tons Welbeck 1-in. slack, 49s. 8d. per ton.—E. Foster & Co.

12 wagons New Hucknall ⅝-in. main slack, 48s. ton.—C. Franklin.

12 wagons Selston Bright slack, 44s. ton.—Milner, Thomas & Co., Ltd.

Two barges New Hucknall ⅝-in. low main slack, 47s. 1d.—A. Blackman &

¼ mile "D" troughs and covers, £105.—Sutton & Co. (accepted).

6 miles "A" and "C" and 3¼ miles "D" troughs and covers; 2¼ miles 3 in., 4½ miles, 4 in., 3-way earthenware conduits—

Sutton & Co. (accepted)	**£11,921**
W. T. Henley's Telegraph Works Co.	12,466
Siemens Bros. & Co., Ltd.	12,670

One 6,600-V trifurcating box, £181.—A. Reyrolle & Co., Ltd. (accepted).

Repairs to electric van, £250.—Agricultural & General Engineers, Ltd. (accepted).

Manchester.—Electricity Committee. Accepted:—

Switchgear for 2,500-kW and 1,500-kW motor converters at Dickinson Street sub-station, battery booster, short circuiting switch.—Bertram Thomas.

Cables.—Pirelli-General Cable Works, Ltd., and W. T. Henley's Telegraph Works Co., Ltd.

Perth.—Accepted:—

Additional generating plant at Friarton Works, £15,000.—W. H. Allen, Son and Co., Ltd.

Salford.—Watch Committee. Accepted:—

Installation of electric light at the Chapel Street police station, £50.—Lincoln, Chambers & Co.

Education Committee.

Electric light installation, £261.—W. Smith & Co.

Electricity Committee.

Erection of transformer sub-stations at Weaste, £320; at Lower Kersal £388.—Moseley Construction Co., Ltd.

FORTHCOMING EVENTS.

Edinburgh Electrical Society.—Friday, May 6th. At the Philosophical Institute. At 8 p.m. Annual meeting.

Roentgen Society.—Friday, May 6th. At Manchester. Paper by Prof. W. J. Bragg, and a demonstration by Prof. A. V. Hill.

London Association of Foremen Engineers.—Saturday, May 7th. At the Cannon Street Hotel. Sixty-eighth anniversary festival.

Batti-Wallahs.—Monday, May 9th. Lunch at the Holborn Restaurant. At 1 p.m. Speaker, Canon H. Bickersteth Ottley.

Institution of Electrical Engineers.—

North-Eastern Centre.—Monday, May 9th. At the Armstrong College, Newcastle. At 7.15 p.m. Annual general meeting.

South-Midland Centre (Students' Section).—Tuesday, May 10th. At the Birmingham University. At 7.30 p.m. Annual general meeting.

Faraday Society.—Monday, May 9th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary meeting.

National Association of Supervising Electricians.—Tuesday, May 10th. At St. Bride's Institute, Bride Lane, E.C. At 7 p.m. Paper on "Electric Light Wiring Systems," by Mr. F. T. Alldread.

Institution of Railway Signal Engineers.—Wednesday, May 11th. At the Midland Grand Hotel, St. Pancras, N.W. At 6 p.m. Discussion on the Reports of the Sub-Committees on "Track Circuit Nomenclature" and "Track Circuit Record Forms."

Physical Society of London.—Friday, May 13th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary scientific meeting.

NOTES.

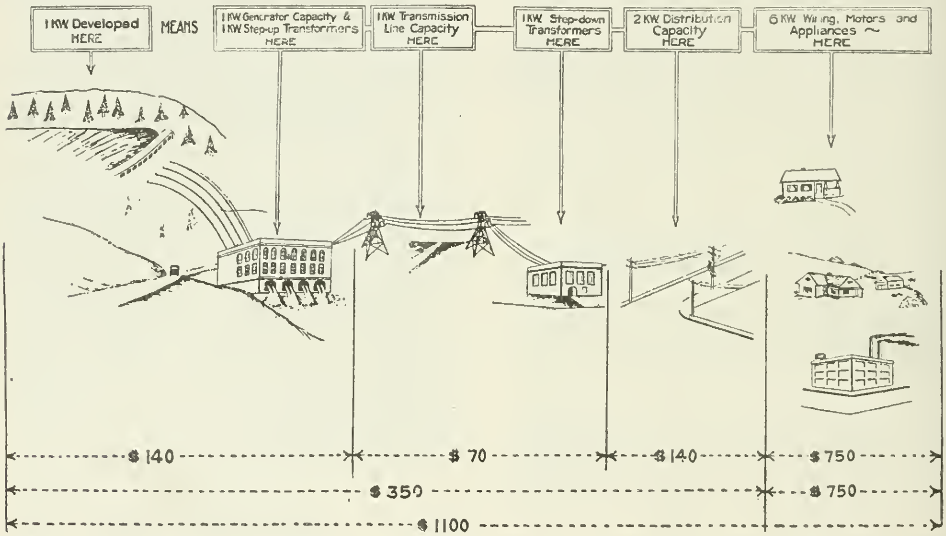
Birmingham Electrical Golfing Society.—The Spring meeting was held on the course of the Robin Hood Golf Club, on April 26th, under ideal conditions. The "Trade" Cup was won by T. P. Holder (4), 78, A. Pearson being second with (12) 79, and J. H. Harpin third with (12) 81. J. H. Berry won the sealed nine holes with (9) 41. There was a representative gathering, and the event was keenly enjoyed. It is proposed to hold the Summer meeting early in June.

Apprenticeship Association.—The fifteenth annual report of the Skilled Employment and Apprenticeship Association shows that during 1920, 355 boys and 214 girls were "placed" by the Association; 118 boys were apprenticed to the engineering and heavy-metal trades and 41 to instrument making. A total of 1,605 cases was dealt with during the year by the London Committees, and it is pleasing to note that the subscriptions and donations were increased by a special effort on the part of the Committees. In spite of this, however, the Associaton finished the year with a deficit of £20.

What Hydro-Electric Development Means to Industry.—In the west of the United States, where industrial progress is dependent upon the development of hydro-electric energy, every effort is being made to demonstrate to the public the direct results of such development. An effective appeal to the layman has been formulated by Mr. J. M. Morris, of the Westinghouse Electric and Manufacturing Co., Los Angeles.

The basis of the appeal is four charts which have been prepared from actual data on present conditions by the Southern California Edison Co.

One of the charts shows the comparatively large sum of money that must be spent in utilising the energy as compared with the cost of generation, transmission, and distribution. This is shown as indicative of the huge sums that will be spent annually in the electrical industry in the West. We reproduce from the *Electrical World* this chart, which also bears the following statement :—


1 KW Developed HERE
MEANS
1 KW Generator Capacity & 1 KW Step-up Transformers HERE
1 KW Transmission Line Capacity HERE
1 KW Step-down Transformers HERE
2 KW Distribution Capacity HERE
6 KW Wiring, Motors and Appliances ~ HERE
$ 140
$ 70
$ 140
$ 750
$ 350
$ 750
$ 1100

Estimated cost of future power development on Pacific Coast, $50,000,000-$70,000,000 per year.

On a basis of $50,000,000 per year this represents approximately 140,000 kW in generator capacity.

Represents $105,000,000 per year in wiring (including labour), motors, lamps, and appliances.

The other charts present different aspects of the argument, either graphically or verbally. Thus one states that "the kW in additional electric power, at a cost of $350, makes possible the building of one home, the irrigation of four acres, and the employment of one person in an industry, and means $6,000 to the community."

Appointment Vacant.—Electrical engineer and manager for the Abertillery Urban District Council. See our advertisement pages to-day.

Several vacancies for Junior Inspectors of Factories under the Home Office will be filled shortly at a salary of £200, rising by £15 a year to £350, and a war bonus. Candidates should send in applications before May 21st. Particulars may be obtained from the Private Secretary, Home Office, Whitehall, S.W. 1. Appointment is by competitive examination. The age limits are 23 to 30 years on August 1st, 1921, with a possible extension up to 35 years in case of men who have had 10 years' experience. Preference will be given to those who have served with H.M. Forces in the war.

London Traffic.—London Members of Parliament met on April 28th, with Mr. J. D. Gilbert in the chair, further to discuss the question of traffic congestion in the metropolis. As the result, a Sub-Committee was appointed to consider the suggestion of the Ministry of Transport that the London members should assist in framing proposals to deal with the problem. The Committee is to consist of Mr. Kennedy Jones, Mr. Gilbert, Viscount Curzon, Mr. Purchase, and Sir William Bull.—*The Times.*

The Attraction of Good Lighting.—To convert the wealthy corporation to a new principle or method of business, or, at any rate, to bring it to the stage of interest and experiment, is a relatively simple matter. In connection, for example, with the lighting of shop windows, little difficulty has been experienced in persuading the big department stores to install up-to-date systems. Small traders, however, have not been convinced so easily of the advantages of scientific design, and the majority of suburban shops pathetically exemplify the futility of pouring the new wine of gas-filled lamps into the old bottles of obsolete equipment.

Here and there one may see windows lighted adequately and artistically, and yet more rarely a small community of well-illuminated shops may be discovered. Such an aggregation is to be seen at Palmer's Green. Messrs. J. Prosper & Sons, the local electrical contractors, are lighting enthusiasts (this in itself is a very useful basis for successful propaganda), and they have the further merit of recognising that practice is far more efficacious than precept. By equipping their own shop window with concealed "X-ray" reflectors and "Mazda" gasfilled lamps, and thus distinguishing it from the windows on either side, the firm created a feeling of discontent among its neighbours to such excellent effect that within a few weeks 12 shops in the same block had installed "X-ray" equipment.

Educational.—At a meeting of the Swansea Electricity Committee a letter was read from Dr. T. Franklin Sibly, the Principal of the University College of Swansea, stating that they were seeking to secure for the engineering department of the College, the advantage of occasional courses by engineers of high professional standing in the district, and inquiring whether the Council would be prepared to allow the borough electrical engineer, Mr. J. W. Burr, to deliver an advanced course of special lectures in the College if invited to do so by the Council of the College. Mr. Burr had intimated his willingness to undertake the course on the understanding that no remuneration should be paid to him. The Committee, highly appreciating the honour paid to Mr. Burr, readily consented to his giving the course of lectures.

Leeds.—Owing to the supply of wireless operators being understood to be in excess of the demand, the class for training such operators at the Leeds Central Technical School is to be closed.

Italy.—In order to provide skilled staffs, it has been decided to found a Laboratorio-Scuola di Radiotrasmissioni in the Via Cappuccio, in Milan. The Government, local societies, and manufacturers have joined financial forces to realise the undertaking.

Finsbury Technical College. — The Governing Body of the Finsbury Technical College announces that the entrance examination for the Session 1921-22 will be held on Tuesday, September 20th next. Applications for admission should be forwarded to the College not later than September 15th on forms to be obtained from the Registrar, Leonard Street, City Road, E.C. The programme of the College is under revision, and will be issued in due course.

The Dangers of Radium.—Concerned by the dangers attending the application of radium, the French Academy of Medicine has appointed a committee to frame a list of measures of precaution. The decision followed the reading of a paper by Prof. Bordier, of Lyons University, who declared that the dangers incurred by those manipulating radium were far greater than those faced by X-ray operators. While the ravages of the X-rays are visible at an early stage on the hands, radium works insidiously on the marrow of the bones and on the spleen, the damage being unknown to the victim until one day he finds his health undermined by a pernicious anæmia, which may be fatal. Dr. Béclère, who for years has employed radium at the Saint Antoine Hospital, is rather optimistic. He thinks that if certain precautions already known are followed, the dangers become very slight. The salts of radium, he states, should not be touched by the hands, but by instruments. The wooden table at which the operator sits should have a leaf of lead to avert risk to the legs, for the radium rays pass easily through wood. The chest of the operator should also be protected by a shield of lead, and he should wear spectacles, which, though of clear glass, ought to contain salts of lead. In that way, says Dr. Béclère, only the hands are exposed, and those very slightly.—*Daily Telegraph.*

The Electrification of a Diamond-Cutting Factory.—The most important of the factories erected by Sir Bernard Oppenheimer, under his scheme for training ex-Service men in the diamond-cutting industry, is that at Brighton, where operations are carried out on a commercial basis, the men being enabled to earn a wage which, though not very large at first, soon compares favourably with that earned in other skilled trades.

The Brighton factory has been equipped throughout on most modern lines, and the buildings are so commodious, well-lighted, and clean, that the recovery of the men is undoubtedly accelerated by their surroundings.

The whole of the power required for driving the various sawing, cutting, and polishing machines is electric, the workshops containing in all 105 motors with the necessary control gear and each bay about 100 polishing units.

Both d.c. and a.c. power is brought in from the mains of the Brighton Corporation. The former is a 460-volt, 3-wire, supply for lighting, and the latter is 6,600 volt, 3-phase, transformed down to 400 volts, and distributed to the motor circuits by a switchboard.

The first step necessary on receipt of the uncut diamond is to mark it out; it is then sawn into suitable sizes, which is accomplished by means of saws driven from line shafts, two 10 h.p. squirrel cage motors running at 960 r.p.m., being required in the saw room. It is interesting to note that the saw blades used are of phosphor bronze, 3/1,000ths of an inch thick. They are trued up in centres, and on them is pressed diamond dust and olive oil so as to produce the required degree of cutting power. The saw-making sets are driven by 1/10 h.p. motors at 2,000 r.p.m., and there are 1,500 polishing units installed. The polishing bays are each equipped with six 7½-h.p. disks at a speed of 2,400 r.p.m. Each motor in these bays, as throughout the installation, is controlled by a special auto-transformer starter panel.

From the electrical point of view the chief interest lies in the extent to which the electric drive fits in with the main object kept in view in laying out the factory and its equipment—that is, the provision of simple, clean, and efficient methods of carrying out the various processes involved.

The lighting scheme, by a suitable combination of general and local units, enables a high degree of illumination to be concentrated upon any part of the work in hand.

The whole of the electrical equipment for both power and lighting was supplied and erected by the General Electric Co., Ltd.

Miners' Electric Cap Lamps. — The Miners' Lamps Committee, as a result of its investigation into the question of the safety and practicability of miners' electric cap lamps, has advised the Secretary for Mines that he should approve such lamps for general use in mines under the Coal Mines Act, subject to each type of lamp passing the necessary official tests as to its safety and mechanical soundness. The type of cap lamp made by Messrs. Oldham & Son, Ltd., Denton, near Manchester, having passed these tests and been put through a series of practical trials in coal pits extending over many months, has been approved by Order, dated April 20th, made under Section 33 of the Coal Mines Act, 1911. Applications for the approval of types of cap lamp of other makes are now being dealt with by the Mines Department. The Order of April 20th, which is now in the press, and will be published shortly, also approves the following new types of miners' electric hand lamps:—

Pearson Ni + Fe lamp, made by the Alkaline Miners' Lamps, Ltd., Stratford.

Patterson type G-1 lamp, made by Messrs. Patterson & Co., Newcastle-on-Tyne.

The Federation lamp, made by the Federation Lamp Co., Sheffield.

The Adams lamp, made by Messrs. Adam Bros. (Longton), Ltd., of Longton, Staffs.

Wanted—A Motor.—The engineer-in-chief and manager of the Shanghai Municipal Council Electricity Department (Mr. T. H. U. Aldridge, M.I.E.E.), has sent us the following letter received from a Chinese client, which indicates that the virtues of the electric motor are being fully appreciated in Shanghai:—"Due to the fact that we are fail to make profit by using a engine, which by its slowness in work, expensive in charges and also dirty and noisy. The engine we are now using is 12 h.p. Having learned that an electric motor is a hasty and energetic worker, it works quietly, expends economically, locates only a small space, and is easy to operate. By the above several goodness we would like to make a change, and it might satisfy us when taking into use. Hope you will send us one for our benefit at your earliest convenience."

Deputy Wardenship of the Standards.—The President of the Board of Trade, by arrangement with the Lord President of the Council, has appointed Mr. J. E. Sears, junr., C.B.E., M.A., A.M.Inst.C.E., F.Inst.P., to be Deputy Warden of the Standards in succession to Major P. A. MacMahon, F.R.S., who has retired under the age limit. Mr. Sears is Superintendent of the Meteorology Department at the National Physical Laboratory, under the Department of Scientific and Industrial Research, and will continue to hold that post in addition to that at the Standards Department of the Board of Trade.

The Kelvin Medal.—In the presence of a large gathering of representatives of all branches of science and engineering, Dr. W. C. Unwin, F.R.S., was presented with the first Kelvin Medal on May 4th. The chairman of the Award Committee (Mr. J. A. Brodie), in a brief speech, introduced Mr. A. J. Balfour, O.M., F.R.S., who made the presentation.

Mr. Balfour, in his speech, said that not only was the medal a form of recognition of the merits of the living, it formed a fitting memorial to the great Lord Kelvin. He had been one of Kelvin's personal friends, and had happy recollections of the kindness and courtesy he showed to all with whom he came into contact. Kelvin was essentially a mathematical physicist, but he was also pre-eminent as an engineer, and was perhaps the greatest man of his kind since Archimedes. The combination of theory and practice which he made it his duty to encourage has had its results in the progress seen by the present generation. The speaker, however, desired to do honour also to Dr. Unwin. Wherever there were engineers, Dr. Unwin's name was honoured, and his fame was world-wide. His work had long guided the young engineer in his studies. Probably his name was not widely known among the general public, but among those who mattered he was more than well known. His text-books formed the foundation of the study of many branches of engineering, and these alone would justify the committee's choice. In presenting the Kelvin Medal to Dr. Unwin he (Mr. Balfour) was voicing the unanimous verdict of the whole of the scientific world.

Dr. Unwin (who found it difficult to speak for a few moments) said that it added to the great honour conferred upon him to receive the medal from the hands of Mr. Balfour. What he was able to accomplish was due in no small measure to able and loyal assistance. He was a teacher, and it pleased him to see how facilities for young engineers had grown in this country, although we were still behind France and Germany. Dr. Unwin recalled the scientists of his early days, when Joule was determining the mechanical equivalent of heat, and Bessemer was producing the steel which was to take the place of wrought iron to such a great extent. He spoke of the failure of the first trans-Atlantic cable, and the invention by Lord Kelvin of the siphon recorder. Dr. Unwin mentioned that he had been a member of the Institution of Civil Engineers for more than 50 years, and had received a liberal education from the papers he had heard read before the Institution.

In conclusion of the proceedings, votes of thanks were accorded Mr. Balfour (who briefly responded) and the chairman.

Conditions of Living and Prospects in Brazil.—In our issue of April 15th a correspondent inquired as to the climate of Brazil and the prospects of the electrical industry in that country. As a result, we have received from the *South American Journal* a publication entitled "South America as a Field of Travel" (January, 1921; price 1s. 2½d., post free), which deals with the characteristics of the various South American Republics individually at considerable length; anyone who contemplates a sojourn in South America will do well to obtain a copy. The account given of the beauties and other amenities of Rio de Janeiro presents a highly attractive picture, and a full description is included of Sao Paulo, the second city of the Republic, concerning which our correspondent specially inquired. Comparatively recent improvements have resulted in "transforming this insanitary, old-world town to a bright, healthy, and beautiful city." The town of Santos, the port of Sao Paulo, was formerly "most unhealthy and a nest of yellow fever, but an excellent system of sanitation and drainage has completely eradicated this disease." The possibilities of this great Portuguese Republic are, like its area, immense, and a great deal of information regarding them is given in the brochure, which also deals with Argentina, Chile, &c.

Fire. — The main sawmills department of Messrs. Charles Jenkins & Sons, timber merchants, Rheola Road, Porth, equipped with complete electrical machinery, and one of the most extensive in Wales, was destroyed recently by a fire which did £4,000 damage. The brigade was able to save the large carpentry shops with their expensive electrical plant. The damage is covered by insurance.

The Batti-Wallahs' Society.—At the Batti-Wallahs' lunch at the Holborn Restaurant, on May 9th, at 1 o'clock, the speaker will be Canon H. Bickersteth Ottley, of the Royal Chapel of St. Katherine, Regent's Park. He is a member of the League of Nations Union, and will take the League of Nations as the subject for a short address.

Californian Projects.—According to Mr. F. G. Baum, consulting engineer to the Pacific Gas and Electric Co., in the Pit River scheme a pressure of 220,000 V will be used, because it costs less than a lower pressure would. It is intended to transmit 150,000 kVA per circuit. From the generating station to the first sub-station the distance is 200 miles, and from the first to the second sub-station 260 miles.

INSTITUTION NOTES.

Institution of Electrical Engineers.—In connection with the election of the Council of the Institution, the E P.E.A. is recommending its members to support the following candidates for election as ordinary members of the Council :—Lieut.-Colonel F. A. Cortez-Leigh ; Messrs. A. Page, T. Roles and W. C. Tapper.

Liverpool Sub-Centre of the North-Western Centre.—The report of Committee for the session 1920-21 shows that eight ordinary general meetings have been held, with an average attendance of 74. The annual general meeting was held on April 25th, at which Prof. E. W. Marchant, D.Sc., and Mr. H. Dickinson (city electrical engineer) and Messrs. A. J. Eames, J. Hamilton, A. E. Malpas, P. Priestly, and P. J. Robinson, together with past chairmen, were elected members of the Committee. Mr. G. E. Nisbett was elected chairman, Messrs. B. Wellbourn and E. M. Hollingsworth vice-chairmen, and Mr. Oscar C. Waygood hon. secretary. The grant to meet the expenses of session 1920-21 was £120. The total expenditure amounted to £116, leaving a balance in hand of £4. The membership of the Sub-Centre amounted to 367, an increase of 73. The area has been extended definitely to include the members in the Wigan and Southport districts. The Students' Section has made remarkable progress during the session. It has held four general meetings, and made two visits to works.

Western Centre.—The 22nd general meeting of the Centre was held at Bristol, on May 2nd, and a good audience assembled under the chairmanship of Mr. A. J. Newman. Additional interest was shown in this meeting, as it had been announced that the President of the Institution (Mr. Ll. B. Atkinson) would give an address. After the transaction of routine business, the President was found in his best form and lectured on "Four Great Electric Lights," taking as his basis Faraday the discoverer, Maxwell the interpreter, Kelvin the measurer, and Silvanus Thompson the teacher. Subsequently, a complimentary dinner was held to enable members to meet the President, and a capital musical programme was rendered by Miss O'Gorman, Messrs. J. G. Royce, L. Dore, and Huntingdon. We hope to give fuller details in a later issue.

Diesel Engine Users' Association.—At the last meeting of the Association the question of "Lubricating Oils Suitable for use in Diesel Engine Air Compressors" was considered. The meeting was unanimous on the point that whatever quality of lubricating oil was used in the air compressor, the smallest practicable quantity should be introduced. The recommendations with regard to oils suitable for use for lubricating air compressors which were finally adopted for inclusion in the report on "Air Compressor Explosions and Troubles," issued by the Association in 1916, stated that the oil should be entirely free from suspended particles of water, sand, or other impurities, and from inorganic acids. It should in no case be lower in closed flash point than 350° F. Both straight mineral oils and compound oils containing small quantities of saponifiable oil have met with success on Diesel engine compressor service, but the majority of successful oils have been straight mineral oils.

Illuminating Engineering Society.—A paper on "Ship Lighting in Relation to Comfort, Safety, and Efficiency," was read before the Society, by Mr. W. J Jones, on April 26th. The speaker said that the question of efficient lighting in warships had received greater attention in America than it had in this country, and charts showing the intensities required in various departments of a vessel had been drawn up. With regard to the lighting of liners, Mr. Jones said that the modern requirement was from 10,000 to 12,000 lamps, as compared with about 1,200 20 years ago.

In the subsequent discussion, Mr. Fletcher, of the Admiralty, spoke of the trouble due to eye strain being experienced in the Navy, and said that "daylight" illumination had not met with any marked success.

Warrington Electrical Society.—The Society has just held its second annual meeting, and in the course of the discussion of the next season's syllabus, it was suggested that visits should be arranged to the larger works of the town. Mr. F. V. L. Mathias was re-appointed chairman ; Mr. Smith, vice chairman ; Mr. J. B. Robertson, secretary ; Mr. H. Rogers, treasurer ; and Council : Messrs. Brooking, Seymour, Baird, Senior, Leggatt, Sykes, Bishop, and Barton.

Glasgow Corporation Electricity Department Engineering Society.—Formed three years ago to encourage the interchange of technical information and otherwise to further the interests of the members, the Society has just concluded a most successful session. There are now 300 members on the roll. The papers contributed and discussed during the session covered a wide range of subjects of special interest to electricity supply engineers. The Society meets once a month during the winter, and the meetings are open to all employés of the department.

Birmingham and Midland Institute Scientific Society.—The annual report states that the society's laboratory and library have been arranged as in pre-war days, and are available at all times for experimental work, and a selection of instruments has been purchased by the society for wireless telegraphy and telephony, which are being added to from time to time, and it is hoped that in the near future the wireless room will be complete with all instruments necessary for reception and transmission. Several demonstrations have already been given, and a great deal of experimental work carried out. The members interested in this branch of science meet on most Tuesday and Thursday evenings for Morse practice, wireless lectures, both elementary and advanced, and examination and explanation of wireless instruments.—*Birmingham Post.*

Royal Institution.—At the annual meeting, held on the 2nd inst., the Report of the Visitors for the year 1920, testifying to the continued prosperity and efficient management of the Institution, was read. The following were unanimously elected as officers for the ensuing year :—President, the Duke of Northumberland ; treasurer, Sir James Crichton Browne ; secretary, Colonel E. H. Grove-Hills.

British Science Guild.—The annual dinner was held at the Hotel Cecil on Tuesday, Lord Montagu of Beaulieu, the president, being in the chair.

Iron and Steel Institute.—The annual dinner, fixed for yesterday, was abandoned on account of the conditions prevailing in the coal, iron, and steel industries.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

The London County Council Highways Committee recommends that Major A. E. Carr, D.S O., power station superintendent, L. and Y. Railway Co., be appointed repairs superintendent at Greenwich power station in the electrical branch of the tramway department, and that Mr A. G Evans (assistant engineer, Messrs. Preece, Cardew and Rider) be appointed technical assistant (Grade I) in the electrical branch of the tramway department. The commencing salary in each case is £300 (based on pre-war conditions), with temporary additions, the total remuneration on the present bases of rates being £590.

Mr. W. M. Valon, for 11 years manager and engineer of the Corporation Gas Works at Stafford, has accepted the position of technical director with Messrs. Major & Co., chemical distillers and dye makers of London. At a farewell gathering last week, he was presented with a portable typewriter from the staff and employés of the Gas and Electricity Departments.

Mr. W. J. Talbot, who acted as vice-president last year, was last week appointed President of the Walsall Chamber of Commerce. He was for two years electrical engineering lecturer at Walsall Technical Institute. About 18 years ago he became engineer and manager of Messrs. John Russell & Co.'s seamless tube works, and later with Dr. G. Stead established the Talbot-Stead Tube Co., Ltd. He is chairman of the Electricity Committee of the Walsall Town Council.

Halifax Tramways Committee recommends the Council to grant an honorarium to Mr. J. W. Galloway, tramway engineer, for his extra services during the period of the illness of Mr. J. D. Caird, traffic manager, and until the new general manager (Mr. B. Hall, of Wigan) commences duty.

Mr. George Watson, consulting engineer, of London, has been engaged as consulting engineer to Accrington Corporation in connection with extensions to the destructor works at a fee of 200 guineas, plus out-of-pocket expenses.

Barnstaple Town Council has granted a gratuity of £100 to Mr. J. Hadfield, electrical engineer, in respect of extra services rendered by him in connection with the installation of new plant.

Mr. J. S. Craig, late of the switchgear sales department of the Metropolitan-Vickers Electrical Co., Ltd., has been appointed representative of the Cantie Switch Co., Ltd., for Lancashire and Yorkshire district.

Lancaster Corporation has adjourned for six months a recommendation by the Finance Committee to increase the salary of Major G. C. Milnes, electrical engineer, from £500 to £600. It was stated that the salary was £275 in 1914, and was increased on Mr. Milnes's return from the war to £500. Mr. Tester, a predecessor, received £300 in 1904, when the units sold were 333,834. Now they were 628,000 for lighting, and just under a million for power. According to other authorities, the scale would be £670.

Mr J. W. Wilkinson now has no connection with the firm of "Wolf Brothers," of 9, Warwick Court, W.C. 1, the partnership firm of Wolf Brothers & Wilkinson having been dissolved as from February 28th last. For the present, however, Mr. Wilkinson is retaining his office at the above address, and is carrying on his consulting work in connection with the electrical driving of mills, factories, and mining machinery alone.

Mr. Fred. C. Gibbons, M.I.E.E., managing director of Messrs. Browett, Lindley & Co., Ltd., has also been appointed chairman of the company.

Mr. Hugh S. Davidson, who has resigned his position as manager of Messrs. Malcolm & Allan, Ltd., London, was the recipient, on Monday, of a gold watch and chain. The presentation was made by Mr. Butler, in the presence of a deputation on behalf of the London staff. During the 10 years Mr. Davidson has been with the firm he has been responsible for the carrying out of numerous contracts of all descriptions, including a very large one at the Motor Transport Depôt, Slough.

Obituary.—Mr. Wm. E. Bull.—We regret to record the death, which occurred on April 27th at his home, 89, Upper Tulse Hill S.W., of Mr. William E. Bull, senior London representative for Messrs. Falk, Stadelmann & Co., Ltd. Mr. Bull had been connected with the illuminating trade since boyhood, entering the business of Prince & Symmons, Commercial Street, E.—one of the pioneer firms in the oil-lighting trade—in 1874. He joined Messrs. Falk, Stadelmann in 1901, and soon secured a large circle of friends, by whom he will be missed. He was an ardent swimmer, being president of the Amateur Swimming Association. Well known in Masonic circles, he had been secretary of the Shepherd's Bush Lodge for the past 21 years.

Will.—The late Sir R. P. Ashton (of Kilburn, Brown & Co.), who was deputy-chairman of the Enfield-Ediswan Cable Works and a director of other companies, left £26,239.

NEW COMPANIES REGISTERED.

"Alfo" Electrical Engineering Co., Ltd. (174,379).—Private company. Registered April 25th. Capital, £2,000 in £1 shares. To carry on the business of electrical engineers, &c. The permanent directors are: H. Y. Fowler, 35, Draycott Street, Dingle, Liverpool; W. F. Almond, 64, Park Road, Liverpool. Qualification: £250. Secretary: W. F. Almond. Registered Office: 37, Moorfields, Liverpool.

Riley Patents, Ltd. (174,390).—Private company. Registered April 25th. Capital, £5,000 in £1 shares. To acquire from G. B. Riley and others for exploitation in the United Kingdom, the U.S.A., Canada, and Newfoundland an invention relating to loud-speaking telephones, and to carry on the business of manufacturers of and dealers in telephones and telephone apparatus, either in metal, rubber, wood, china, glass, composition, or other material, manufacturers of electrical, wireless, and other clocks, motor pumps and motor accessories, &c. The subscribers (each with one share) are: S. C. Peacock, 10, Hanover Square, W. 1, director of Kendall, Claude & Co., Ltd.; C. W. Grogan, 47, Stanhope Gardens, South Kensington, W., mining engineer; C. F. Spens, 11, Haymarket, S.W., export merchant. The subscribers are to appoint the first directors. Qualification: 1 share. Registered office: 20, Denman Street, W.

Moodys, Ltd. (174,389).—Private company. Registered April 25th. Capital, £1,500 in £1 shares. To adopt an agreement with A. E. Moody and V. H. Moody, and to carry on the business of electrical engineers and contractors, manufacturers of and dealers in electrical materials and goods, &c. The first directors are: A. E. Moody, 24, Hungerford Road, Holloway, N. (managing director); V. H. Moody, 1, Craven Park Road, Harlesden, N.W. 10; B. Guest, 108, Craven Park Road, Harlesden, N.W. 10. Qualification: £1. Remuneration: 5 guineas each per annum. Secretary: B. Guest. Solicitor: E. E. Winterbotham, 1, Fredericks Place, Old Jewry, E.C.

Premier Private Telephone Co., Ltd. (174,408).—Private company. Registered April 26th. Capital, £2,000 in £1 shares. To acquire a certain patent for an invention relating to improvements in telephones, and to adopt an agreement with J. Kay and J. Jennings. The permanent directors are: E. C. Aspden, 92, Grenville Street, Stockport; A. L. Barnes, 47, Bloom Street, Stockport; J. Kay, 120-122, Castle Street, Edgeley, Stockport; A. Dutton, 78, Castle Street, Edgeley, Stockport; G. E. Pennington, 60, Torkington Street, Stockport; S. Ridgway, 95, Chatham Street, Stockport; G. Trafford, 5, Lord's Avenue, Weaste, Salford; D. Wallace, 42, Curzon Avenue, Rusholme, Manchester; W. S. Whittaker; 65, Wellington Street West, Higher Broughton. Solicitor: S. Bishop, 23, Fountain Street, Manchester.

Heads (Electrical), Ltd. (174,402).—Private company. Registered April 26th. Capital, £3,000 in £1 shares. To take over the business of manufacturers of electrical accessories, and motor and general engineers carried on by J. Rest, W. Rest, C. H. Carter, and F. Allandale, at 11, Noel Street and 165, Wardour Street, W., as the "J. R. C. Manufacturing Co." The first directors are: B. M. Head, 20, Goldsmid Road, Brighton (permanent managing director); J. Rest, 6, Dumbarton Road, Brixton Hill, S.W.; C. H. Carter, 40, Wilson Road, Camberwell, S.E. Remuneration of B. M. Head not less than £4 per week from April 16th, 1921, in addition to travelling and incidental expenses. Solicitor: G. F. Donne, 58, Ship Street, Brighton. Registered office: 165, Wardour Street, W.

Sheet Metal Plating Co., Ltd. (174,426).—Private company. Registered April 27th. Capital, £5,000 in £1 shares. To adopt an agreement with H. J. Hunt and H. J. Vince, and to carry on the business of electro and other platers, welders, electrical and water supply engineers, founders, &c. The subscribers (each with one share) are: A. H. Lister, 325, Kingston Road, Merton, S.W., carman and contractor; H. J. Hunt, 42, Meyrick Road, Clapham Junction, S.W. 11, sheet metal worker. The first directors are: H. J. Hunt (life director, subject to holding 200 shares) and others to be appointed by the subscribers. Secretary: A. J. McCarthy. Registered office: 20, Finsbury Square, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Packham & Son, Ltd.—Satisfaction in full on April 7th, 1921, of first and second debentures dated November 27th, 1914, securing £1,200 and £1,111 10s. respectively.

Vickers-Petters, Ltd.—First mortgage debentures, dated April 11th, 1921, to secure £75,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: W. H. Gillett and W. K. T. Risk, 39, Threadneedle Street, E.C.

E. S. Co., Ltd.—Satisfaction to the extent of £3,000 on March 24th, 1921 of debentures dated November 17th, 1920, securing £6,000.

East Anglian Electricity Co., Ltd.—(a) debentures for £3,300, created 1898-1900, have just been registered chiefly under Section 12 of the Companies Act, 1907; (b) satisfaction in full of £2,950 debentures dated 1898 to 1914 has also been registered, the actual dates of repayment ranging from January, 1909, to January, 1921.

Pleno, Ltd.—Mortgage dated April 11th, 1921, to secure £150, charged on 35 and 37, Anker Street, Nuneaton. Holders: Trustees of Lily of the Valley Lodge, Order of Oddfellows, Wolvey, Warwick.

English Electric Co., Ltd.—Conveyance dated April 12th, 1921, supplemental to trust deed dated September 15th, 1919, securing £1,000,000, charged on various properties in Preston, Coventry, and Ashton-upon-Ribble. Trustees: Debenture Corporation, Ltd.

Brotherton Ediswan Tubes & Conduits, Ltd.—Particulars of £40,000 debentures, authorised April 7th, 1921; whole amount issued, charged on the company's undertaking and property, present and future, including uncalled capital, subject to prior charges.

Martin & Element, Ltd.—Particulars of £6,500 debentures, authorised March 24th, 1921; whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital.

Charles W. Webber, Ltd.—Mortgage dated April 4th, 1921, to secure £2,000 charged on 33-5-7, George Street, Weston-super-Mare, with stable, garage, &c., in rear thereof. Holder: H. W. Rendle, "Oakdene," Severn Road, Weston-super-Mare.

Wilson, Hartnell & Co., Ltd.—Assignment dated April 11th, 1921, to secure all moneys to become due to mortgagees under a specified order, charged on account against Turton Urban District Council for the supply and erection of overhead mains, poles, sections, boxes, underground cables, &c. Holders: British Insulated & Helsby Cables, Ltd.

Julius Sax & Co., Ltd.—Satisfaction in full on March 22nd, 1921, of mortgage debentures dated October 27th, 1908, and February 15th, 1909, and July 9th, 1915, securing in all £3,500.

Patex, Ltd.—Issue on April 14th, 1921, of £50 debentures, part of a series already registered. (Previously issued, £2,400.)

Telegraph Manufacturing Co. (Colonial), Ltd. (71,854).—Return dated March 22nd, 1921. Capital, £2,000 in £1 shares. All shares taken up and paid for in full. Mortgages and charges: Nil.

Cutting Brothers, Ltd. (81,178).—Return dated December 1st, 1920. Capital, £40,000 in £10 shares (3,000 ordinary and 1,000 preference). 1,877 ordinary and 502 preference shares taken up. £20,590 paid (being £10 per share on 1,477 ordinary, 502 preference, and £2 on 400 ordinary). Mortgages and charges: £30,000.

CITY NOTES.

Indo-European Telegraph Co., Ltd.

Mr. J. Herbert Tritton presided on April 27th at the annual meeting, held at 18, Old Broad Street, E.C. He said that whilst the report was for the year 1920, the accounts were those for 1918, the latest they could furnish for the moment, though they hoped before the end of the summer to present those for 1919. Reviewing the accounts for 1918, with regard to the Russian assets, a full statement was made in the last report. The main position with regard to those assets remained as then outlined, except that normal accretions of interest, &c., had slightly increased the item of Russian Government debts to £97,223. The directors wished, however, to state that they regarded it as an imperative duty to deal with the question of those doubtful assets, and they hoped at the next general meeting to inform the shareholders of the method they proposed to adopt. They had satisfied themselves that, apart from the Russian items, the entry under sundry debtors contained nothing that was not worth its face value. With regard to the market value of the investments, omitting the Russian assets, those, at the date of the balance sheet, showed an appreciation over 1917. He was pleased to be able to inform them that they had, under the Peace Treaty, recently been paid by the German Government the full value, together with dividends and accrued interest, of the 200,000 marks Prussian 4 per cent. Treasury bonds (matured in 1917) standing under unappropriated investments. With regard to the financial position at the moment, he must remind them that the equalisation of dividends fund was now exhausted with the exception of about £3,000, and that, therefore, a larger dividend than 7 per cent. for 1921 could not reasonably be expected. Turning to the report, the year 1920 had been a year of disappointment for directors and shareholders alike. Since their last meeting trouble after trouble had supervened in Eastern Europe and in the Near East, and they had found it impossible to maintain their existing position in many sections of the line, their officials and staff having, in many instances, to be withdrawn. Complications in the Near East also extended to Persia, culminating in the threatened withdrawal of the British troops from that country and the enforced evacuation of the families of all telegraph and other officials residing in Persia. He was sure the shareholders would join with them in an expression of sympathy and thanks to those members of the staff and their families who, in those repeated migrations, had had to face dangers and difficulties of every description. Their thanks were particularly due to Mr. Watt, one of their representatives abroad, who faced with great courage the possibility of serious personal danger whilst carrying out his missions from the company. Their representative in Teheran remained at his post and was doing all in his power in the interests of the company. The Persian Government having surmounted their difficulties, would be in a position doubtless to further the re-establishment of the company's telegraph system crossing their country which, meanwhile, was in a state of suspended animation, though the international importance of the route seemed greater than ever. He had informed them sufficiently of their troubles, and they might realise what their anxieties had been during the year under review. Happily, however, he could present a less depressing report. Their arrangements with Germany presented no difficulty in theory, although for reasons of which they would be fully aware, they were not at the moment able to reach a definite conclusion of the negotiations. Negotiations with Poland reached the final stage after a visit which their colleague, Mr. Axel W. Berg, made to Warsaw for the purpose, and it might well be that the reconstruction and repair work on that section might begin in the early summer. Owing to its having been in parts the battlefield of contending armies, that portion of the route naturally required a considerable amount of work. With regard to that section of the route which was controlled by the Soviet Government, he was pleased to inform them that they had learned from the Moscow Government that, in principle, there was no objection whatever to the conclusion of an arrangement by which their line would transit that territory on its old ground. The directors had also reason to hope that where the influence of the Soviet Government might be needed in territory which might be described as more or less debateable ground, it would be exercised in favour of the company. They would thus see that the directors were once more encouraged to hope that all might, within a measurable space of time, be again well with the company, and that reconstruction and consolidation might everywhere be begun along the route. It was only in the Polish section that reconstruction over a considerable distance might have to be faced, and even there they were confident that by the utilisation of temporary links pending permanent reconstruction they would very quickly supply a workable line. For material they would certainly not be delayed; the greater part of it was ready at convenient points waiting to be handled. During the enforced inactivity of the company the directors had devoted a certain amount of time to the development of radio-telegraphy. Experiments on the Galletti system had perforce to be abandoned owing to the intervention of the war, and it had not been found possible to resume them. Whilst the company had, therefore, ceased to interest itself in any one system, certain radio patents and assets held by them had, together with the experience of the directors, been placed at the disposal of a new company, the Radio Communication Co., Ltd., against a substantial holding of shares. That company, having standardised various sets of apparatus, was doing very considerable business, particularly in the supply and working of sets on ships belonging to some of the foremost shipping companies in this country, and the directors considered that the investment should prove to be in every way a profitable one. It was in connection with their wireless work that he reserved for comment an item in sundry debtors in the 1918 accounts of advances (then £11,000, since increased to £13,000) made to the Galletti Co. The directors were of opinion that those advances were fully secured by the fact that they had a controlling interest in the assets of the Galletti Co., which included not only an important number of shares also held by that company in the Radio Communication Co., but a good claim against the French Government for compensation for requisition and appropriation during the war of the plant of the Galletti station in France.

Mr. Charles Holland seconded the motion, which was carried without discussion.

North Metropolitan Electric Power Supply Co.

Mr. E. Garcke, in his speech at the annual meeting, held on April 27th at Electric Railway House, Westminster, said that the net revenue for the year 1920 was their record figure, and the result would have been even better had it not been for the depression in trade. The net revenue, including interest and dividends received, was £101,354, compared with £65,868 for 1919. They were recommending a dividend on the ordinary shares at the rate of 7½ per cent. for the year, compared with 4½ per cent. for the previous year. The result was satisfactory, especially in view of the fact that the expenses of working—particularly the item of coal—had increased considerably. The improvement was in a measure due to the revised rates of charges introduced as from April 1st last year. A judgment had been obtained by the company for the annulment of a pre-war contract for the supply of electricity in bulk to the Stoke Newington Council, and in future it would be on their standard terms. This decision of the Court had, moreover, enabled them successfully to negotiate with the Middlesex County Council for a revision of the rates of supply to the Metropolitan Electric Tramways. Satisfactory arrangements have now been made for a revision of the price. A large number of new contracts had been made with consumers who required a supply for power purposes, and important bulk supply contracts had been entered into with the Harrow Co. and the Welwyn Garden City for distribution in their respective areas. Arrangements had had to be made for providing additional plant and cables to enable the company to supply the increased demand, and £87,000 had been expended on capital account during the past year. Further capital expenditure would be necessary during the current year. For this reason the authorised share capital of the company had been increased by £500,000 to £1,500,000 under the powers contained in the North Metropolitan Power Supply Act, 1920. The Electricity Commissioners have delineated a provisional area, which was described as "The London and Home Counties Electricity District," in which the area of supply of this company had been included, for the formation of a Joint Electricity Authority, in combination with the electricity supply undertakings owned by local authorities and companies in the metropolitan area. The directors were opposing the proposal to the extent that this company should be left out of the scheme. The position of this company was very different from that of an ordinary electricity supply company. Its powers to supply had been granted in perpetuity, and it was not subject to compulsory purchase at any time. The area of this company's supply was an exceptionally favourable one, and was rapidly developing for industrial purposes, and the demand was steadily increasing. The development during the next few years would be as rapid as in the previous years. The results of the first quarter of 1921 were very satisfactory, and, given normal industrial conditions, there was every indication that the results for the current year would show still further improvement.

English Electric Co., Ltd.

Sir Charles E. Ellis (chairman) presided on April 27th, at the Connaught Rooms, Great Queen Street, W.C., over the second ordinary general meeting of this company. The chairman, in moving the adoption of the report, said he would like, in the first place, to point out that, although the total of the credit side of last year's profit and loss account amounted to £410,835, that figure, as was clearly shown in last year's printed accounts, included a special item of £230,000, representing undivided profits brought in by certain subsidiary companies at the date of amalgamation. Although these particular profits appeared in the profit and loss account, they would remember that they were applied in creating a capital reserve account and in writing off the expenses of their debenture issue, &c. It was obvious, therefore, that this £230,000 could not be taken into account when comparing the results of the two years. As regarded the balance sheet, if they took the liabilities side first, they would observe that the share capital had been increased since the date of the previous balance sheet. This addition was explained in detail last year, and arose out of certain arrangements with their subsidiary and allied companies. The issue of 8 per cent. 6-year notes had been alluded to in the report. For some little time after the amalgamation, it was extremely difficult to forecast the volume of working capital that would be required. Experience showed, however, that the amount provided by the constituent companies and at their disposal was insufficient, more particularly in face of the steady rise in the prices of material; and the provision of further funds by way of a short-term loan was decided upon. The issue affected their accounts this year to the extent of only £150,000, the balance being received early in January. In the opinion of the board, the company was fortunate in making this issue in November last; had the issue been deferred to a later date, the subsequent stringency of the money market would have debarred them from securing equally satisfactory terms. They would have seen from the report that they had written off the whole of the expenses of this issue. Seeing that these notes were for the short term of six years, they had also considered it prudent to provide for the whole of the premium payable on redemption, which had been done without encroaching upon the capital reserve account set aside last year. They would thus appreciate that the profits of future years would be entirely relieved from the dead-weight both of the expenses of, and the premium on, this issue. Of the remaining items in the balance sheet, the sundry creditors showed a considerable increase this year, which, however, was more than set off by the new item of "Stock, work in progress, &c.," and the increase in the sundry debtors. He might explain that the appearance of stocks and work in progress in this year's accounts represented a further step in the gradual process of consolidating their allied concerns. He hoped that in the year 1921 they would be able to make still more progress in this direction, and that the next balance sheet would reflect the company's undertaking in a still simpler form. During the last year their principal task had been that of consolidating the company's organisation. Satisfactory progress had been made in the adaptation of the Coventry works and the restoration of the other factories to their normal activities. They had proceeded, with the least possible delay, to the application of their fixed policy of devoting each works to the manufacture of that class of machinery for which, by reason of its lay-out and past history, it was best adapted. It was obvious that the rapidity with which any such re-arrangement could be carried through must depend to a great extent on the contracts in course of execution at each works; but it was gratifying to be able to record that, in spite of the volume of work in progress and the necessity of taking no action which would impair their power to meet commitments, substantial progress had, in fact, been made towards their ultimate scheme for the best possible utilisation of their five works. They recognised, however, that the successful working of any scheme depended above all on continuous team work by their staffs, not only in each works, but between each works and the rest. He could not let pass this opportunity of acknowledging what they owed to those staffs. They had worked loyally and without losing their individuality for a corporate interest. To return to the special functions of their works, at Coventry they had manufactured turbine-electric units of very large sizes, rolling mill equipments, and the larger classes of engineering products. Preston had for long been well known as an important centre of traction work, it had now specialised even more completely in that branch of the industry, and at the present time electric locomotives, in addition to all forms of electrical traction equipment, were being manufactured there. At Rugby and Stafford the manufacture respectively of the medium sizes of steam turbines and of electrical generating and industrial machinery had been further developed. The Bradford works, which had been specially laid out for the smaller range of industrial motors, had now in addition their own machine moulding plant. Like all other engineering firms they were dogged throughout 1920 by the unfortunate effects of the moulders' strike, which began in 1919 and was protracted into the early part of the year, but in recent months there had been a welcome improvement in the foundry position. They had been able to enlarge and improve the foundry capacity of their own works, and thus to become to a greater extent independent of outside suppliers. Their business, both at home and abroad, was well maintained up to the later months of the year, but the general depression which began to affect the steel and kindred industries in the early autumn became noticeable in the electrical trade a little later. They had, fortunately, a considerable order book still to be executed, and it was not unreasonable to hope that in all except the smaller classes of their manufactures the flywheel action of this volume of orders would be sufficient to carry them over until trade revived. He referred a year ago to the importance of railway electrification proposals for the future of the electrical industry. Since then little progress had been made with the electrification of railways in the United Kingdom; but the delay was due mainly to difficulties of finance, and the technical advantages of electrification were not in dispute. In this connection it would be of interest to them to learn that the execution of the contract which the company obtained last year from the New Zealand Government for the electrification of the Arthur's Pass section of the Midland Railway of New Zealand was proceeding satisfactorily. Amongst the problems to which the board had devoted its most anxious attention had been the enforcement of economy in selling expenses at home and abroad. To this end he was glad to report that their working arrangement with Siemens Bros. and Co., Ltd., to which he referred last year, had been followed by the formation of the English Electric & Siemens Supplies, Ltd. This company (the capital of which was held by Messrs. Siemens and themselves in equal parts) would deal exclusively with marketing the minor products of the two concerns and electrical supplies generally. It had taken over their former subsidiary company, the English Electric Supplies, Ltd., together with a section of the selling organisation of Messrs. Siemens, and should effect a definite saving in that side of their work. If they looked at the labour position, he should wish to say in the first place that as a firm they had in the main no complaint to make as to the manner in which their workmen had settled down to work. They had worked hard and well; and through their ready co-operation on the Works' Committees their differences of view had been brought to light as soon as they had arisen, and had shown themselves in all cases susceptible to treatment by a full and frank discussion. None the less, it was certain that the wages rates in British engineering, and even more those in the industries from which they drew their materials, had led, and were leading to, the loss of many important contracts in world competition. Their raw materials were to a large extent the highly finished products of their suppliers; and if they were to extend or even fully to regain their pre-war business abroad, considerable reductions would be necessary in the price of those products, and, therefore, in the cost of the whole range of processes through which they were built up from the basic materials of coal and iron. How these reductions were to be brought about in a perfectly fair way he did not propose to discuss then, and would only say he had no doubt whatever that they would be able to meet the crisis if both employers and workers would be sure that the necessary sacrifices were distributed as fairly and equitably as was humanly possible over all those concerned. The immediate future must be an anxious time for every industry. Apart from wages and all questions of internal organisation, every industry had to-day to reckon with factors which were essentially political, and therefore beyond its control, yet which exercised a profound influence on the whole system of international trade. They could, however, say this with confidence, that whether a revival of trade came soon or late—and that it would come sooner or later no one could doubt—the electrical industry had an assured future, because it was bound up with those improvements and economies in productive organisation which they all, he thought, regarded as a necessary element in the future prosperity of the world.

Mr. W. L. Hichens (deputy chairman) seconded the motion.

A shareholder pointed out that it was proposed to wind up the United Electric Car Co., but in a previous report it was stated that the works were well equipped and constituted a very valuable asset to the company.

The chairman said the works still remained the property of the company; it was only a winding up for better organisation.

The report was adopted.

British Electric Transformer Co., Ltd.

The annual meeting was held on Friday last at Winchester House, E.C. Mr. A. F. Berry, who presided, first referred to the death of Mr. F. J. Marchment, who had been a director of the company for 15 years. He said that the issued capital now stood at £625,000. Sundry creditors amounted to nearly £95,000 more than last year, owing to the increased business done and being done. It was proposed to add a further £3,000 to the depreciation reserve account, making the total £23,300. The stock of materials stood at more than double the figure at which it stood in the previous balance sheet. That asset had been valued by the manager, as in past years, on a conservative basis. The "work in progress" amounted to nearly double last year's figure, and no profit had been taken into account on that work. Sundry debtors stood at about £41,300 more than last year, and they were all considered good, and since December 31st the sum of £98,790 had been received on account of them. With regard to the profit and loss account, general charges had increased by about £12,000, while the gross profit had been increased by about £23,000 and the profit for the twelve months had been increased from £48,038 to £70,266. The available balance amounted to £80,790. The dividend on the ordinary shares was at the same rate as for 1919. With regard to the working for the current year, they started with 50 per cent. more work in hand (money value), or 30 per cent. more in horse-power than they had at the beginning of 1920. It would interest original shareholders to note that in the last ten years the company had made far more rapid progress than it did in the first fifteen years of its life. In the last three years it greatly extended its operations, and, had it not been for strike and lock-out troubles, which lost them about one month's output in one way or another, they would have shown still greater progress. The year under review had been most difficult. The future was always difficult to foretell, but given the support of all from whom they had hitherto had it, and whose interests were best served by giving it, they could look forward to full-time employment and a continued improvement in trading results. It was essential in a business such as theirs to aim high, and it was only by strong and united action that they were able to keep so fully employed. Nothing succeeded like success, and he had confidence that, as they were having to reduce prices to secure work, they might rely on the necessary increased effort from their shops, even though they had, as they should have, to pay wages more in accord with the reduced cost of living. The next few years would test the capacity of even the best captains of industry. It would be most difficult to restart businesses that had stopped or speed up the output of those which had slowed down. Their business was, by reducing costs of production, to see their order sheet kept well filled well ahead. He was very disinclined to support any attack either upon the Government or Trade Unions, for, although he believed that the art of governing was developing, there could be no doubt about the development of attack upon government. There were, however, matters which those of them who were responsible for the creation and development of an industry would be glad to see handled differently, or not handled at all by Governments and Trade Unions. "Too many cooks spoil the broth" to-day, for Government Departments and leaders of Trade Unions were not in any way naturally fitted to control industry. The men who invented, designed, financed, and organised the manufacture and sale of those British goods which the world wanted were the natural leaders of industry. They were the creative force in the country, with a faculty for providing employment for their people. It was those men, backed by investors, merchants and exporters, who until recently made British trade predominant throughout the world. The overlapping which resulted from Governmental or Trade Union interference with industry had produced most grievous results. The men at the head of Trade Unions did not themselves even pretend that they were naturally fitted to create or direct industry, and he never yet met one who had ever been responsible for the building-up of an industry. Their useful work lay in quite other directions, and should be done without encouraging strife and class hatred, which made the lot of all most difficult. Those who preached "smashing" and "war" were either ignorant, ill-advised or desirous of acquiring some "pieces" that they thought would result from the smashing process. A civilisation that had been built up here from the days of Stonehenge, *i.e.*, some 4,000 years old, might be lightly destroyed, but could not rapidly be changed for the better. Useful endeavour to benefit the people of a country came rarely, if indeed ever, from those who preached sedition, strife and bitterness. It had been his privilege to meet some of the leaders in science and industry, both here and abroad, and he found in them no trace of envy, hatred, malice, or any uncharitableness. Electrical science, like others which were founded largely upon mathematical and natural sciences, had been developed to such lengths that it was difficult, even for those of them who were specialists in any particular lines, to keep ahead of their foreign competitors, unless they were helped, rather than hindered, by their own countrymen who benefited by their labours. He looked forward to the time when the workers in an industry, such as theirs, owned as shareholders a very considerable proportion of the business in which they were engaged. They had made a considerable start in that direction, and nearly 300 of those whose daily work was in connection with the company were already shareholders. There was only one remedy for unemployment and that was work, and reasonably long hours of good work cheerfully done for a fair day's pay. They themselves might well have had another quarter of a million's worth of orders on their books had they been able by overtime or increased effort to give more reasonable delivery. As with them, so with hundreds of firms up and down the land. Not only had orders passed never to return—those orders which would have stood abroad as England's advertisement to secure work for them in the years to come—but actual orders had been cancelled right and left, though he was glad to say not with themselves. It was late to grieve over what might have been—England's trade opportunity at the beginning of 1920 was still a wonderful one. He maintained that even now England's opportunity was enormous, and there were signs that, as ever, the people of this country would now tighten up themselves and take their work in hand with a view to making up for lost time.

Mr. T. Rowe seconded the motion, which, after a short discussion of a congratulatory character, was carried.

River Plate Electricity Co., Ltd. After providing for all expenses, bad debts, depreciation, and 5 per cent. debenture interest, 7 per cent. is recommended on the ordinary stock for the year, £20,000 being put to general reserve, and £6,982 carried forward. The *Financial Times* states that after the close of the year arrears of amortisation due upon five per cent. obligations of the German Company, amounting to £12,300, were received. The greater part of arrears of interest for the period from 1914-1919 has also been received, but there is still in dispute a sum of over £3,000 in respect of interest in arrears. The board has entered into contract with the Compania Hispano-Americana de Electricidad, which is in process of taking over all the assets in South America of the German Company, under which the Compania Hispano has purchased from this company and paid for £63,600 of the 5 per cent. obligations of the German Company, and, as to the balance of £60,000 then remaining, the company has agreed to accept the obligation of the Spanish Company in place of the obligation of the German Company.

Belgian Investment Companies. The directors of the *Société Financière des Transports et d'Entreprises Industrielles*, of Brussels, dealing with the working of the supply works and tramways in which the company is interested, record with satisfaction the overcoming of the difficulties in connection with the supply of coal. This had now become abundant, raw materials had become cheaper, and freights lower, and Government restrictions and control were disappearing, the only difficulty now remaining being that of labour. Under the circumstances the situation of most of the undertakings experienced an improvement in 1920. The net profits realised last year amounted to 4,143,000 fr., which allow of the payment of a dividend at the rate of 12 per cent. on the ordinary shares, or 54 fr. free of tax, and 40.45 fr. net on the founder shares.

The report of the *Société Générale Belge d'Entreprises Electriques*, which is an investment company, states that in order to assist in meeting the growing demand for power, a further sum of over 10,000,000 fr. was invested in supply undertakings during 1920. Electricity supply works represent 70.5 per cent. of the value of the company's securities in portfolio, combined supply works and tramways 14.5 per cent., and tramways, purely and simply, 15 per cent. As to the geographical distribution of the securities, it is mentioned that 42.5 per cent. of the investments apply to Belgium, 18 per cent. to France and her colonies, 17 per cent. to Italy, 10 per cent. to Spain, 7 per cent. to the Argentine Republic and Siam, and 5.5 per cent. to Poland, Livonia, Hungary and Russia. The gross profits in 1920 amounted to 4,933,000 fr., as compared with 2,903,000 fr. in the previous year. After deducting the financial charges, the sum of 1,634,000 fr. has been written off for depreciation, particularly of Russian holdings, and the net profits of 1,825,000 fr. permit of the payment of a gross dividend of 35 fr. per share on the old shares, 22.50 fr. on the shares fully paid up during the year, and 10.40 fr. on the founder shares.

German Companies. The *Lloyd Dynamowerke A.G.*, of Bremen, proposes to pay out of net profits of 513,000 marks a dividend at the rate of 8 per cent. for 1920, these figures comparing with 188,000 marks and 7 per cent. respectively in the preceding year.

The *Concordia Elektrizitats A.G.*, of Dusseldorf, intends to pay a dividend at the rate of 15 per cent. out of net profits of 1,111,000 marks in 1920, comparing with 10 per cent. and 60,000 marks respectively in the preceding year.

The accounts of the *Deutsche Kabelwerke A.G.*, of Berlin-Lichtenberg, record net profits of 3,172,000 marks for 1920, as against 1,392,000 marks in 1919, the dividend rising from 15 per cent. in 1919 to 17 per cent. last year. The directors state that a liquidation of the English participation has not yet taken place.

The *Elektrizitats Lieferungs Gesellschaft*, of Berlin, states that the supply works in which the company is interested experienced an increasing demand, and the installation departments were adequately occupied in 1920. Out of the net profits of 4,631,000 marks, a dividend has been declared at the rate of 14 per cent., as compared with 3,958,000 marks and 12 per cent. respectively in 1919.

The directors of the *Kabelwerk Duisburg*, reporting on the year 1920, state that it was difficult to obtain new orders after April and May, and even the acceptance of delivery of completed manufactures was refused in some cases. The net profits were 12,950,000 marks, as against 990,000 marks, and the dividend and bonus represent 25 per cent., as in 1919. Owing to the growing uncertainty of the economic conditions, the prospects are not regarded as very favourable.

The net profits of the *Sachsenwerk, Licht und Kraft A.G.*, of Dresden, are reported at 8,073,000 marks for 1920, as against 2,245,000 marks in 1919. The directors recommend the payment of a dividend at the rate of 16 per cent. on share capital of 40,000,000 marks, as compared with 20 per cent. on 9,000,000 marks in the previous year. It is now intended to make a fresh issue of share capital for 15,000,000 marks.

The *Ges. fur Elektrische Unternehmungen*, of Berlin, which is an investment company in supply works and tramways and manufacturing undertakings, earned net profits of 8,470,000 marks in 1920, including the balance forward, as contrasted with 5,792,000 marks in 1919. It is proposed to pay a dividend at the rate of 12 per cent. on share capital of 75,000,000 marks, as against 8 per cent. in 1919.

The directors of the *A.G. Mix und Genest (Telephone und Telegraph Works)*, of Berlin, recommend a dividend at the rate of 15 per cent. for 1920 as compared with 7 per cent. in 1919. At the same time it is proposed to increase the share capital from 12,600,000 marks to 25,200,000 marks. The net profits are returned at 3,150,000 marks, as contrasted with 650,000 marks in the previous year.

The report of *Voigt & Haeffner A.G.*, of Frankfort-on-Main, states that the increased profits realised in 1920 were due to a larger turnover and exchange profits on foreign business. After having made provision for depreciation, the accounts show net profits of 12,920,000 marks, as compared with 1,660,000 marks in 1919, and a dividend has been declared at the rate of 20 per cent., as against 18 per cent. in 1919.

The *Hamburger Hochbahn A.G.* reports net profits of 1,843,000 marks for 1920, as against 764,000 marks in the previous year. It is proposed to pay a dividend of 1 per cent. on the B shares, as contrasted with ½ per cent. in 1919, and 2 per cent. on the A shares, as against 1½ per cent. The rate on the A shares will be increased to 5 per cent. by a payment of the Hamburg State under its guarantee.

The directors of the *Bergmann Elektrizitats Werke A.G.*, of Berlin, report gross profits of 45,155,000 marks for 1920, as compared with 22,162,000 marks in the previous year, the net profits being 13,568,000 marks and 8,488,000 marks in the two years respectively. It is proposed to pay a dividend at the rate of 15 per cent., as against 12 per cent. in 1919, to devote 500,000 marks to provident purposes as in the preceding year, and carry forward 1,068,000 marks. The present share capital of 80,000,000 marks is now to be increased to 100,000,000 marks.

The *Ges. fur Elektrische Hoch und Untergrundbahnen*, of Berlin, proposes to pay a dividend at the rate of 5½ per cent. on the ordinary shares for 1920, being the same rate as in the preceding year. Including the balance forward, the net profits amounted to 4,568,000 marks, as compared with 4,542,000 marks. Fares were again increased, and the total receipts nearly doubled, but the number of passengers carried fell off by 12,000,000, the average fare having risen from 26.66 pfennigs in 1919 to 58.27 pfennigs last year.

Para Telephone Co., Ltd.—The profit for the year was £12,718, plus £6,426 brought forward. The total dividend distribution has been 10 per cent., free of tax. £8,605 is being carried forward. Mr. T. M. Steuart, presiding at the recent meeting, said that although the telephone subscribers had increased during the year, the number was not so large as anticipated owing to the abnormal conditions which existed in Para during the year. A considerable extension had been made in the telephone system in order to incorporate districts hitherto outside the area of the telephone system. The work was nearly completed, and the opening up of the new districts would substantially add to the number of subscribers.

Radio Corporation of America.—The balance sheet at December 31st, 1920, shows: Assets, cash and receivables, $881,507; merchandise inventories, $689,516; investments in Government and industrial bonds, $3,375,210; stocks of associated companies, $550,385; plant and equipment, $8,901,675; deferred charges, $606,669; patents and goodwill, contracts and franchises, $10,107,982. Current liabilities are $1,883,227.

British L. M. Ericsson Manufacturing Co., Ltd.—The annual meeting of this company was held on April 29th. On attendance, a representative of the Electrical Review was informed that, exercising the power accorded by the Articles, no members of the Press would be admitted.

Aster Engineering (1913) Co., Ltd.—Total distribution for 1920, 7½ per cent., free of tax; £6,000 to reserve for bad debts; £3,635 to depreciation; £40,573 carried forward subject to E.P.D. and Corporation Tax.

City of Buenos Ayres Tramways (1904) Co., Ltd.—A dividend of 1s. 3d. per share, less tax, for three months ending March 31st is announced.

Brush Electrical Engineering Co., Ltd.—It is mentioned in the report for 1920, to which we referred briefly on p. 561 of our last issue, that £91,227 was expended on capital account during the year. £105,244, part of the general reserve fund existing on December 31st, 1919, was capitalised and distributed to the holders of ordinary stock in the proportion of £1 of new ordinary stock for each £1 of existing stock held. The whole of the ordinary stock was then converted into £1 fully-paid ordinary shares at par. In July, 1920, an issue was made of 339,512 ordinary shares of £1 each at par. Of this issue, which was not underwritten, 248,075 shares were allotted in response to applications received. The authorised share capital of the company is now £600,000 in £1 ordinary shares, of which 458,565 shares have been allotted. The directors state that the business generally continues to develop satisfactorily. The new shop in course of erection for the extended manufacture of Brush-Ljungstrom turbo-generators has been delayed owing to difficulties in obtaining delivery of the steel work, but progress has been more rapid of late, and work on the buildings is now active. The demand for these machines and their accessories for electric supply purposes has largely increased. Mr. J. E. Spagnoletti resigned his seat on the board and Mr. C. Shirreff Hilton, a former director, was elected to fill the vacancy. Meeting: May 9th at 88, Kingsway, W.C. 2.

Johnson & Phillips, Ltd.—The directors report that the profit for the year 1920 on trading accounts, &c., after making provision for bad and doubtful debts, and after charging to revenue upwards of £23,000 for maintenance of buildings, plant, &c., amounted to £98,406, plus £63,795 brought forward. After deducting the dividend paid April 30th, 1920, less tax, £30,625, and a bonus of 1 per cent. on first mortgage debenture stock, less tax, £512, the total is £131,064. There are deducted remuneration of directors,' auditors' and trustees' fees, £1,511; interest on debenture stock to December, 1920, £3,657; reserve *re* debenture sinking fund, £9,227; interest on second debentures to December, 1920, £2,500; depreciation on machinery and plant, &c., £12,236; interest on loans, £4,450; income tax and excess profits duty, £24,312; loss on sale of 4 per cent. funding loan, £2,776; leaving £70,394. The directors recommend a dividend at the rate of 12½ per cent. per annum, less income tax, on the 437,500 ordinary shares, requiring £38,281, leaving to be carried forward (subject to E.P.D. for 1920, and Corporation Profits Tax) £43,113. Meeting held yesterday, Thursday.

Bromley Electric Light & Power Co., Ltd.—Mr. F. E. Gripper presided at the recent annual meeting. He said that the output for 1920 was the largest they had ever had; they had also increased their maximum rate to 10d. These two factors had increased their receipts by £7,607, but the working expenses had also greatly increased. The future prospects were difficult to forecast owing to the strike atmosphere. They hoped to get the benefit of substantial reductions in the cost of coal and other materials. If strikes did not materialise into anything serious, with normal business they might look forward to maintaining the 6 per cent. dividend, and, he hoped, increasing it, as under the present financial conditions 6 per cent. could not be considered an adequate return on ordinary share capital.

North of Scotland Electric Light & Power Co.—The directors report that the connections in Montrose have increased from 1,555 kW to 1,743 kW; in Brechin, from 908 kW to 928 kW, and in Inverness from 2,088 kW to 2,346 kW, making a total of 5,017 kW in the three towns. After providing for interest on debentures and loans amounting to £3,917, writing off £284 from suspense account, and making provision for income tax, amounting to £1,992, there remains a balance of £7,529, plus £729 brought forward. A dividend at the rate of 1¼ per cent. for the year, being the maximum allowed under the Temporary Increase of Charges Act, is recommended absorbing £625; £5,000 is to be placed to renewal reserve account, £2,000 to general reserve account, and £634 is carried forward.

London & Suburban Traction Co.—The revenue for 1920 totalled £51,961. After deducting administration and general expenses, debenture and loan interest, amount paid into sinking fund for redemption of 5 per cent. debenture stock and other expenses chargeable to revenue, and including £1,205 brought forward, there remains £2,098 to be carried forward. Beneficial effect of increased fares was only felt by operating companies during part of the year, while, on the other hand, increased working expenses prevailed throughout the year. During 1920 £14,120 debenture stock was purchased and cancelled, reducing amount outstanding to £271,178.—*Financial Times*.

Pernambuco Tramways & Power Co.—This company announces that the State Government of Pernambuco has granted it, *inter alia*, the right to increase tramway fares subject to the completion of the electrification of the 10 km. of steam tramway and an extension of 6 km. of single track of the suburban electric lines. In order to repay temporary loans, to complete the tramways, and to extend the lighting and power programmes, separate meetings of shareholders and debenture holders are being held to-day to authorise the creation of a prior lien mortgage for £650,000, after which it is proposed in the near future to make a prior lien debenture issue sufficient to provide £450,000.—*Financial Times*.

Bristol Tramways & Carriage Co., Ltd.—Revenue for 1920 £920,775, an increase of £72,695. The working and general expenses and renewals, however, amounted to £958,885. In view of the abnormal conditions of the year, the directors transferred £45,000 from the reserve fund, so that with the E.P.D. repayable and the balance brought forward, the balance at net revenue account is £90,225. Debenture and other interest absorbs £37,497; preference dividend, 4 per cent., subject to income tax, £14,000; dividends of 7 per cent., free of tax, on the ordinary shares, £35,000; carrying forward £3,728. The receipts of the tramways department increased by £160,079, and those of the carriage department decreased by £89,246. Passengers carried on the cars and motor 'buses increased by 12,145,358 to 84,983,434. Increases of fares were authorised as from July 15th, 1920, and February 1st, 1921. Mr. C. Challenger has been elected a director.

Peterborough Electric Traction Co., Ltd.—According to the *Financial Times* the directors recommend dividends of 18 per cent. on the preference shares for the three years ended December, 1920; £768 to reserve; £3,000 to renewals; £6,132 repairs and maintenance; carried forward £932.

Companies to be Struck off the Register.—The following are to be struck off the Register within three months unless cause is shown to the contrary:—

Electric Tramways of Ribeirao Preto Brazil, Ltd.
Midhurst and District Electric Supply Co., Ltd.

Bath Electric Tramways, Ltd.—After providing for repairs and renewals, debenture interest, and preference dividend, £5,000 is put to contingencies and renewals account and £2,305 carried forward.

Chiswick Electricity Supply Corporation, Ltd.—Dividend for 1920, 8 per cent. per annum; to depreciation reserve, £6,500; carried forward, £2,035.

STOCKS AND SHARES.

Tuesday Evening.

The Stock Exchange was closed for a long week-end, and this had the effect of increasing the amount of business which had to be dealt with on Tuesday (to-day), causing an appearance of activity in various markets owing to the execution of accumulated orders. The tone of the markets continues firm, and the Budget as a factor is literally not mentioned. The reduction of the Bank Rate to 6½ per cent. caused surprise, and a certain regret. It was hoped that the Bank would either leave the rate at 7 per cent. or reduce it to 6 per cent., the halfway house being a most unusual halting-place with the Bank minimum standing as high as it is to-day. It is obvious, however, that the Court of Directors are being influenced strongly by the industrial position. From the monetary point of view, there is no justification for holding the Rate as high as it is to-day, and, were the coal-strike to become settled, it would be followed immediately by a drop to 6 per cent. in the rate, with possibly the hint of a further fall in the near future.

This consideration is doing more than anything else to keep steady the prices of investment securities. People with money are still chary of using it for speculative purposes. The new Central Electric Notes make a good illustration of the way in which first-class investments are wanted, for the price has risen to 3¾ premium. The City of London Electric 8 per cent. second preference shares, which started off at 1s. discount when dealings commenced, have already hardened to a shade above the par price of 20s., and on the new ordinary there is a premium of about 1s. 3d. Other newcomers are expected from electrical companies before long, although it may be that the prospectuses will not be issued until after Whitsun.

The demand for electrical manufacturing shares continues, and is a feature of the industrial markets at the present time. Electric Constructions are 9d. up at 17s. Metropolitan-Vickers preference rose 1/16 to 1 11/16 xd. Siemens went up to 24s., but returned to 22s. 6d. English Electrics, also ex dividend, are better at 13s. 6d., allowing for the deduction. Edisons maintain their better position at 12s.

Telegraph manufacturing issues are equally strong. Callender's show 1/16 gain and Henley's ⅛. The new Henley's are harder at 27s. In the engineering group, Babcock & Wilcox have stiffened to 2½, nor has the continuance of the coal stoppage caused any particular diminution of strength amongst the iron and allied companies' shares. Vickers, however, are lower at 13s. 3d.

Cable stocks have again hardened. Eastern ordinary recovered its dividend, and Globes, Eastern Extensions and Westerns are all better on the week. The reason is to be found in the frequently-repeated statement of the attraction which these stocks and shares offer to the investor, who demands sound security and a net 6½ per cent. return upon his capital. At current prices, the average yield is but little over 6 per cent.—equivalent to 8½ per cent. gross, taking tax at 6s. in the pound.

The upward movement which started last week in London traction descriptions has made further progress. British Electric Traction ordinary is higher at 35½. London and Suburban Traction preference have enjoyed a little activity at the improved price of 6s. 6d., and the ordinary are a trifle firmer at 2s. 9d. Even London United Tramways shares came into the sunlight and changed hands at 4½d. The tube railways are unchanged, Underground Incomes being 71½, and the A shares 6s. Districts, however, picked up to 15½ and Metropolitans to 26, both being a point higher.

Metropolitan Electric Supply ordinary are ⅛ up at 3⅜. City Lights, at 23s. 9d., have regained the decline which occurred on publication of the prospectus offering new ordinary and preference.

Mexicans are better in several cases. The first mortgage bonds of the Tramways have risen 2 to 42, and Mexican Light and Power Firsts are 1½ better at 68½. Pernambuco Trams have given way on the issue of the report. Other foreign traction descriptions are not getting much notice. Marconi's touched 2 11/16 buyers; then came back to 2⅝. Marconi Marines are a better market at 28s. 3d. Radio Corporations remain at 9s. 6d. for the Common and 11s. 6d. for the preferred. Rubber shares are depressed on the price of the raw produce sinking to 9¼d. per lb., the lowest price touched for many years, and comparing with 12s. 9d. per lb. in 1910, when the rubber boom culminated.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1919.	Dividend 1920.	Price May 3, 1921.	Rise or fall.	Yield. p.c.
Brompton Ordinary..	12	12	6	—	£10 0 0
Charing Cross Ordinary ..	7	8	3⅞	—	10 6 6
do. do. do. 4½ Pref...	4½	4½	2⅞	—	7 16 6
Chelsea..	4	6	3⅛	—	9 12 0
City of London	13	14	1 3/16	+6d.	11 16 0
do. do. 6 per cent. Pref...	6	6	17/-	—	7 1 2
County of London	8	8	7⅝	—	10 9 10
do. do. 6 per cent. Pref...	6	8	8	—	7 10 0
Kensington Ordinary	7	9	4⅛	—	10 18 2
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref. ..	6	6	2¾	—	10 18 2
Metropolitan	6	7	8¾	+ ⅛	10 7 4
do. 4½ per cent. Pref. ..	4½	4½	3 1/16	—	7 7 0
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	6	7	2⅛	—	9 2 10
South Metropolitan Pref... ..	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	5⅛	—	9 15 2

Telegraphs and Telephones.

	1918	1919			
Anglo-Am. Tel. Pref.	6	6	78½	—	7 12 10
do. Def...	83/6	1½	15¾	—	9 10 6
Chile Telephone	8	6	5⅛	—	5 6 8
Cuba Sub. Ord.	7	7	7½	—	9 6 8
Eastern Extension	10	10	16¼	+ ⅛	6 8 0
Eastern Tel. Ord.	8	10	161½	—	6 8 10
Globe Tel. and T. Ord.	8	10	16¼	+ ¼	6 3 0
do. do. Pref.	6	6	9	—	6 13 4
Great Northern Tel.	22	22	22¾	+ ¾	9 13 4
Indo-European	13	10	30xd	+1⅝	8 6 8
Marconi	25	25	2⅝	+ ⅛	—
Oriental Telephone Ord.	10	12	2⅛	— 1/16	*5 13 0
United R. Plate Tel.	8	8	6⅛	—	6 10 8
West India and Panama	1/3	Nil	9/16	—	Nil.
Western Telegraph..	8	10	16½	+ ⅜	*6 1 8

Home Rails.

	1919	1920			
Central London Ord. Assented ..	4	4	44½	—	9 0 0
Metropolitan	1¼	1½	26	+1	5 16 5
do. District	Nil	Nil	15½	+1	Nil
Underground Electric Ordinary ..	Nil	Nil	2	—	Nil
do. do. "A" ..	Nil	Nil	6/-	—	Nil
do. do. Income ..	4	2	71½	—	2 16 0

Foreign Trams, &c.

	1918	1919			
Anglo-Arg. Trams, First Pref. ..	Nil	6½	2⅝	—	10 9
do. do. 2nd Pref. ..	Nil	Nil	3	—	Nil
do. do. 5 % Deb. ..	5	5	69½	—	8 8 0
Brazil Tractions	Nil	Nil	31	—½	Nil
British Columbia Elec. Rly. Pfce.	5	5	56	—	9 1 10
do. do. Preferred	2½	5	54½	—	*8 14 0
do. do. Deferred	Nil	8	51½	—	*11 17 6
do. do. Deb. ..	4½	4½	58½	—	7 5 4
Mexico Trams 5 per cent. Bonds..	Nil	Nil	42	+2	Nil
do. 6 per cent. Bonds..	Nil	Nil	23½	+1	Nil
Mexican Light Common	Nil	Nil	11½	—	Nil
do. Pref.	Nil	Nil	18	—	Nil
do. 1st Bonds	Nil	Nil	68½	+1½	Nil

Manufacturing Companies.

Babcock & Wilcox	15	15	2⅛	+ ⅛	6 0 0
British Aluminium Ord.	10	10	16/3	—	12 6 2
British Insulated Ord.	12½	15	1 9/16	—	9 12 0
Callenders	25	15	1⅛	+ 1/16	10 0 0
" 6½ Pref.	6½	6½	17/6	—	7 8 7
Crompton Ord.	10	10	15/-	—	13 6 8
Edison-Swan	10	10	12/-	—	—
do. do. 5 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	17/-	+9d.	11 15 4
English Electric	—	8	13/6xd	+6d.	11 17 0
Do. Pref.	—	6	14/-	—	8 11 6
Gen. Elec. Pref.	6½	6½	19/-	—	6 16 10
do. Ord.	10	10	24/6	—	*8 8 6
Henley	25	15	1 7/16	+ ⅛	10 8 8
do. 4½ Pref.	4½	4½	8½	—	6 18 6
India-Rubber	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	1 11/16xd	+ 1/16	9 9 8
Siemens Ord.	10	10	1⅛xd	—	*8 17 10
Telegraph Con.	20	20	20	—	*6 19 9

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, May 3rd.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Oxalic	per lb.	10d.	..
a	Ammoniac Sal	per ton	£75	..
a	Ammonia, Muriate (large crystal)	"	£65	..
a	Bisulphide of Carbon	"	..	..
a	Borax	"	£34	..
a	Copper Sulphate	"	£33	£1 dec.
a	Potash, Chlorate	per lb.	6d.	..
a	" Perchlorate	"	10d.	..
a	Shellac	per cwt.	£16 10s.	60s. inc.
a	Sulphate of Magnesia .. .	per ton	£16	..
a	Sulphur, Sublimed Flowers .	"	£19	..
a	" Lump	"	£18	..
a	Soda, Chlorate	per lb.	5d.	..
a	" Crystals	per ton	£7	..
a	Sodium Bichromate, casks ..	per lb.	6d.	1d. dec.

	METALS, &c.			
p	Babbitt's Metal Ingots	per ton	£95 to £300	..
c	Brass (rolled metal 2″ to 12″ basis)	per lb.	11¼d.	..
c	" Tubes (solid drawn) ..	"	1/1¾ to 1/2	..
c	" Wire, basis	"	11⅝d.	..
c	Copper Tubes (solid drawn) ..	"	1/5¼	..
c	" Bars (best selected) ..	per ton	£116	..
c	" Sheet	"	£116	..
c	" Rod	"	£116	..
d	" (Electrolytic) Bars ..	"	£78	£1 dec.
d	" " Sheets ..	"	£145	..
d	" " Wire Rods..	"	£89	£1 dec.
d	" " H.C. Wire..	per lb.	11 3/16	¼ dec.
f	Ebonite Rod	"	3/6	..
f	" Sheet..	"	3/-	..
n	German Silver Wire	"	2/9	..
h	Gutta-percha, fine	"	14/- to 16/-	..
h	India-rubber, Para fine	"	10½d.	½d. dec.
i	Iron Pig (Cleveland Warrants) ..	per ton	Nom.	..
l	" Wire, galv. No. 8, P.O. qual.	"	£40	..
g	Lead, English Pig	"	£21 10s.	20s. inc.
g	Mercury	per bot.	£11 5 to £11 10	25s. dec.
e	Mica (in original cases) small ..	per lb.	4d. to 4/-	..
e	" " " medium ..	"	5/- to 10/-	..
e	" " " large ..	"	12/6 to 25/- & up	..
p	Phosphor Bronze, plain castings .	"	1/4 to 1/9	..
p	" " rolled bars and rods	"	2/1 to 2/6	..
p	" " rolled strip & sheet	"	2/2 to 2/7	..
d	Silicium Bronze Wire	per lb.	1/5¾	½d. dec.
r	Steel, Magnet, in bars	"	1/8	..
n	Tin, Block (English)	per ton	£166 to £167	£12 inc.
n	" Wire, Nos. 1 to 16	per lb.	4/-	..
p	White Anti-friction Metals ..	per ton	£78 to £300	..

Quotations supplied by—

a	G. Boor & Co.	g	James & Shakespeare.
c	Thos. Bolton & Sons, Ltd.	h	Edward Till & Co.
d	Frederick Smith & Co.	i	Bolling & Lowe.
e	F. Wiggins & Sons.	l	Richard Johnson & Nephew, Ltd.
f	India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.	n	P. Ormiston & Sons.
		p	————
		r	W. F. Dennis & Co.

German Factories in the Argentine. — The South American market is one which has claimed a considerable share of attention from Germany in her post-war trade activity. According to a F.B.I. correspondent, writing from the Argentine, a movement has been started for the establishment in that country of German factories, with a view to utilising the abundant raw materials available. As an instance which has recently come beneath his notice, he mentions the purchase by Herr Thyssen, the German industrial magnate, of an extensive factory site on the Riachuelo, comprising numerous large and well-built brick buildings, and possessing direct railway connection with all parts of the Republic. Efforts made to interest British capital in the site proved fruitless, though the German buyer is said to have made up his mind within twenty-four hours of inspecting the place. The Thyssen group has also, he states, bought one of the large engineering shops in Avellaneda.

A newspaper cutting forwarded by the correspondent announces that the Argentine Consul in Berlin has informed his Government of a proposal to transplant bodily various Saxon factories engaged in the manufacture of sacking for bags, together with a number of skilled workers. Experiments are at present in progress with raw material from Argentina, from which astonishingly good results are being obtained. Certain obstacles are, however, being placed in the way of the export of the necessary machinery by weavers of similar textiles in Germany. Another German firm proposes to install a factory in the Republic for the purification of oil obtained from Argentine linseed, and a technical personnel is being recruited under the direction of the industrial chemist, Dr. Reichau. The quality of the samples obtained by the process to be introduced leads the Argentine Consul to regard this as an important step in the development of native industries. The Federation's representative in Rio de Janeiro mentions in a recent letter a report that certain German syndicates propose the erection in Argentina of textile mills in areas where adequate water-power is available.—*Bulletin of the Federation of British Industries.*

THE INDUSTRIAL SITUATION IN SWEDEN.

As a growing manufacturing country—one of those non-belligerent countries which were compelled to develop their industrial resources owing to the exigencies of the war—Sweden claims a prominent position, and for this reason the report by Mr. H. Kershaw, Commercial Secretary to H.M. Legation at Stockholm, on the commercial and industrial situation of Sweden at the close of 1920, has been issued at an appropriate moment.

The report states, in its general review, that in the course of years many industries have been brought to a high standard of efficiency, including the manufacture of ball bearings, telephones, and many other electrical appliances. Though the war did nothing to retard the progress of these and other industries, the phenomenal advances in manufacturing and engineering accomplished through the force of circumstances in belligerent countries are said to make it incumbent upon Swedish engineers to exercise their maximum efforts in order to keep pace with the abnormally rapid developments which took place during the war. As to the high costs of production which prevailed in Sweden in the past two years, the report attributes this partly to the dearness of coal. When the latter rose to about 150 to 160 kr. per ton, manufacturers began to feel the injurious effects of the costs of production. As a result of these adverse factors many suggestions were made in responsible quarters to press forward the schemes for the more extensive utilisation of the waterfalls for the provision of electrical energy for lighting and power purposes on a commercial basis. Now, however, that the price of coal has fallen to about 70 kr. per ton, the report remarks that it remains to be seen whether these schemes will command the same enthusiasm. To this statement may be added the fact that owing to the situation of the State finances and the great expenditure now necessary for the establishment of hydro-electric works, the Hydro-Electric Department is restricting the amount of the extension work being carried out at existing works and in connection with proposed new hydro-electric works.

British and German Travellers in Sweden.—Coming to consider the problem of British trade with Sweden, the Commercial Secretary states that the time has arrived when British manufacturers and exporters must seriously consider the methods of conducting their agencies in Sweden. As he says, an enormous amount of trade has been, and is still, being lost to British manufacturers for no other reason than that many Swedish traders are placed in the position of being required to carry on their British import business through agents domiciled in other Scandinavian countries, which was originally due to the existence of well-established and strong financial houses in these other countries. These reasons, however, no longer hold good. During recent years there has arisen in Sweden a large number of very experienced import and export merchants whose business is well supported by the great banks, which lend their aid not only by credit advances, but also give daily advice on market and monetary conditions. It is true to say, therefore, that a feeling of resentment has gained ground in Sweden towards the prevailing custom, which often compels the Swedes to carry on British import trade through the medium of travellers from other parts of Scandinavia who visit the country periodically.

As a consequence of the rapid growth of harbour facilities at Gothenburg, Stockholm, and Malmo, together with the establishment of free ports and warehouses, supported by a rapidly increasing mercantile marine, a gradual and organic change is taking place in Sweden, so that in the course of time the country will have to be reckoned with seriously in merchant trading, whether directly with Sweden itself or indirectly with the States in the Baltic.

In emphasising the fact that the present is an appropriate time for taking the matter into consideration in all its bearings, the report says that German travellers are visiting the country in large numbers, and many applications are being received from German firms for agents in Sweden. British travellers are urged to discontinue the habit of confining their visits to a few of the large towns such as Stockholm, Gothenburg, Malmo, and Norrkoping, and missing, on the ground that it entails too much trouble, the considerable number of small towns where a very thriving business is to be done. At the same time, it is admitted that British travellers are now visiting Sweden in increasing numbers, although not to a sufficient extent, in view of the large amount of trade which is declared to await enterprising firms.

The Protection of Industries.—During the second half of the year, according to the report, perhaps the most important agitation ventilated publicly related to energetic demands on the part of industrial representatives for the imposition of import duties on those classes of manufactures which form some of the staple industries in Sweden. In order to understand the real meaning of this movement the report mentions that many industries originated during the war, and a number developed their operations and carried on a thriving business owing to the practical cessation of imports. Money was plentiful, and consequently prices reached a high level, and it was easy to carry on manufacturing owing to the almost complete absence of competition

A reversal of these factors, however, took place in 1920, and in consequence of the very low rate of German exchange, and in conflict with outside competition, many important Swedish industries were faced with serious problems, which were still more accentuated by the high scale of wages. Under the circumstances a comprehensive case for additional protection was submitted to the Government by the Federation of Swedish Industries. The principal industries affected are iron and steel, textiles, glass, boots and shoes, furniture, and certain branches of the electrical industry.

In spite of the strong case put forward by the representative associations, both the Swedish Board of Trade and the Economic Council, which were invited to express an opinion on the question, decided against an all-round raising of the Customs duties and import prohibitions. The utmost they found it possible to recommend, compatible with the general economic conditions, was the imposition of provisional increases in the duties in isolation cases where very urgent reasons existed in connection with certain distressed industries which it was in the national interest to maintain. The report states that the answer of the authorities to these requests for vigorous protective measures—suggested trebling of the import duties—is not surprising.

It is, however, important to note that the Government had not given an answer by the end of last year, and has not done so down to the present time. What the Government did, after hearing the views of the Swedish Board of Trade, which by no means is the equivalent of the English Board of Trade, was to appoint a committee to consider the whole question. The committee held various meetings, and then held conferences with the representatives of various industries which it is necessary to maintain in the national interest, subsequently settling down to the drawing up of their conclusions, which were published by the Ministry for Commerce at the beginning of April of the present year. There is no report; the members of the committee have merely stated their individual views; three members are against any increase in the duties, while the others are divided as between a partial and a general increase in the duties. Now the Government has to determine its attitude on the problem or, in other words, to give its answer to the petitioning industries.

Dealing with industry and trade in detail, the report remarks that the national industries had to face considerable difficulties during the year. Manufacturers not only had to fight competition, but at the same time they were unable to obtain capital or realise funds at a time of considerable stress owing to the stringent credit conditions and the shortage of money. On the one hand, the importation of large quantities of goods from Germany and from other countries also having a depreciated currency naturally reduced very largely the market for Swedish goods; and on the other, it was impossible to reduce the enhanced costs of production owing to the high rates of wages and the operation of the eight-hour day.

Iron and Steel.—Leaving on one side timber and wood pulp and paper, the report approaches the iron and steel industry, which is stated to have experienced a temporary improvement in the early months of the year, but the production is still far below the average output in previous normal years. As statistics of production and of the number of blast furnaces and steel furnaces in operation have already been issued by the Swedish Iron and Steel Association for the whole of last year, it is unnecessary to refer to the figures given in the report for the first nine months of 1920.

On the whole, iron and steel manufacturers were able to maintain their position in the export markets surprisingly well, but considerable difficulty was experienced in the home market, owing to the large imports of semi-finished and of manufactured iron and steel products, of which steel rails represented a large proportion. Generally speaking, the iron and steel industry at present is in a difficult situation, and many works have been compelled, in order to keep in operation, to sell at prices almost below the costs of production. The two factors of decreasing demand and falling sale prices, together with the severe competition from Germany, are the causes of the existing state of affairs; and it was for these reasons that the Iron and Steel Association made urgent representations for the introduction of protective measures.

Electric Traction and Wireless Stations.—After dealing with the textile and other industries, the report proceeds to refer to the State railways. It is mentioned that a Bill was introduced into Parliament asking for the allocation of 26,000,000 kr. out of the 1922 funds as an instalment towards the electrification of the railway between Stockholm and Gothenburg, the total expenditure of which is estimated at 75,000,000 kr. In this connection it is stated that a number of electric locomotives has already been ordered by the State railway authorities. Similar assertions were made some time ago in the Swedish newspapers, but no firm has hitherto admitted having received the order. The accuracy of the statement is, moreover, questioned by the fact that, as the report says, "there is some doubt at present as to whether the direct current or the single phase, alternating current system should be adopted. The alternating current system had been previously decided upon, but the head engineers now appear disposed to alter their opinion." It is, however, not mentioned that the change of opinion is due to the knowledge gained by the Swedish State railway engineers of the working of the direct current system in the United States on the occasion of the visit which they paid to that country some months ago.

Wireless telegraphy follows shipping, shipbuilding, free ports, and warehouses, and the suggested train ferry between Sweden and England. The chief public stations are at Vaxholm, Karlskrona, Tingstade, and Gothenburg. An attempt to establish wireless communication (spark system) between Sweden and Italy was made in the night of August 26th-27th, 1920. The experiment was completely successful, and messages were exchanged directly between the Swedish station at Karlborg and the San Paulo station in Rome. A proposal is now under consideration for the construction of a new high power station at Falkenberg on the West Coast, for direct communication with America, which is expected to be one of the largest stations in the world.

Water Power and Electrification.—The electrical manufacturing industry is entirely ignored by the report, but under the heading of water power and electrification—the latter term is used by the Swedes also to designate electric supply schemes for agricultural districts—it is stated to be estimated that the available water power at "industrial mean water" (about nine months of the year) totals 6,700,000 h.p., the development of which has seriously engaged the attention of the Government and of manufacturers during the past few years. The difficulty experienced in procuring coal and the very high prices which had to be paid for this fuel have created an enormous incentive to progress in electrification schemes.

Another important aspect is the electrochemical industry, which is growing year by year. The industry already exports considerable quantities of calcium carbide, nitrolime, chlorates and perchlorates, sulphate of sodium, and chloride of lime; and among electrometallurgical products are mentioned electro pig iron, electro steel, ferro-silicon, ferro-manganese, zinc, and lead.

Some of the largest power stations are at Trollhattan, which is equipped with 13 turbo-generators, each of 11,500 h.p. and developing a total of 104,000 kW. The large station at Porjus is built underground as a protection against frost, and the power is distributed to the Kiruna and Malmsberg mines of the Grangesberg Co., and is also employed for the working of the electric railway between Gellivare and the Riksgransen (Norwegian frontier).

At present only about 30 per cent. of the cultivated area of Sweden is electrified, and with a view to increasing the number of power stations the Government granted to the "Electric Power Construction Loan Fund" the sum of 3,500,000 kr. in 1918-19, but it appears that the applications for loans received by the administrators of the fund exceeded 17,000,000 kr. The Government made a further grant of 2,500,000 kr. to the fund in 1920, and a still further amount of 1,500,000 kr. has been earmarked for 1921. The authorities are petitioning for larger grants inasmuch as it has not been possible down to the present to grant more than one-third of the applications under the scheme.

The total production of energy at the State power stations in 1920 amounted to 740,000,000 kWh, as compared with 685,000,000 kWh in the previous year; and the total income derived from all the generating stations was 15,070,000 kr. last year, as contrasted with 12,370,000 kr. in 1919.

A discussion of labour and social questions, statistics of imports and exports, &c., bring the report to a conclusion.

MAGNETOS FOR INTERNAL-COMBUSTION ENGINES.

By A. E. WATSON, A.M.I.E.E.

(Abstract of paper read before the Institution of Electrical Engineers.)

The function of a magneto is to supply at perfectly regular intervals a sudden electrical impulse in the form of a spark between a pair of points in the engine cylinder usually about 0.5 mm. apart which are, at the moment when the spark is required, surrounded by gas at a pressure which may reach as high as 6 or 7 atmospheres. It is agreed that, with any of the gaseous mixtures met with in practice, provided a spark is produced between the plug points, ignition is bound to occur.

The characteristics of sparking plugs indicate that, in order to ensure satisfactory starting, the magneto must give a peak voltage of 10,000 volts when the engine is turned by hand or by the electric starter. This speed may be taken as being approximately 100 r.p.m. on the engine in the case of motor cars of small and moderate sizes. It is much less in the case of lorry and tractor engines where self-starters are not fitted.

Typical speed/voltage curves are shown in fig. 1. The upper limit of speed is very rarely encountered, except in the case of aeroplane engines, when with some cylinder arrangements the normal speed of a two-spark magneto may be 2¼ times engine speed. The conditions as regards voltage required are usually less severe in such a case than at low speeds, as the temperature is considerably higher, and at extreme speeds the gas pressure in the cylinders is reduced, due to throttling in the induction system. A figure of 8,000 volts is certainly an outside one, even for high-compression engines with well-designed induction systems, and 5,000 to 6,000 volts is a more usual figure. On the other hand, adverse conditions due to plug leakage are generally more likely to occur at high speeds than at low ones.

Adverse conditions due to leakage may be due to various causes, all but one of which are effective at starting when everything is cold and when the magneto running slowly produces a comparatively feeble spark. Leakage through the body of the insulator of the plug itself is generally only evident when the insulation of the plug has been heated. Some porcelains show a well-marked leakage at quite low temperatures, but mica shows practically nothing up to 500 deg. C. With satisfactory sparking plugs a temperature sufficient to render the insulation conducting will certainly be sufficient to cause trouble to develop through pre-ignition, before any failure would arise due to electrical leakage. The spark discharge consists of two portions, first a capacity spark in which the energy stored in the capacity of the leads, terminals, &c., discharges practically instantaneously across the gap, and following upon this a flame-like spark or arc, the duration of which is controlled by the electrical constants of the machine. The total energy in the discharge does not strictly represent the capability of a magneto for dealing with a leaky circuit. Clearly this is more a function of the maximum current which the magneto can supply than of the total spark energy, the condition being that the machine shall furnish the leakage current of the system at the same time that it charges all the terminal capacity up to the sparking voltage. A machine giving a small current lasting for a long time will be much less suitable for this purpose than one giving a heavy current for a shorter period, even though the total energy may be greater.

Direct measurement of the current which the magneto can yield is difficult. The simplest and most satisfactory method of comparing different machines is by shunting their terminals with a high resistance in parallel with a spark-gap. The value of the resistance necessary to stop sparking is then employed as a criterion of the capability of the machine for dealing with a leaky circuit. Such a test is generally called a "utility test," and the resistance required to quench the spark is the "utility" of the magneto.

Fig. 2 gives a series of utility figures obtained on various types of magnetos, the majority of which gave satisfactory service, showing that in many cases the machine had a very large margin to spare over what was actually required of it. The machine shown in curve 6 actually did give trouble in service, due to a defect in the design, which was overcome, and the machine then gave the results shown on curve 1, after which no further trouble was experienced. Curve 7 is for a battery ignition set and is just the reverse of that given by the magnetos. Battery sets are always good starters, but usually fail to function at very high engine speeds, unless very great care is taken in their design. At the present time there is no generally accepted standard of utility which a magneto must fulfil, but the author's firm has adopted the figure of 4 micromhos, and no case has yet been observed of a machine which passes this test giving trouble on an engine.

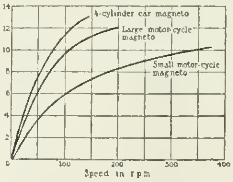


Fig. 1.—Performance of Various Magnetos at Low Speeds.

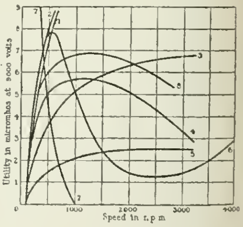


Fig. 2.—Comparative Utility Curves.

The principles of operation of a magneto are next dealt with, and the cycle of operations accompanying each spark is considered in successive steps which may be divided into: (1) storage of energy in the magnetic field, and (2) the collapse of that field and the transference of the energy to the secondary circuit. The relation between the properties and the dimensions of the magnets and the energy which can be stored in the magnetic field are considered in detail, attention being drawn to the importance of the shape of the B H loop and its effect upon the energy which can be stored. It is shown that the most important property of the magnet is the maximum value of B H and that the value of B H and the curve connecting B H and H are, therefore, important criteria in the choice of a permanent magnet.

Until a year ago the range of magnetic properties of available steels was somewhat restricted. Great use is made in America of chromium steels which, although not quite equal to tungsten, give results considerably better than the plain carbon steels. A good chromium steel magnet will give a $(B\ H)_{max.}$ of from 240,000 to 250,000, against a corresponding figure for tungsten of from 280,000 to 300,000, while a plain carbon steel will not usually exceed 200,000. These steels were also used in Germany during the war, when tungsten was unobtainable in that country. During the last 12 months, however, the range of steels available has been enormously extended by the introduction of the new cobalt steels. From these steels, which contain cobalt alloyed with iron in various proportions in addition to other elements such as tungsten, chromium, &c., a very wide range of figures can be obtained. With 35 per cent. of cobalt, values of $(B\ H)_{max.}$ as high as 900,000 can be reached, the value of $B_{rem.}$ being from 10,000 to 10,500 with a value of H_c of about 200 to 240. Such a steel is expensive owing to the high price of cobalt, but a very much smaller amount of it is required, and the higher coercive force opens up great possibilities in the way of simplification of design, owing to the reduction in magnet length permitting straight bars to be used in place of the horseshoe magnets hitherto employed. These steels have not yet been available for a sufficient length of time to allow their influence on design to become apparent, but there is little doubt that they will lead to very considerable developments during the next few years. The utility of the machine is by no means proportionate to the energy output, and the present trend of design is to maintain or to increase the utility while reducing the energy output. Hence the size of magnets provided in machines of a given performance has been considerably reduced.

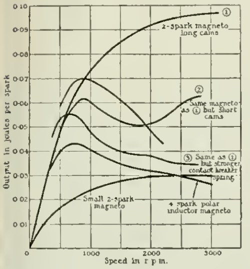


FIG. 3.—TYPICAL MAGNETO SPARK ENERGY CURVES.

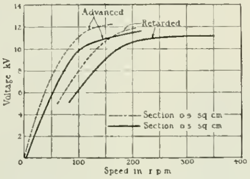


FIG. 4.—EFFECT OF TWO DIFFERENT SIZES OF COPPER CROSS-SECTION IN PRIMARY WINDING. EXTENDED POLE-TIPS.

A condition to be fulfilled by the design is that the removal of the armature shall not take the magnet appreciably beyond the point of $(B\ H)_{max.}$ This gives a relation between the gap between the poles of a magnet, the magnetic constants of the material, and the length of the magnet employed. As the magnetic constants will vary with the material employed, it is useful to express the proportions of the magnet in terms of the magnetic potential between its extremities. This is zero when the magnet is short-circuited, and should never exceed the value corresponding to the optimum value of B H. The value of this quantity ranges from about 600 for very small motor-cycle magnetos, to 1,200 for machines intended for lorry and similar work. Ordinary tungsten steels have the optimum value of B H at about H = 40, corresponding to a length of from 15 to 30 cm.

The general effect of both armature and air-gap reluctance is to reduce the available amount of stored energy; both must, therefore, be reduced to the least value possible. The air-gap is generally about 0.1 to 0.15 mm. measured radially. The universal employment of ball-bearings for the armature spindle facilitates the maintenance of such a small gap. The armature reluctance can be kept low by using material of high permeability and taking care not to work at too high a density, but if the density chosen is too low the size of the core and the length of the primary winding are increased, thus reducing the constraint of the primary winding upon the flux, and reducing the amount of flux distortion at low speeds. The usual density in most machines is from 12,000 to 15,000 lines per sq. cm., and the corresponding magnetic potential between the pole-faces when the armature is in its zero position is approximately 100 C.G.S. units, or, say, from 8 to 16 per cent. of the value corresponding to storage of maximum energy.

The effect of armature resistance has a very important bearing upon the operation of the machine, more especially at low speeds. The effect of the primary resistance is to cause a flux-change to occur in the armature core as it rotates in the act of distorting the field, inducing in the primary winding a small e.m.f. which maintains the current producing the distortion. The e.m.f. necessary for a given flux distortion will be independent of the speed and of the time elapsed since the beginning of the cycle and so will, therefore, be the rate of the flux-change. Consequently, for low speeds of rotation and long cycles the total flux-change will be very much less than for short ones, so that the flux actually distorted at the point of break will diminish as the speed is reduced, and there will be a corresponding diminution in the stored energy. Consequently the spark energy will rise as the speed increases up to a maximum value at which the amount of flux leaking back is small compared with the total. This maximum value is generally obtained at about 2,000 r.p.m. and is clearly shown in fig. 3. To get the best performances at low speeds without any sacrifice in other directions, the cross-sections of the primary winding must be as great as possible and its length of mean turn a minimum. It is impossible to design a machine which will give a good performance at low speeds over a large angle and will still give ample spark energy in all positions at high speeds without exceeding the optimum value of B H for the magnet.

Machines employing a separate transformer have an important advantage in that the whole of the space on the armature can be filled with short-circuited winding. Fig. 4 shows the way in which the performance of a magneto at low speeds varies with changes in the copper cross-section of the primary winding, and also with the shape of the pole-shoes; the pole-shoes have been extended so as to give a more uniform performance. Fig. 5 shows the way in which the position of maximum utility varies with the speed and angular position of the armature. To obtain a variable point of ignition, a better arrangement on theoretical grounds is to fix the position of the armature with relation to the pole-shoes at which the spark occurs, and obtain any necessary variations in timing by altering the angular relation of the magneto to the engine, which may be done by several forms of special coupling.

Having traced the storage of energy in the stretched magnetic field, the author considers the transformation of this energy into that represented by a current flowing in the high-pressure circuit. In an actual machine the presence of eddy currents in the armature core and pole-shoes retards the movement of the flux and, therefore, lessens the secondary voltage which a given flux-change can produce. Further, the primary and secondary windings, each with its own associated capacity, form a pair of coupled circuits which interact. It is important to make the necessary flux-change as small as possible, for it is upon this that the performance of the machine at low speeds primarily depends. The most obvious point calling for attention is the correct lamination of the magnetic circuit. It has always been the practice to laminate the armature core carefully, and now the majority of British firms and one or two American ones are fitting laminated pole-shoes. Fig. 6 gives comparative tests made on the same machine with solid and laminated pole-shoes, and shows clearly the advantage derived from the latter. By adopting the laminated construction a saving in weight of from 25 to 30 per cent. can generally be effected without any deterioration in performance.

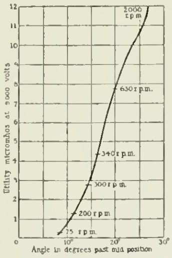


FIG. 5.—VARIATION IN POSITION OF MAX. UTILITY WITH SPEED.

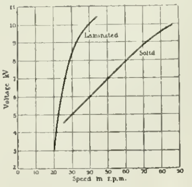


FIG. 6.—COMPARATIVE TESTS ON MACHINE WITH SOLID AND LAMINATED POLE SHOES.

The condenser may be regarded as a device for suppressing sparking at the contact-breaker points, and as forming one element of an oscillatory circuit inductively coupled with the secondary. In practice the rupture of the primary circuit can never be instantaneous, and there is a definite relation between the sparking voltage between the two points and the time that has elapsed since they commenced to separate. The rate of pressure-rise and maximum voltage developed appear to be independent of the cam shape, so that the mechanical conditions of break do not appear to be of great importance. A voltage of about 350 volts appears to be necessary for a gap of 0.1 mm., rising somewhat as the gap is reduced to 0.001 mm., and then falling again. On this basis, provided the voltage had not attained a higher figure than 350 volts during the first 0.001 mm. travel of the points, sparking would not occur, whereas it is found that the capacity must be much more than corresponds to this rate of rise in order to suppress sparking.

(To be concluded.)

THE INDUSTRIAL APPLICATION OF VARIABLE-SPEED MOTORS.

By Dr. S. PARKER SMITH.

(*Abstract of lecture delivered at the* Western Centre *of the* Institution of Electrical Engineers.)

The forty-first ordinary meeting of the Western Centre of the Institution of Electrical Engineers was held at Swansea on April 4th, when a large audience assembled to hear Dr. S. Parker Smith lecture on "The Industrial Application of Variable-Speed Motors."

The Lecturer approached the subject from the point of view of the designer, and in the course of a comprehensive and interesting discourse, stated that series-parallel sets were economical but expensive; resistance control was suitable only for starting, and was very uneconomical, but field control was simple and economical. In Creedy's ingenious device the number of poles was changed by changing the number of phases. The lecturer deplored the lack of encouragement given to British manufacturers in their endeavour to produce variable speed motors—they were almost driven abroad to get a suitable number of steps in speed. He desired British firms to lead not to follow. A.c. commutating motors were almost solely built by Continental firms, and the British Thomson-Houston Co. was practically the only firm in this country supplying that type of machine. It would be very misleading to say that those motors could be built for any desired power and speed range. The three-phase commutator was the latest production in electrical engineering, but it had more limitations than the one-phase commutating motor. The chief limitation was that due to the pulsating flux. With the d.c. motor two speeds were obtained with series-parallel control, and speed was increased slightly by weakening the field. In the a.c. one-phase motor six speeds were obtained with no trouble at all. It was more difficult to overcome the pulsating flux in the three-phase than in the one-phase machine. A perfectly satisfactory job was made from about zero to four times synchronous speed. It was perfectly satisfactory for all continental railways with the exception of French ones, which preferred to use d.c.; in Italy three-phase was used. By imposing cascade commutating motors on induction motors not only were all the characteristics obtained that were obtained with d.c. commutating motors, but a wider range of speed control was obtained by varying the voltage—that applied to motors with series characteristics. Some years ago a paper was read before the Institution of Civil Engineers by Mr. Ll. B. Atkinson, in which means were shown of obtaining a shunt characteristic with an a.c. commutator, and also means for varying the speed. Mr. Atkinson's methods had been developed, not in this country but in Germany. In future there would be demands for speed control without converting to d.c., but the devices must be simple. Co-operation between the user and the maker was absolutely necessary—it was not the policy of makers to build machines for orders as an experiment unless it was done by agreement; makers should be encouraged to build experimental machines in conjunction with the users, and a cordial and friendly arrangement should be made that a certain system would be tried for obtaining a desired result. He considered if that were done there would not be nearly the trouble and difficulty experienced in the past. Where a hard and fast specification was given it was usually accompanied by stringent guarantees, which were probably necessary under past conditions, but which tended to kill experimental work. If they were to develop on the lines suggested and to lead instead of follow, they must have co-operation in that direction.

Principal Sibley (Swansea University) urged that the Institution might allow more than one meeting a session at Swansea, and also alluded to the engineering course at the Swansea College and the lectures which were to be given by Mr. J. W. Burr, the borough electrical engineer of Swansea.

Prof. Bacon (Swansea College) commented on the fact that the lecturer was a man who had the courage of his convictions. It was good to know that a man of his calibre was in charge of heavy engineering at South Kensington. He agreed with Dr. Smith's opening remark that the life of the Institution was in its provincial Centres, and those Centres served up a much more appetising bill of fare than that obtainable in London.

Mr. J. W. Burr (Swansea) explained that he had offered to lecture to the Swansea University. Municipal supply engineers realised that induction and synchronous motors were not suitable for all purposes; they also realised that it was necessary in most places to install rotary converters, &c. Supply authorities had no objection to a man wasting "juice" if he wanted to. With regard to power factor, that was a point which all station engineers had to tackle. They realised that consumers taking current at 0.6 power factor were in effect using a 1,000-kW generator to give 600 kW, and to adjust them 400 kW had to be added to capital charges; that not only applied to generation, but also to transformation, distribution, and transmission losses, and it behoved them as engineers to improve their power factor.

Mr. A. Ellis (Cardiff) said he could lay claim to being one of three of Sir Charles Parsons's first pupils, and had Sir Charles given up hope of developing his turbine as the British manufacturer had given up the variable speed motor, the electrical and the shipping industries would not have been in the position they occupied to-day. He agreed with Dr. Smith that instead of leading they were following, and thought it very desirable that supply engineers should extend to manufacturers that co-operation which was necessary to bring about desired results.

Prof. Isaacs pointed out that the induction motor had many advantages of which the absence of a commutator was held to be the greatest. It was a fact that to-day many mills were being driven at uneconomic speeds because induction motors were installed. Dr. Smith had shown them the way to get over that difficulty. He indicated that they were on the wrong track, and that the development of the polyphase commutator motor must be improved. There was a scarcity of literature in England on that matter, and at scarcely any university would be found an example of a polyphase commutator motor. Perhaps the representatives of manufacturers would bear those points in mind.

Mr. Jenkins (Metropolitan Vickers Co.) said that the commutator motor at first sight appeared very simple. In connection with the lecturer's remarks that German manufacturers were more ready to develop than British manufacturers, it should be recalled why they were able to do that. In Germany there were practically only three manufacturing companies; prices were fixed, and nothing was sold under a fixed minimum, and in that way prices of plant in Germany were kept up to a level to enable them to develop at home and take the export markets. Considerable assistance was derived by manufacturers from industrial banks, and before the English manufacturer could develop similarly, he must have corresponding facilities; he considered the time was ripe for such a policy to be considered by Great Britain. The lecturer had inferentially stated that the German was a super-engineer. His (Mr. Jenkins's) experience was different. He considered the plant turned out by the A.E.G. in no way compared with similar plant turned out by English firms.

Mr. Smith (Student, Swansea University) was very glad to have the opportunity of saying how much students appreciated this form of lecture. It was of very special value inasmuch as Dr. Smith had treated the broad aspect of the subject.

Dr. S. P. Smith, in reply, said he would like to remove the rather wrong impression he might have given that he was "cracking up" German engineers. He did not think any firm had done better than the Oerlikon in building the variable-speed motor, and he believed that was a genuine Swiss firm. Where Germans had beaten them was in theory, not in practice. If the larger engineering interests would only pay more attention to developing and look ahead, the user would go on increasing his demand; 1,500 volts had been adopted for the electrification of railways in Great Britain. Supposing single-phase had been advocated, to which firm would they have turned in this country for the single-phase equipment? When the Swiss decided to continue with single phase, what they said was: "We are accustomed to single phase, our manufacturers are accustomed to it." Therefore, they decided without hesitation on the single-phase system. Had the reverse been the case, they would have gone out of the country for their electrical equipment. Much as he disliked flywheel sets, he had to regard them at the moment as makeshifts, and he hoped that opinion would prove true; he hoped the day would come when they would manage without flywheel sets. Tremendous advance had been made in foreign countries, and in Switzerland the valley stations were linked up with the hill stations. They should forge ahead with the electrification of railways; the present methods, however, were too cumbersome.

The Chairman (Mr. A. J. Newman, Bristol) said that the suggestion of having two meetings in Swansea would be considered by the committee, but funds did not go so far as they once used to. The Western Centre had a fairly ambitious programme, and although the area was extensive it was at the same time sparse. There were no nuclei outside Bristol, Cardiff, and Swansea, but the committee would give every consideration to the wishes expressed.

Dutch Manufacturing Conditions.—The report for 1920 of the N. V. Hazemeijer, of Hengelo, Holland, states that the difficulties of obtaining raw materials arising from the war gradually disappeared in 1920, and it was possible to increase manufacturing to a level corresponding with requirements. At the end of the year the general depression caused a decline in the orders coming to hand, although the new year started with a good stock of orders on hand. During the first quarter of 1921 the value of the deliveries was greater than in the equivalent period in 1920, but the amount of new business booked showed a diminution. Foreign competition was being experienced, and on the other hand customers were only buying for immediate requirements. The net profits earned in 1920 amounted to 129,000 florins, permitting of the payment of a dividend at the rate of 11 per cent. on the ordinary shares and $6\frac{5}{8}$ per cent. on the cumulative preference shares.

THE UNDERGROUND RAILWAY TRAINING SCHOOL.

Until about 14 months ago new members of the staff of the London underground electric railways were trained under the tuition of individual instructors, but the system proved to be not all that might be desired. A school was, therefore, brought into being for the purpose of centralising the engagement of all new staff for the traffic departments of the various railways, and to provide demonstration equipment for the training of the staff.

The school, an opportunity to visit which presented itself last week, through the instrumentality of the London Electric Railway Co., was opened on February 4th, 1920, and is located at the Lambeth (North) station on the Bakerloo Railway, the accommodation provided comprising office facilities for the principal, a lecture room, booking office school, motor equipment room, medical officer's room, and a kinema hall, all fully equipped.

The accompanying illustrations are two views of the interior of the motor equipment room wherein is installed a complete full-size motor car equipment of the type used on the District Railway. Full electrical and air pressures are available, so that the pupil is able to stand in front of the control board (fig. 1), which represents the inferior of a train driver's cab, and by manipulating the power and brake levers he is able to follow the sequence of operation of the circuit breaker, control rheostat, contactors (fig. 2), power rheostats, motors, &c., as well as that of the air valves and compressor of the Westinghouse brake equipment, which is shown on the right-hand side of fig. 2.

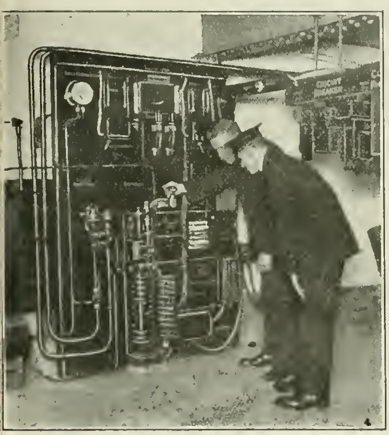


Fig. I.—Motormen's Class Room, Showing Control Board.

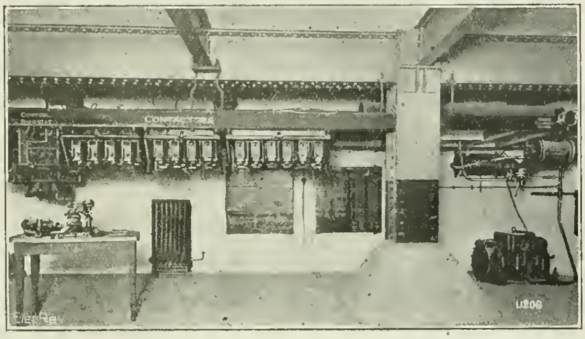


Fig. 2. Motormen's Class Room, Showing Contactors and Brake Equipment.

With regard to the system of instruction, new men are instructed in the duties of booking clerks and porters, which are the preliminary grades, and in this portion of the training period is included the study of the history and "geography" of the railways, the avoidance of accidents, and the absolute necessity for courtesy on all occasions. It is of interest to note that the kinematograph is found to be a very valuable means of teaching the avoidance of accidents, and especially of demonstrating the right and wrong ways of doing things.

Before promotion to the higher grades of gatemen, collectors and liftmen, guards and signalmen, and motormen, men who have previously passed out of the school as proficient in the preliminary grades return for further instruction, which embraces lectures and the display of kinema films. Classes are also held twice a week which are open to all grades of men in the service for the improvement of their general knowledge of matters connected with the working of the railways.

After having completed their period of training the men are examined, and, if found proficient, a certificate is issued. This certificate must be obtained before they are allowed to take up the duty for which they have been trained. Moreover, in addition to the theoretical instruction the men are sent out on the line for a period of practical training under the guidance of a competent instructor.

All employés newly appointed to the service are required to undergo a medical examination by the companies' medical ledge of matters connected with the working of the railways.

During the first year of the school's existence, *i.e.*, February, 1920, to February, 1921, 257 new members of the staff were engaged, whilst 433 men of various grades passed through the school for instruction, and 320 medical examinations were made in respect of new staff and promotions to higher grades. It is pleasing to note that the men show no objection to attend the school; they are keen to attain the higher grades, especially the grade of motorman, because apart from the higher pay which the position carries, drivers do not have to come in contact with the travelling public.

THE INSTITUTE OF PHYSICS.

Inaugural Meeting.

The inaugural meeting of the recently-formed Institute of Physics was held in the Hall of the Institution of Civil Engineers on April 27th. Sir **Richard Glazebrook**, K.C.B., F.R.S. (president), who occupied the chair, briefly outlined the history of the movement for the formation of an institute for physicists, and thanked those who had given so much time to the institute, which had commenced with every expectation of success. Sir Richard then dwelt upon the aims and objects of the organisation which, briefly, were to bring together workers in the field of physics, both as regards pure research and industrial applications, and to raise the intellectual status of the profession by the grant of diplomas to fully-qualified physicists.

Sir J. J. **Thomson**, O.M., F.R.S., then spoke. He said his informal remarks would not deserve the title of "address"—the term used by the president. He welcomed the formation of the Institute, and said that already 300 members had joined, but the total membership would soon reach thousands. He had always been surprised that chemistry—really a branch of physics—should have an institute of its own, while there was no Institute of Physics. Referring to the place of physics in modern industry, the speaker said that, although he had been a student of physics for 50 years, his acquaintance with industrial physics had been purely accidental. Fifty years ago physical laboratories were few and sparsely populated. To-day they were many, but crowded. Then, physics was an army with many good generals, but very few "troops." At the present time physics offered a means of livelihood to every competent man, but the chances of making a fortune were very remote. In the early days the study of physics was its own reward. Now research had secured a firm position in industry, there were many endowed institutions, and several large firms had their own research departments. Apart from research there was a pressing need for the skilled supervision of the physicist in the processes of production. There was a certain widely-used British article which, made by hand and by old-fashioned methods, was far superior to the German model. When "mass production" methods were employed in its manufacture the quality fell considerably, and it was rendered inferior to the German article. Here was a task for a qualified physicist. The modern demand for physicists was far in excess of the supply. The proportion of university graduates who took honours in science was really small. An extra year spent in research was necessary, but in many cases this was beyond the students' means. This extra year brought a man from intellectual "adolescence" to "manhood," and gave independence of thought. Fortunately grants were now available to aid students in research, and although he had had, in the course of his duties, much experience of boards for the award of scholarships and fellowships, he had never met a more sympathetic body than the Research Grants Committee. The importance of research could not be over-estimated; it was as much a function of a university as education. Thanks were due to the Government for its aid in this direction, as well as to many private individuals. The growth of the science of physics in the last 50 years had been wonderful. He calculated that about 400 physical papers had been published in 1873. In 1920 the number had risen to 2,700—rather a terrifying prospect for those who wished to keep abreast of the science.

While talking about research, Sir Joseph urged his audience not to confine it to industry alone, but to foster research for research's sake. Many scholarships had been awarded for research in a very abstract science, that of pure mathematics. In conclusion, he congratulated the Institute, and hoped that it would prove of great assistance to industry and intellectual development.

Sir William Bragg, in proposing a vote of thanks to Sir J. J. Thomson, which was accorded with enthusiasm, said that Sir Joseph himself was an institution in physics, and they were thankful to him for his encouragement and advice.

The chairman then called upon the Rt. Hon. A. J. Balfour, O.M., F.R.S., who was present to welcome the Institute.

Mr. Balfour said that when Sir Richard Glazebrook had asked him to be present at that meeting, and when he had learned of the formation of an Institute of Physics, he was surprised that not until 1920 had such an institution been inaugurated. This country was behind no other in the study of physical science. As president of the Department of Scientific and Industrial Research, he knew of the valuable work done for the industries of the country by physicists. The outside public did not know; they seldom did know about those things which concerned them most. He referred to the industrial disputes which were oppressing the nation, and said that the energy involved should be employed in the conquest of nature—in producing more from natural resources —instead of in quarrels over the distribution of the very small proceeds of our present knowledge. All his life he had been interested in physics, and his mind went back to his Cambridge days when he came into contact with such men as Kelvin, Maxwell, Rayleigh, and J. J. Thomson. These were geniuses, and such men could not be produced by any system of education. Nevertheless the work of lesser men was of great utility, if not to make epoch-making discoveries, to pave the way to these. Money could not be expended in a better direction than that of scientific research, and it was with the greatest reluctance that the Treasury had been compelled to restrict grants for this purpose owing to the impoverished state of the country. Cambridge University, of which he was Chancellor, had led the way in science and urgently required pecuniary assistance. He was surprised that the imagination of some of our financial magnates had not been fired with the thought that any assistance they could give would be of benefit to the whole of civilisation; perhaps they desired to see immediate results, but these were of rare occurrence. The material idea would have to give place to the intellectual view. The work of physicists was fraught with interest and advantage to all, and if only for that reason the inauguration of an Institute of Physics must be regarded as a red-letter day.

Sir Robert Hadfield (treasurer), in proposing a vote of thanks to Mr. Balfour, said that his remarks had been of great interest, and he hoped that the result would be an influx of new members.

THE USE OF X-RAYS FOR TESTING MATERIALS.

In his third Cantor lecture at the Royal Society of Arts, on March 21st, Major G. W. C. Kaye dealt with the practical Application of X-rays to the testing of materials. The lecturer said that the great merit of this method was that it enabled a much clearer idea of the properties of materials to be obtained without damaging the specimen in any way. Furthermore, it provided in some cases the only means of detecting concealed defects in the material without sacrificing any part of the structure, and also of ascertaining the accuracy of assembly of component parts of structures. The present practical application of X-rays to the investigation of materials had reached a point where it was possible to examine lead to a thickness of 4 or 5 mm., tin to the extent of 12 mm., carbon steel or iron to the extent of 7.5 cm., aluminium and its alloys from 12 to 15 cm., and wood from 20 to 40 cm. It was difficult, however, to lay down figures of penetration into materials precisely, because progress was so rapid that they might be doubled next week. The limiting factors were the length of exposure and voltage, and it was possible now, for example, to get a photograph through an inch of steel in rather less than a minute, using 130,000 volts with a few milliamperes through the Coolidge tube. Within the thicknesses he had mentioned it was possible, with considerable accuracy, to hunt out anything of a foreign nature in the material being investigated, and even to detect the finest tool marks and thin mould marks. Different densities in the materials displayed different densities in the radiographs. For example, a rivet would show darker than the material in which it was placed, whilst carbon, nickel, and tungsten steels differed very little in transparency.

One promising outlet for the X-ray method of testing was in connection with welding. Electric and oxy-acetylene welding had come into great prominence during the war, and an indifferent welder could turn out large numbers of welds which appeared to be first class, but which in practice had proved to be quite unreliable. There was no adequate mechanical test for a weld, and in any case, such a test, whether mechanical or microscopical, destroyed the weld, good or bad. When an X-ray photograph was taken of a weld, the presence of a shallow line indicated that the two parts were not truly joined together throughout the whole of the depth. Blisters and blowholes showed up as light spots, and were the sign in many cases of overheating. The examination by X-ray photography of welds up to 1 in. in thickness was now quick, easy, and certain, and with modern equipment lengths up to 2 ft. or more could be investigated at once, the exposures taking a fraction of a second. The amount of detail revealed in the photographs was extraordinarily good, and compared favourably with photo-metallography, which only tested a tiny bit of the weld and involved its destruction. The lecturer thought the X-ray method for testing welds had not made the progress it deserved, perhaps because it was a somewhat severe critic of present-day welding. Again, X-ray investigation promised to be exceedingly useful for the detection of hidden cracks, which were the great bugbear of metallurgists. Such cracks were often the sequel to pipes or blowholes in the original ingot. In the case of alloys the uneven distribution of the component parts resulted in a streaky or patchy negative. Also X-ray examination often would diagnose defective soldering or brazing, the substitution of one metal for another, hidden corrosion in gas cylinders, ferro-concrete and the armouring of cables, and so on. X-ray examination also proved very effective during the war with regard to explosives, particularly in relation to enemy ammunition, the exact composition of which we did not know. Most of this work was carried out by the Research Department at the Royal Arsenal, Woolwich.

In the case of timber, different varieties absorbed X-rays to different degrees. X-rays were turned to good account in this connection during the war in the examination of timber for aircraft at a time when the submarine was endangering the country's supplies of high-grade timber, such as spruce and Oregon pine. The result of this was that designs were got out for building up aeroplane parts from smaller timber. In using smaller timber for struts and spars much of the workmanship was completely hidden from view, and it was impossible to ascertain the quality of it except by X-rays. Wood was very transparent to X-rays, and thicknesses up to 18 in. could be dealt with very rapidly. Another application of the rays was in examining the behaviour of the built-up structure while it was being tested, and it was possible to observe which parts collapsed first in the hidden structure as the material was put under test. Radiographs taken of built-up structures in this way threw an astonishing light on the behaviour of built-up aeroplane parts.

Other industrial applications of X-rays were in the manufacture of carbon and graphite brushes for electrical machinery, insulators, &c. Again, one of the gravest troubles encountered in the manufacture of optical glass was the destructive action on the molten glass of the fire-clay pot, and it was found that this was due to the presence of iron and other impurities in the clay of which the pots were made. It was possible by X-ray records to sort out the good pots from the bad ones, and so save considerable expense in spoiled glass. Another use to which radiography was put during the war was the examination of the electrically-heated clothing of airmen in order to ascertain where the wiring had failed, whilst the examination of the distributors of magnetos, in order to avoid taking the apparatus to pieces, was yet another application.

The ideal aimed at in X-ray photography was to make it as easy and automatic as taking an ordinary photograph. The present limitations of the process in metallography were prescribed largely by technique and equipment, and great improvements would have to be made if it were to become a commercial process in heavy engineering. Adequate means would have to be found to reduce the length of exposure, and attention would also have to be paid to the production of heavier X-ray tubes and higher voltages, or more sensitive screens and plates. All experience tended towards demanding higher voltages. The Coolidge tube worked at 180,000 volts, preferably less, but the voltage could be increased to 300,000 by lengthening the arms and immersing the whole tube in oil. If there were a demand for it, no doubt the electrical engineer would overcome the difficulties of supplying 500,000 or more volts, as transformers had been made for such a voltage. A single-phase transformer, however, for 1,000,000 volts would have dimensions of 13 ft. by 9 ft. by 10 ft. high, the terminals would be 28 ft. high, the weight 20 tons, and the cost £10,000. Heavier currents would demand more elaborate cooling devices, and probably glass tubes would have to go. Silica tubes might be the alternative, or even metal tubes might be resorted to. Such tubes would probably be radically different in design, and attempts would have to be made to improve the deplorable inefficiency of the whole apparatus. Again, great improvements in fluorescent and photographic plates were called for. No screen was available which would permit the examination of more than a quarter of an inch of steel; photography had to be resorted to, and the time taken might be prohibitive, at any rate for routine mass inspection. The photographic plate only registered about 1 per cent. of the X-rays passing through it, and progress had been in the direction of thickening the emulsion or loading it with more silver. Any X-ray plate was far more sensitive to visible light than it was to X-rays, but it should be possible by suitable improvements in fluorescent screens to lessen the exposure considerably. There were several developments in that direction already.

In conclusion, Major Kaye said the subject of industrial radiology was young, and although progress had been rapid, care must be taken not to claim too much for it. From such experience as there had been, it could be said that the method had settled down to be a valuable laboratory tool to supplement other methods of testing materials, and the existence of the method had not been without a stimulating effect upon the standard of workmanship in various directions. He, therefore, asked his audience for its moral and material support for the scheme of an Institute of Radiology in London.

LEGAL.

Bailey v. Lumby.

At Dewsbury County Court, on April 27th, His Honour Judge Bairstow, K.C., gave judgment in a case in which John William Bailey, haulage contractor, Staincliffe, claimed an account of alleged partnership dealings with Charles Walton Lumby, electrical engineer, of Firth Place, Shipley, and the winding-up and dissolution of the alleged partnership. Plaintiff alleged that the parties entered partnership in August, 1920, each undertaking to put in £600 within three months, the business to be known as the Staincliffe Engineering Co. They were to share the profits equally, and Mr. Lumby was to receive also £5 per week for working at the garage. The defendant denied that there was a partnership or that any agreement had been drawn up and signed. His Honour gave judgment for the defendant, holding that there was no written agreement, and that if an agreement had been proved he would have concluded that there was no partnership to dissolve, because there had been no carrying on of business. He gave the defendant costs also.

The Nash Fish Hydrophone.

(Continued from page 512.)

The Royal Commission on Awards to Inventors, sitting at Martlett House, Bow Street, London, on Monday, resumed the hearing of a claim which was made on behalf of Mr. G. H. Nash, C.B.E., chief engineer of the Western Electric Co., Ltd., and Messrs. E. R. G. Penny, R. A. Mack, and B. B. Grace, three other employés of the company. It was a claim for the hydrophone known as the "Nash Fish," which it was submitted, practically destroyed the danger of the German submarines during the war.

Mr. Temple Franks presided in the absence owing to illness of Mr. Justice Sargant.

Mr. Hunter Gray, K.C., said the claimants' work was purely spontaneous and at the company's own expense. He was informed by Mr. Nash that he had spent over £3,000 of his own money, and from the time he started until 1919 he never received a penny either by way of award or wages.

The Chairman: What do you say they expected to get out of this voluntary work? Were they expecting an arrangement by which they were to be remunerated, or to get work for the company?

Mr. Gray said he believed the work was done for patriotic reasons primarily. So far as he knew, no claim had been made except to this Commission. The claimants were all British-born subjects.

At the request of the Chairman, Mr. Gray proceeded to refer to the main features of the invention, and said he was going to submit that the service which had been given by these claimants was probably the biggest service that had come before the Commission. Considering that something like a million tons of shipping was lost per month, not to speak of the number of lives that were lost, he submitted that this was a very special case, and that nothing less than £100,000 should be considered, having regard to all the circumstances of the claimants' work, the enormous use that had been made of it, and the valuable results which had been obtained by this invention. The Western Electric Co. would not have any of the award, nor did it ask for any.

The Chairman: It is a claim for past services, not for the use that may be made by the Government of the invention in the future?

Sir Arthur Colefax: We will accept an award for future user, but we do not contemplate that there will be any.

The Chairman: It ought to be made clear whether any award given is a complete indemnity.

Mr. Gray: On behalf of the claimants I accept that.

The Chairman: I understand that there was no arrangement between the claimants and the Admiralty with regard to remuneration, but the company were to construct the apparatus. Did the company pay the claimants any commission?

Mr. Gray: No, not at all; the claimants had their salary as officials of the company, and had nothing from the orders executed by the company.

Sir Arthur Colefax: The Western Electric Co. got a monopoly of the supply of these equipments.

It was mentioned that there were orders for 400 or 500 sets.

Mr. G. H. Nash, one of the claimants, was called to give evidence, and explained in detail what his invention was and the use which was made of it by the Admiralty.

Cross-examined, witness said he knew that the Admiralty had made official reports on the sinking of German submarines, and it did not surprise him that these reports did not give one single instance of a submarine being sunk by the use of the "Nash Fish." It might be that there were a number of sinkings which were credited to some other device. This invention had nothing to do with his work as chief engineer of the Western Electric Co.; he carried out his studies in connection with it in the evenings and during week-ends. It was not true that he was indebted to anyone connected with the Admiralty for any success that he might have obtained by the invention.

The Chairman: The case for the Admiralty is as to the amount of the award?

Sir Arthur Colefax said that was so. He was not questioning that Mr. Nash was both industrious and ingenious. But the result of his invention did not, in the view of the Admiralty, prove itself of greater advantage than other means they had of detecting submarines. This invention was not responsible in any case for submarines being sunk, and that was the Admiralty's official view. No doubt the submarines were hunted by the help of the "Nash Fish," and there were other inventions which were equally good. Further, they contended that although Mr. Nash might have developed these matters separately, they also had in the Admiralty got all that he had got, otherwise than through him. They had been developing the matter before he commenced.

The Chairman said that whatever the Admiralty had in their workshops, they did allow this particular means of protection from submarines to be developed, and they did not follow out their own ideas which they commenced.

Sir Arthur Colefax admitted that there were one or more developments of this "Nash Fish" which they put into use. He was told that out of some 3,000 vessels fitted with detecting means not more than 200 were fitted with anything that was traceable to Mr. Nash. The Admiralty had others working along these very lines, and they thought the other devices were quite independently developed and brought to a state of perfection equal to anything that Mr. Nash did, and the Admiralty had paid a substantial sum in respect of these inventions. He agreed that Mr. Nash and the other three claimants were the first to produce a hydrophone which was capable of being towed at speed and giving some directional indication of a submarine if the latter was making sufficient speed or sufficient noise. But his case was that by the time Mr. Nash's hydrophone was put into use the German submarines had learned to go slow when they were being hunted, and also to become much less noisy. He was prepared to admit that although there were no cases of a submarine being sunk by the use of this appliance it was of service in harassing the submarine. At the same time there were equally effective means for doing this. The Admiralty had, some time ago, considered what should be done with such of those appliances as they had, and they had decided that there should be no renewals.

Mr. Hunter Gray said he could claim that whatever part of the Admiralty's appliance was old the claimants added parts which made it a success, and those parts had not existed before. All the information which Mr. Nash got he learned for himself, and he did not get any of it from the Admiralty.

The Court then adjourned.

The Bastian Electric Co., Ltd.

The petition of W. F. N. May and Another for an order for the compulsory winding-up of this company was before Mr. Justice P. O. Lawrence in the Companies Winding-up Court on Tuesday.

Mr. Dighton Pollock, for the petitioners, said they were judgment creditors, and the petition was opposed by the company, the allegation being that the petitioners were really acting as agents for a company called May & Padmore, Ltd. He submitted that the whole of the opposition was irrelevant.

Mr. Schwabe, K.C., for the respondent company, said their case was that the petitioning creditors were the representatives of a company with which the respondents were in litigation, and in respect of which the respondent company had a much larger claim than the petitioning creditors. He asked that the company should not be wound up while litigation was proceeding, and said that every other creditor was opposed to the petition.

He read an affidavit by Mr. Charles Bastian, who denied that the company was insolvent. He related how an agreement was made with Messrs. May & Padmore, Ltd., to manufacture certain patented articles for the company, and how under this agreement three of the directors of May & Padmore, Ltd., joined the board of the Bastian Electric Co., Ltd. It was also provided that May & Padmore, Ltd., should be responsible for the financial side of the Bastian company's business. In March, 1920, disputes arose, as the result of which the Bastian company was unable to carry on business, and a receiver was appointed. Since then, however, the financial position of the company had improved, and it had secured an important Admiralty contract for the supply of electric heating apparatus parts.

An affidavit by the petitioners was read by Mr. Pollock. They said there was a perfectly good defence in the litigation on the agreement. They denied that May & Padmore, Ltd., guaranteed to supply credit to the Bastian Co., and they were not seeking to crush the latter company out of existence so as to be in a position to manufacture electric heating apparatus.

Mr. Pollock said the winding-up petition was presented in March last, and the writ in the action was dated April 13th. The relief claimed was a declaration that the agreement was valid and subsisting, damages for alleged breach of the agreement, and an injunction restraining the defendants from advertising or inserting certain notices in the electrical and other trade papers.

His Lordship said there must be a meeting of the creditors of the company to decide whether there should be a winding-up and whether that winding-up should be compulsory or voluntary. The company was to furnish to the Official Receiver a complete list of the names and addresses of the creditors and the amounts of their claims. The Official Receiver would preside, and he would report the result of the meeting to him (the judge). The petition would be adjourned to await the result of this meeting.

Dore *v.* Hackney Borough Council: Judgment.

Judgment was delivered in the case of Dore *v.* Hackney Borough Council at the North London Police Court by Mr. Forbes Lankester, K.C., on Tuesday. The circumstances have been reported briefly already. The Council was summoned for making default in supplying electric power to the house of the plaintiff as required under the Hackney 1893 Electric Lighting Order. The borough electrical engineer was satisfied that the work had been properly done, and the committee was anxious to give the supply, but acting on the orders of the Electrical Trades Union the Council's employés refused to connect because the work was not done by Trade Union labour but by a man who was his own master.

The magistrate, in giving judgment, said (as reported in the *Daily Telegraph*) that the Council had either to yield to the threat of the trade union or run the risk of dislocating the business of the borough depending on electric light and power. It chose the first-named alternative. It was not for him to approve or disapprove that decision. His only duty was to say whether in the circumstances he was of opinion that the default was caused by inevitable accident or *force majeure.* He held that the default was not due to inevitable accident, and it remained for him to consider what was the meaning to be placed on the expression *force majeure.* It was first used in the model electric lighting orders approved by the Board of Trade, and imported from the orders into the Electric Lighting Clauses Act of 1899. He could find no decision as to the meaning of the expression in these orders, or where the words were used in any statute; but there were several decisions as to its effect in commercial contracts. So far as he could find it had been held to apply only to physical or material constraint outside the control of the contractor. It had been held to apply to strikes actually proceeding, to war, to breakdown of machinery, but never to fear, however reasonable, of the consequences of threatened action. It was to be observed that the threat, if acted upon generally (and he was told that this trade union controlled the action of electrical workers throughout the kingdom), would deprive all men in the position of Mr. Cant of an honourable and legitimate livelihood, whilst it avowedly amounted to a claim on the part of the union to dictate to all their fellow-subjects the class of persons they should employ to do private electrical work on private premises. Some might regard such a threat as high-handed and insufferable tyranny on the part of the union. It was not for him to say; he was only required by the statute to say whether he was of opinion that a threat of this kind amounted to *force majeure* within the meaning of the proviso in the order. In view of the decided cases he was of opinion that the Council's default was not due to *force majeure,* and that the default could not be excused. He therefore fined the Council 5s. per day for nine days (£2 5s.) and ordered it to pay 20 guineas costs. The case was of very wide application, and he should assist any appeal to the High Court, as he thought that if the meaning of the expression *force majeure* was to be extended it should be done by the High Court, and not a Court of summary jurisdiction.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

11,152. "Electric switches." Butlers, Ltd., and A. Reeves. April 18th.

11,167. "Apparatus for recording telephone calls." H. Rawson. April 18th.

11,182. "Combined electric safety devices and insulators." I. Valen. April 18th. (Norway, April 16th, 1920.)

11,192. "Fusible safety cut-out for electric motors." B. Platschick. April 18th.

11,206. "Apparatus for obviating over-regulation in automatic regulating devices." Siemens-Schuckertwerke. April 18th. (Germany, April 17th, 1920.)

11,235. "Electric lamps to be carried on the person." G. Oldham and J. Oldham. April 18th.

11,236. "Galvanic batteries." G. Oldham and J. Oldham. April 18th.

11,237. "Electric cut-outs and resistances." G. Oldham and J. Oldham. April 18th.

11,238. "Electric switches." G. J. Sutton. April 18th.

11,273. "Electric transformer regulating switches." E. Thomas. April 19th.

11,274. "Telegraph keyboard perforators." A. C. Booth and A. S. Wilmot. April 19th.

11,286. "Oscillating brush gear for electrical machines." F. S. Thwaites. April 19th.

11,289. "Tungsten arc lamps." Patent-Treuhand Ges. fur Electrische Gluhlampen. April 19th. (Germany, April 28th, 1920.)

11,299. "Automatically controlled electrical generating plants." A. W. Sclater. April 19th.

11,301. "Electric contact plugs." H. Durheim. April 19th. (Switzerland, April 19th, 1920.)

11,312. "Telephone repeaters." Western Electric Co., Ltd. (Western Electric Co., Inc.). April 19th.

11,323. "Electrically actuated mechanism for producing sliding or rotary motion." E. N. Bray. April 19th.

11,326. "Electric switches." Compression Starter & Switchgear Co., Ltd., and R. Lomax. April 19th.

11,349. "System of pole-changing for polyphase induction motors." O. T. Blathy. April 19th. (Hungary, April 19th, 1920.)

11,356. "Electric switch." L. Horvath and G. von Martiny. April 19th. (Hungary, May 8th, 1920.)

11,363. "Apparatus for converting heat into electrical energy." F. E. Beeton. April 19th.

11,375. "Electric battery." K. Warnon. April 20th.

11,388. "Telephone steriliser." J. A. V. Frew, S. Graham, and T. B. Macmillan. April 20th.

11,392. "Anti-vibration devices for incandescent electric lamps, &c." J. R. Thompson. April 20th.

11,396. "Dynamo-electric machines." P. Forster. April 20th.

11,398. "Electric switch." G. W. Homphry. April 20th.

11,402/3. "Means for improving current-carrying capacity of three-phase alternating current cable systems." A. M. Taylor. April 20th.

11,412. "Recording, reception, and reproduction of sounds." O. Bothe. April 20th. (Germany, April 20th, 1920.)

11,427. "Hand sets." Western Electric Co., Ltd. April 20th.

11,433. "Electric horns for motor cars, &c." H. J. Sims. April 20th.

11,446. "Control of electrically operated fluid compressors." Westinghouse, Brake & Saxby Signal Co., Ltd. April 20th. (United States, August 31st, 1920.)

11,467. "Electric device for treating air." E. R. Case. April 20th.

11,469. "Electric geysers." A. F. B. Andrew. April 20th.

11,473. "Electric fire, burglar, &c., alarms." Bayerische Vereinsbank. April 20th. (Germany, April 20th, 1920.)

11,475. "Art of increasing efficiency of electro magnetic radiation." W. E. Hitch. April 21st.

11,501. "Perpetual motion or magnetically propelled power generator." A. E. W. Maseyk. April 21st.

11,511. "Containers for electric batteries, &c." S. W. Cox. April 21st.

11,516. "Automatic cut-out or switch for electrically-heated apparatus." H. Jaggi-Zumbuhl. April 21st.

11,517. "Containers for electric batteries, &c." New Eccles Rubber Works, Ltd. April 21st.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

21,542. "Signal or call apparatus for restaurant tables and the like." A. M. Bree. September 2nd, 1919. (161,204.)

26,990. "Electrical ignition means for internal combustion engines." E. C. White and G. Davenport & Co., Ltd. November 3rd, 1919. (161,208.)

27,123. "Glow or incandescent electric lamps." G. Malatesta. November 4th, 1919. (161,211.)

27,150. "Methods and means for covering metal cores in the manufacture of electrodes." W. H. Boorne and W. Darge. November 4th, 1919. (161,212.)

30,119. "Induction motors." Colner Elektromotorfabrik, J. Broncken. September 25th, 1918. (Addition to 136,156.) (140,745.)

32,495. "Telephone receivers, transmitters, and other electric or magnetic acoustic or vibratory apparatus." S. Hockly. December 29th, 1919. (161,241.)

32,783. "Electric generators and motors." R. Ranklin and Van Randen and Co., Ltd. December 31st, 1919. (161,245.)

32,880. "Apparatus for waving or curling the hair." Quain Electric Co., Ltd., and J. R. Spink. December 31st, 1919. (161,249.)

1920.

64. "Electric battery." P. Odion and A. Cayrol. April 25th, 1914. (137,324.)

66. "Process for the manufacture of an electric insulating material." E. F. A. Bultemann. January 29th, 1918. (137,326.)

151. "Signalling systems applicable to wireless receiving systems and other purposes." British Thomson-Houston Co., Ltd. (General Electric Co.). January 2nd, 1920. (161,256.)

226. "Electric and like kettles." R. W. Coan. January 3rd, 1920. (161,263.)

254. "Electric oscillation arcs." Radio Communication Co., Ltd., and B. Binyon. January 3rd, 1920. (161,266.)

431. "Telephone transmitters." V. F. Feeny (Magnavox Co.). January 6th, 1920. (161,277.)

520. "Dial switches as used in automatic telephone or like systems." Automatic Telephone Manufacturing Co., Ltd., S. R. Smith, and J. Savin (partly communicated by Automatic Electric Co.). January 7th, 1920. (161,283.)

697. "Generation of electricity by means of the rise and fall of tides." R. I. Ward. October 8th, 1920. (161,295.)

729. "Mine signalling or like systems in which the main signals are given by a number of impulses transmitted in succession." Automatic Telephone Manufacturing Co., Ltd., and C. Remington. January 9th, 1920. (161,297.)

1,314. "Electric motor driving arrangements." Siemens Bros. Dynamo Works, Ltd., and J. F. Crowley. January 15th, 1920. (161,313.)

1,830. "Sparking plugs." R. F. Hall. January 20th, 1920. (161,327.)

2,427. "Suspending means for electric light fittings." F. I. Green. January 26th, 1920. (161,353.)

5,807. "Electrical accumulators." Saunders Electrical Co., Ltd., and C. Saunders. February 26th, 1920. (161,404.)

8,519. "Sparking plugs." J. E. Barrows. March 23rd, 1920. (161,429.)

11,278. "Radio navigational systems." G. P. Grenfell, J. Erskine-Murray, J. Robinson, and H. L. Crowther. April 23rd, 1920. (161,448.)

11,313. "Electro-magnetic wave receiving systems." J. Robinson and H. L. Crowther. April 23rd, 1920. (161,449.)

18,235. "Continuous current gyroscope motor." F. Krupp Akt.-Ges. November 18th, 1915. (146,302.)

19,176. "Transmission dynamometers." F. Krupp Akt.-Ges. July 7th, 1920. (147,137.)

19,443. "Electric current interrupters." Firm of C. Zeiss. May 28th, 1918. (147,485.)

19,844. "Electric transformers or self-induction coils." Soc. Francaise Radio-Electrique. May 20th, 1915. (147,801.)

23,979. "Electric distribution or fuse boards and the like." H. B. Prentice. August 17th, 1920. (161,497.)

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THE ECONOMIC POSITION OF THE ENGINEERING INDUSTRY.

WE summarise in this issue part of a very remarkable pamphlet published by the Engineering and the National Employers' Federations, the object of which is "To present a comprehensive and reasoned statement of the case, and thereby secure the co-operation of workpeople in bringing about the changes necessary to overcome the difficulty of the present position."

The pamphlet is unsigned, but those responsible for its production have our heartiest congratulations upon a sound and brilliant piece of work.

Being the work of engineers it was sure to be practical, concise, and readable, and above all, reasonable. The penalties of miscalculations and mis-statements fall automatically and promptly upon men engaged in design and construction, and this may be one of the reasons why their work is, generally speaking, reliable. If they design and make any member of a structure or machine too weak for its work, it breaks, and the consequences must at once be faced. Another reason is that having had a scientific education, they have imbibed from early youth a love of truth as the only possible basis for science and practice. The loopholes, evasions, postponements, pitfalls, and dialectic victories of the politician and the lawyer are not for them.

The pamphlet is non-political, and so convincing in its statements and conclusions that it is almost non-controversial. It sets forth the facts as to the depreciated exchanges in a very complete and able manner; and it enumerates all the coincident events which have brought about the present state of things, the Great War being, of course, the fundamental cause.

We may remark in passing, however, that our position is not due only to the war and its effects, as is shown by the fact that one of our most formidable competitors in the iron and steel trade is our own wonderful little ally, Belgium, whose coal pits were producing more than their pre-war output soon after the armistice, and which is now exporting steel rails and sections at prices far below our costs of production.

The document makes no criticism of the clumsy efforts of our Government, first, to keep up prices (and consequently wages) in order to collect (and squander) more revenue; and afterwards to bring down prices and costs by a sudden deflation of credit which has proved equally disastrous. As stated above, it is a non-political pamphlet, and, therefore, does not touch upon the share borne directly by the politicians in bringing about the present ruin. It shows how the depreciated exchanges have prevented the foreigner who desires goods from buying them; and also how the home consumer ceased to buy, partly because he could not afford the high prices and partly because, as soon as the slump began, he waited for the prices to touch bottom.

It points out the disastrous cumulative effect of the moulders' strike, followed by the present coal strike, coming as they did at times when every nerve should have been strained to meet the commercial crisis.

We are glad to see that after nearly six weeks' complete stoppage there is at last a move to appoint an arbitrator or mediator between the miners and the coal owners, and that our suggestion of Sir Arthur Duckham as the best man available for the job has been taken up and strongly advocated.

He should have been appointed before the strike began and before all this terrible waste of the national resources took place. We confess that we do not belong to the "fight to a finish" school. All these disputes could or should be settled by negotiation or arbitration taking place without a stoppage. The principle of peaceful settlement once fairly tried, instead of industrial war, would save so much in cash alone, as to make real progress in the standard of living possible once more. The people that say: "Let us make an end of it—fight it out," generally end in making only a bad beginning of more trouble.

The question of capital and credit for industry is dealt with in the document, and it is shown how the manufacturers' depleted capital has become "frozen up" in unsaleable stock, while the banks, duly restricting credit as instructed, refuse the money necessary to carry on.

On the question of taxation, the pamphlet, in its studied avoidance of politics, is almost too restrained; though the share of taxation in adding to the intolerable burden upon industry is clearly stated.

The appalling increase in costs of production of fuel, raw material, and finished machinery is set forth quite clearly and temperately, and without imputing blame, but it is shown beyond dispute that unless those costs can be brought down to a level enabling us to compete with manufacturers in other countries, we cannot hope to sell our goods or to obtain employment.

The cost of living, as the foundation of the *real* value of wages, is also dealt with, and finally sound conclusions are reached. Then follows an appendix giving details of specific recent instances in which trade that we might have had at competitive prices has gone elsewhere, for the one and only reason that our costs of production were too high to enable us to get the orders, even though in several instances manufacturers were willing to work without any profit at all. It is an appendix which almost makes for despair, though there is no spirit of despair discernible in the authors of this work.

They have, very rightly, avoided politics and industrial controversy. But we feel bound to point out indications on these topics which we think spring from their pages, though they are not expressed by them.

This country is industrially in a very serious situation. We depend to such an extent upon our foreign trade that unless means can be found to enable us once more to compete in the world's markets we shall lose them, perhaps for ever. We owe nearly eight thousand million sterling on which we are paying a high rate of interest, and about one thousand millions of this huge burden is due to our friends abroad.

Our profits are disappearing, and costs of production on many articles are nearly double those of our competitors.

In these circumstances we cannot afford to allow our financial and fiscal affairs to be muddled. We cannot afford a vast army of unproductive officials, nor any unnecessary ministers. We cannot afford any kind of incompetence in high places. We cannot afford four hundred millions a year for drink. We cannot afford to find a revenue of over a thousand millions of which only about one-fifth is for extinction of debt. We cannot afford to borrow capital for industry at 10 per cent.

We cannot afford to neglect our water power, or our canals, or to postpone the development of electrical power distribution on an adequate scale. We cannot afford money for unremunerative expenditure, while remunerative undertakings are starved. And to come back to the subject matter of industrial relations, we cannot afford strikes. They are as costly as little wars, and nearly as harmful in other ways.

We cannot afford to "slack" in our working hours, or to neglect or refuse to use any machinery designed to increase our productivity. We cannot afford to starve science and invention. We cannot afford to keep a million ex-service men idle because we won't admit them into industry. An aristocracy of skilled workmen in a protected compound is a thing we *cannot* afford.

Electrical Wages Dispute.

Last week we recorded, and with no small feelings of satisfaction, that the national executives of the National Federated Electrical Association and the Electrical Trades Union had jointly come to an agreement that they would recommend their members to adopt wage reduction proposals of 10 per cent. in two instalments, namely, 5 per cent. in May and 5 per cent. in July. But if we or anybody else imagined that the Dove of Peace which had been hovering within the precincts of the Ark of the electrical contracting industry intended to settle there, such rash imagination was corrected very soon thereafter, when it was discovered that the said Dove had kept to its wings. Unfortunately leaders seem to have little influence with those on whose behalf they act, and so it came to pass that on Tuesday a strike of electrical contracting employés was in full swing following the decision, as one Press report has it, "that members (of the E.T.U.) must cease work at once against any reduction of wages." Elsewhere it is stated that the men's representatives agreed to submit the 10 per cent. proposal to the rank and file "without recommendation for acceptance or rejection." It is said that a national ballot of the whole of the members of the union resulted in favour of a strike, but only a part of the members have downed tools, and these are in the employ of electrical contracting and shipbuilding firms. Another Press report says "about half the employés have struck work, the others accepting the reduction." As we are not yet familiar with the whole of the circumstances which brought about the cessation of work we are unaware of the grounds on which electrical wiremen and contracting employés claim a continuance of all the advances of recent years now that the cost of living is falling. The electrical contracting industry, at home, like the electrical manufacturing industry both for home and export trade, is in urgent need of decreased costs of production. Work is being held up in the expectation that its cost will fall. Will those who depend upon the industry for their livelihood be so unwise as to prevent its revival at so unpropitious a time? With reasonable prices and stability the slackness at present prevailing in the trade could give place to great activity. If the strike action has been taken against the advice of the Union Executive, it is deplorable from every standpoint, and cannot be expected to succeed; indeed it was reported on Tuesday night that in some instances the men had already returned to work. There seem to be powerful elements at work in the Electrical Trades Union which are never happy unless they are menacing the interests of their trade. Is this the "control" of the industry that has so long been their avowed doctrine?

Whitley Councils.

We noted with much concern that the Hammersmith Borough Council had decided to sever its connection with the various Joint Industrial Councils formed under the Whitley scheme, and to return to direct negotiation with its own employés on matters relating to wages, &c. The secretary of the E.P.E.A. has addressed a letter to the Council, in which he very ably sets forth the objections to this policy, and the disastrous results that may ensue from its adoption generally, the gist of which letter appears elsewhere in this issue.

We have pinned our faith to the Whitley Council system as by far the most promising means of avoiding not only strikes, but even disputes, between employers and employed, by restoring in a measure that close and intimate relationship which used to exist in the old days between them, and enabling them to discuss their respective needs and aims face to face. That the work done by these Councils even in their present undeveloped condition has been of immense value to the industries concerned is beyond question; as Mr. Jones points out, and as we have shown from time to time when dealing with this subject, questions of wages and living conditions, though necessarily the first to be attacked, by no means form the be-all and end-all of the Councils' existence—they have many other important functions to serve. By seceding from the system, the Hammersmith Borough Council has dealt a blow at it which is directed in reality against the common welfare, and we earnestly hope that so mischievous a policy will be quickly abandoned. Autonomy is a precious thing within reasonable limits; but carried to the limit by the individual it is nothing other than anarchy. No one in any civilised country has absolute control over his own actions, for he is a member of a community, and his actions may affect the well-being of his neighbours; hence the necessity of a code of laws. The same consideration applies to Borough Councils, and we commend to the notice of the Hammersmith Council the admirable example of no less a municipality than that of the City of Manchester, which not long ago explicitly renounced its freedom and declared its willingness to accept the decisions of the Whitley Councils as binding upon itself.

International Credits: The Ter Meulen Scheme.

It is common to speak of the League of Nations as of something which it is hoped at some time in the "dim and distant future" to bring into existence, and into action in the world's tangled and troubled affairs.

Believing as we do that the League is actually commencing to function for the peace and welfare of humanity, it is with peculiar pleasure that we record the receipt of a business document from its office in Trafalgar House, Waterloo Place, S.W.—the headquarters at which the Ter Meulen scheme of International Credits is established with Sir D. Drummond Fraser, a prominent banker, as organiser.

A full explanation of the scheme is conveyed in a booklet which may be obtained for 6d. from Messrs. Harrison & Sons, Ltd., 44, St. Martin's Lane, W.C. 2, and the booklet has reached us accompanied by an explanatory note, setting forth the objects and the working of the scheme.

The International Credit is intended only for cases in which necessary security for exports on credit or payment in cash for such exports is not otherwise available. When such cases arise it is requested that the British exporter should express his willingness to accept the Ter Meulen Bonds as collateral security, and propose to the foreign importer to request his Government to put the scheme into operation and furnish the bonds as security. It is only as the need arises and the desire for Government action is manifested by both parties that the scheme will be brought into action.

The foreign Government then has to satisfy the Special Commission of the League of Nations that the security pledged by the bonds is adequate, and it is believed that a certificate to that effect by the Commission will give to the bonds a full face value in the eyes of any British banker, who will then grant the necessary credits to the exporter on this side. Apart from the provision of the collateral security the business will be conducted on normal lines, and the collateral can only be dealt with or realised if default is made by the purchaser of the goods.

The sooner this excellent scheme is brought into operation the sooner will the difficulty of the foreign exchanges be overcome and British export trade restarted.

It would appear to be especially helpful in the case of contracts taking a considerable time to execute, such as those for electrical engineering plant.

We trust that every effort will be made by our business men to utilise this excellent scheme, and incidentally to build up the reputation of the League of Nations.

The Institute of Physics.

The recent inauguration of the Institute of Physics raises one or two questions upon which some comment may be offered. In the first place, although there is little doubt that industry generally is now appreciating much more than it did a few years ago the importance of the physicist, there is more than a possibility, owing to the unforeseen reaction which has followed the war, that the full advantage of this appreciation will, at any rate temporarily, be postponed. There is a vast difference between the practical usefulness of the physicist and the chemist in industry, and although the works chemist is now a well-recognised member of most large engineering staffs, we have not yet reached the stage when the works physicist has become equally familiar. Consequently, the physicist must continue for some time yet to depend upon assistance from the Government and donations from industry to carry on his work in the more inspiring atmosphere of the laboratories of our universities and teaching institutions.

Unfortunately, the impoverishment of the nation has compelled the cutting-down of the sum at the disposal of the Department of Scientific and Industrial Research, and this limits the opportunities even for men of promise to carry on original work in physical research. That, however, should not discourage those who have the full industrial development of pure science at heart. There is, of course, a direct incentive to manufacturing firms to subscribe to the funds of their own research associations, and less incentive to put down money for pure science research from which immediate results are not necessarily forthcoming. The inauguration of the Institute of Physics offers one more opportunity for appealing to industry to assist, not only in the national interest, but in the individual interests of particular trades, by the provision of funds which will aid in the conduct of research work in our universities and teaching institutions on well-defined lines.

Another matter which arises out of the inauguration of the Institute of Physics is the position with regard to the formation of new technical institutions. It has been urged that our old-established institutions, which nominally cover every branch of engineering and science, are not able to provide for the greater specialisation that has come about since they were originally formed. There is a good deal of truth in this contention, and one or two instances can be mentioned where some of the younger men, who have been compelled by the trend of events to specialise severely, have broken away and taken action on their own account. A recent example of this is the formation of the Institution of Production Engineers, the complaint in this case being that there is no opportunity at present afforded by any existing society for the discussion of the practical aspects of production, which is such a vitally important problem to all industries to-day. In the same way, a Chemical Engineering Group was formed a few years ago, to give opportunities for the discussion of engineering problems attaching to the chemical industry, and although the Engineering Group is now affiliated to a parent society, at one time there was a threat to break away and form a separate institution. Similarly, the formation of the Faraday Society has fully justified itself, and it seems that the Institute of Physics will equally be found a necessity if full opportunities are to be given for physicists to discuss their own particular problems. This tendency would seem rather to lead away from the ideal put forward on more than one occasion that the older institutions, such as the Institutions of Civil, Electrical, and Mechanical Engineers, should sectionalise themselves and cover the whole field of activities implied by their names. The Institution of Electrical Engineers has, it is true, made a move in that direction by the formation of its Wireless Section, and it may well be that this type of development could be extended with advantage.

STATUTORY UNDERTAKINGS AND THE FUEL SUPPLY.

[By a Legal Contributor.]

A question of very considerable importance to supply authorities is suggested by the shortage of fuel. Suppose that, owing to their being unable to find coal, those who are under statutory obligation to provide electricity are unable to fulfil that obligation, what is the position? Are they under any penalty, or are they liable to any consumer for breach of contract?

The question involves the consideration of those provisions of the electric lighting Acts which compel undertakers to give a continuous supply.

It is provided by Sec. 30 of the schedule to the Electric Lighting Clauses Act that (1) whenever the undertakers make default in supplying energy to any owner or occupier of premises to whom they are required to supply energy under the special order they shall be liable in respect of each default to a penalty not exceeding 40s. for each day on which the default occurs.

It has been held that where there is no special contract between the undertakers and the consumer obliging the former to give a supply, the latter cannot maintain an action for damages for failure to supply—his only remedy being to proceed for penalties (Clegg *v.* Earby Gas Co. (1896) 1 Q.B. 592).

Taken by itself, this clause imposes a very serious liability upon a company or local authority supplying electricity, for it would extend to every default which they might make. Even if the supply were cut off for a few minutes in the day, it might involve them in a claim for penalties. Its rigour, however, as we shall presently see, is modified by a subsequent clause.

In cases where the local authority are not themselves undertakers, severe penalties are inflicted if there is any failure to supply energy to public lamps. Sub-sec. (2) provides that where the local authority are not the undertakers, and the undertakers make default in supplying energy to the public lamps to which they may be and are required to supply energy under the special order, the undertakers shall be liable in respect of each default to a penalty not exceeding 40s. for each lamp and for each day on which the default occurs. Sub-sec. (3) provides that whenever the undertakers make default in supplying energy in accordance with the terms of the Board of Trade regulations, they shall be liable to such penalties as are prescribed by the regulations in that behalf.

The fourth sub-section is of the greatest interest. It provides "that the penalties to be inflicted on the undertakers under this section shall in no case exceed in the aggregate in respect of any defaults not being wilful defaults on the part of the undertakers, the sum of £50 for any one day, and provided also that in no case shall any penalty be inflicted in respect of any default if the Court are of opinion that the default was caused by inevitable accident or *force majeure* or was of so slight or unimportant a character as not materially to affect the value of the supply."

Let us examine some of the cases in which these provisions have been considered, in order to see whether they provide any answer to the question at issue.

What, in the first place, is *force majeure*, which is sometimes described in legal documents as "the act of God or the King's enemies"? In a case which was heard in Dublin in 1899 it was proved that the supply of energy had broken down owing to certain defects in a cable which had not made themselves apparent for a considerable time. It was held that the Corporation was excused on the ground of inevitable accident (Sun Insurance Co. *v.* Dublin Corporation, December 9th, 1899). But the defence of *force majeure* or inevitable accident will not avail an undertaker in every case. In Shaddick *v.* London Electric Supply Corporation (*Journal of Gas Lighting*, May 8th, 1900, p. 1235), the keeper of certain licensed premises at Deptford summoned the defendant corporation for failure to supply electricity to his premises. The default was admitted, but the defence was *force majeure*, it being contended that the supply of electricity having become deficient owing to unavoidable causes, it became essential that some part of the district of the company should be cut off, and that Deptford was selected as causing the least public inconvenience. The full penalty of 40s. was inflicted in each of the seven cases, with 20 guineas costs in the first case, and 2s. costs in each of the others. It would seem, however, that where the company are taken by surprise, and asked to supply a number of consumers for whom they have not made adequate arrangements, they will be leniently dealt with. Thus in Marylebone Vestry *v.* Metropolitan Electric Supply Co. (*Journal of Gas Lighting*, January 2nd, 1900, p. 34), the company were summoned by the Vestry and Guardians for making default in supplying electrical energy to the workhouse and vestry premises on certain days. The company admitted the default, and contended that the same was due to inevitable accident, caused by the great increase in the demand for electricity which had exceeded their expectations. The case was at first adjourned, and eventually small fines were imposed.

It would seem that if any negligence on the part of the company can be proved, it is futile for them to urge a plea of *force majeure* or inevitable accident.

Thus the faulty laying of a cable which leads to a break owing to subsidence; defective insulation leading to short circuit; carelessness at the central station which leads to a stoppage of all the machinery; none of these things could be pleaded in answer to a summons for failure to supply. On the other hand, the breakage of a cable owing to floods, the bursting of a boiler, or sudden stoppage of machinery owing to some undetected fault would always be received as a complete answer to a charge of failure to supply. But it is essential, in the interest of the consumer, that the company should take every precaution to secure that even when one set of engines breaks down another shall be ready to take its place.

If the undertakers cannot reach the consumer's premises without breaking up land not dedicated to the public use, and the owner of the land refuses his consent to the breaking up, this would appear to be an answer to a complaint under this section (Bellamy *v.* Liverpool United Gas Light Co. (1904), 2 L.G.R. 1,182).

These cases lead inevitably to the conclusion that mere inability from a business point of view to supply is no answer to a claim for penalties. Whether this inability is due to strike or lock-out, or inability to procure coal, the undertakers remain liable for failure to supply. The answer of the consumer who cannot turn on his lamps to the complaint of the company "We have no coal" is clear and explicit. "You are under statutory contract to supply me with electricity, and you have broken that contract. You should have laid in sufficient coal to tide you over the period of a strike."

That any consumer will ever attempt to assert his right to the above extent may be doubted; but it is important for those who are connected with the electrical industry to realise that so far as legislation is concerned they are not at present protected by any strike clause.

THE PRESENT ECONOMIC POSITION OF THE ENGINEERING AND ALLIED INDUSTRIES.

The following are extracts from a document issued by the Engineering and the National Employers' Federations (Broadway, Westminster, S.W. 1). We refer to the matter in our leading columns. Since our article was written we have been favoured with a copy of a pamphlet issued by the Amalgamated Engineering Union in reply to the Employers' statement. We propose to treat it with equal fullness in a later issue:—

The Fundamental Cause of the Depression.

The fundamental cause of the existing depression is the war, and we have to find to what extent the various changes which the war has brought about are the predominant causes in the present depression.

The first consideration of the position reveals the fact that there are in the world, at the present time, two great classes of people with whom we are mostly concerned:—

(*a*) Those who want to buy and can't.
(*b*) Those who can buy and won't.

The position of the peoples in all these countries who want to buy but can't is symbolised by the state of the exchanges as between their currencies and our currency.

Foreign Exchanges.

If English currency for the moment is taken as the standard, the currency of all these other countries is depreciated, because in all cases for the last two years or more the productive industries of these countries have been abnormally disturbed, their exporting capacity has been excessively reduced, and at the same time they have been seeking to buy food, machinery and raw material. For the time being they have largely exhausted their buying power and that means that they have exhausted the capacity to give employment to people of the United Kingdom who are engaged in manufacturing industries.

There are some countries that will be able to renew their productive industry (including agriculture), and therefore in due time to export, if they can receive supplies of machinery, of materials, of seeds, &c. In these cases it is proposed that export credits should be provided, but export credits are nothing but loans, and when an export credit is made we are lending to the country assisted, the product of British labour, capital and industry, notably in the form of manufactured goods, and the degree of stimulation to British industry which export credits can provide is a very limited one and in fact limited to the extent to which industry can be maintained by a Government seeking to borrow in order to maintain industry when it is depressed.

The position with regard to trade with a country whose currencies have been depreciated has been aggravated by the high cost of production of British goods. Some months ago the needs of such countries were so urgent that they were prepared and willing to pay any price that might be asked to satisfy their most pressing needs. They are no longer prepared to take that attitude and are holding back until they can obtain goods at a more reasonable price than at present.

While this state of things is dominating the situation it happens at the same time that industrial production is reviving rapidly in Germany. In that country, where the present market par rate of exchange (*i.e.*, purchasing power in Germany) is somewhere in the neighbourhood of 100 marks to the sovereign while the actual international rate is somewhere about 240 to the sovereign, they are in a position to offer goods at less than half the price at which it is possible for British manufacturers to sell. Under these circumstances European countries are naturally turning to Germany to supply their wants, and it is manifestly becoming daily more difficult to obtain orders for British goods from the Continent.

Australian and Far Eastern Exchanges.

The state of affairs prevailing in India, China, and Australia, though arising out of the war, is very different in character from that which has disturbed the European exchanges. The unit of Indian currency is the rupee, a silver coin, but owing to the fact that the price of silver for many years before the war was kept fairly steady, and owing also to the fact that the balance of trade as between the United Kingdom and India was, all factors being taken into account, kept steady, it was possible, through the joint action of the Home Government and the Indian Government, to stabilise the rupee at 1s. 4d., *i.e.*, 15 to the sovereign. The war caused a vast disturbance to the balance of trade, and stimulated activity, both in India and in China, the other great silver using country, with the result that there arose a great need for additional silver for coinage purposes. At the same time, the annual production of silver was being severely restricted owing to the Mexican Revolution. The combined effect of increased demand with reduced supply forced the price of silver to a level about three times as high as its pre-war level. The Government machinery for regulating the Indian exchange completely broke down in face of the overwhelming economic forces which were brought into play, and at one time the rupee attained the extraordinary value of 2s. 8d., that is to say, double its pre-war exchange value. Extraordinary measures had to be taken, and the United States Government, by selling several hundred million ounces of silver from their reserves to the Indian Government, eased the situation.

A committee of the best experts investigated the question and recommended certain measures which were adopted by the Government, the outstanding one being that an effort should be made to stabilise the rupee at the value of 2s., *i.e.*, 10 to the £. At the time the recommendation was made this represented an effort to reduce the value of the rupee, but shortly afterwards the price of silver began to fall because the Mexican production was resumed and also because the replacement of silver currency in Europe by paper money enabled enormous quantities of silver to be made available for Indian and Chinese currency requirements. The price of silver fell with even greater rapidity than that with which it rose, and to-day it is only a few pence per ounce different from its pre-war value—the rupee being once again somewhere about 1s. 4d. or a little less in value.

When the rupee was worth 2s. 8d. India placed enormous orders in this country, particularly for textiles, and the extraordinary flow of orders continued even after the fall of the value of the rupee had begun because the rupee still had a higher relative purchasing power if used to buy goods from abroad. When, however, many of the goods were actually delivered in India the value of the rupee had fallen below the stabilised rate of 2s. in the £ and Indians who expected to pay for goods on arrival at the rate of 10 rupees for a sovereign's worth, found themselves called upon to pay 15. Warehouses at the Indian ports are still full of goods of which the Indian purchasers will not take delivery, and for the moment orders from India are negligible in amount. Congestion of warehouses in Australia and South America has taken place for similar reasons.

With regard to Australia and New Zealand, the position which has arisen is a direct consequence of the war. The Australian wool-clip and much of the Australian wheat harvest, together with supplies of meat from New Zealand, were bought by the British Government as part of the policy for maintaining food supplies during the war, for preventing abnormal increases in prices, for securing adequate supplies of wool for clothing the army, and also partly to assist the Australian Government during those times when shipments were held up. The payments of the British Government were made, generally speaking, when goods were delivered into warehouses in Australia, whereas in the case of private purchasers, while the practice would vary probably from case to case, yet, generally speaking, payments were made against shipping documents in the form of a bill of exchange, having a currency of three or perhaps six months. In effect, when the Government became the main purchaser, the Australians were receiving payment anything from three to six months earlier than they had been accustomed to receive it, and this, of course, had a very stimulating effect on their spending power. When the end of the war came very heavy orders were placed in this country for goods of a kind which could not be obtained during the war in adequate quantities. The demand from Australia and New Zealand became so heavy that Australian credits in London began to run down, and then on top of this there came the change once more from Government buying to private buying, and with the resumption of the ordinary conditions of private trading the Australian found a gap of from three to six months in receiving payments in respect of exports. In consequence of this gap, Australian credits in London are exhausted, British firms who have been paid by Australian bills of exchange find it impossible to discount these bills in London, and export trade to Australia has been paralysed in consequence.

The difficulties which have arisen in the case of India, China, Australia and New Zealand are difficulties of the balance of trade and difficulties of currency, but every buyer in those countries is now infinitely more critical of prices than he was before the collapse came and there is extraordinary reluctance on the part of buyers in those countries to place orders for British goods at the level of prices which has been prevailing. It is very certain that an active state of trade cannot be resumed without lower selling prices, involving a much lower cost of production.

The Crisis.

From the point of view of British industry the critical month was August, 1920, and if at that time a combined effort could have been made to reduce the cost of production the worst effects of the slump could have been avoided. As a matter of fact, between the end of July and the end of December the increase of wages reported by the Ministry of Labour added £1,434,000 to the weekly wage bill, or, say, at the rate of £70,000,000 a year.

As the Ministry of Labour statistics only cover a little more than half the wage earners, the aggregate increase must have been much greater.

As the "consumers' strike" was then well under way, it is evident that the increased burden could only aggravate the situation.

"The Consumers' Strike."

So far, attention has been concentrated mainly on those who want to buy but cannot, because their own productivity is low for the time being.

The other class, namely, those who can buy and will not, is equally important.

Actually, of course, there is no sharp division between the two classes, because naturally those who are in urgent want of commodities, whose purchasing power is also reduced, are in many cases not exercising that power in full, because they hope to do so at better advantage later on. This is particularly the case of the ordinary consumer, who is not buying, say, a new suit of clothes because he is waiting till the price is at rock bottom.

The order of events is shown by the following sets of index numbers :—

—	*Times* index No. of wholesale prices of materials percentage increase over Dec. 31st, 1913.	Trade Union percentage of unemployment.	Cost of living index No. percentage increase over July, 1914.
December 31st, 1919 ...	257·8	3·2	125
January 31st, 1920 ...	235·0	2·9	130
February 29th, 1920 ...	256·0	1·6	130
March 31st, 1920 ...	248 7	1·1	132
April 30th, 1920 ...	239·9	0·9	141
May 31st, 1920	217·6	1·1	150
June 30th, 1920 ...	190·5	1·2	152
July 31st, 1920	195·2	1·4	155
August 31st, 1920 ...	193·1	1·6	161
September 30th, 1920 ...	180·1	2·2	164
October 31st, 1920 ...	170·4	5·3	176
November 30th, 1920 ...	128·9	3 7	169
December 31st, 1920 ...	107·8	6·1	165
January 31st, 1921 ...	82·6	6·9	151
February 28th, 1921 ...	61·2	8·5	141

Raw materials reached their highest level at the end of February, 1920; unemployment was at its lowest at the end of April, 1920; and the cost of living was highest at the end of October, 1920.

The Coal Strike.

What was perhaps even more serious was the fact that, at the most critical period of all, the threat of the coal strike was hanging over the nation and buyers at home and abroad avoided making purchases.

The buyer abroad was afraid he would not get delivery, and the buyer at home, particularly the wholesale buyer, was in such dread of the consequence of a coal strike to his business that he was afraid to commit himself.

Then at last, when the coal strike came, foreign competitors seized the opportunity to secure business which might have come to this country.

A coal strike 12 months ago would have been survived as the railway strike was survived, but coming at the critical time that it did, it was fatal to our prospects of evading the worst effects of the slump which was then already in progress.

The aggregate capacity for saving is not equal to the burden imposed upon us, and the shortage of savings, *i.e.*, new capital, has led to higher and still higher prices, which are without parallel, being offered for capital in the form of rates of interest.

The high rates of interest have stimulated savings through further personal economies, but these have not been adequate, and consequently there has been a slowing down of new enterprises.

New Capital is the Engineer's Source of Employment.

The engineer and the builder are fed and clothed out of the savings of those in other occupations, but those, *e.g.*, the farmers of Northern France, of Hungary and of Russia, have at the moment such a slender margin that they cannot achieve the task which incidentally would be enormously to their own advantage. This, to many, may be a new idea, but it is evident that if people in other industries did not save, there could never be an engineering industry at all.

The Freezing of Credit.

Just at the time when the limit was being reached, the fall of wholesale prices already referred to was beginning. Manufacturers and merchants holding of necessity great stocks of material at high prices largely paid for out of borrowed money, were unable to repay the loans from the banks, and the latter being tied up in this way were unable to provide accommodation for others who were just needing it for their enterprises, and who frequently, in consequence, did not know where to turn for the wherewithal to meet their weekly wage bill.

Credit, the life blood of industry, became frozen in great stocks of materials, partly finished and fully finished goods.

Stocks now held will have to be reduced in value to an extent which will induce purchasers to buy, and the holders will have to cut their losses accordingly. This, however, will be possible only if the holders of stocks are able to replace them at much lower prices in future, and this, in turn, means far lower costs of production than exist at present.

(*To be concluded.*)

THE PRINTING AND ALLIED TRADES EXHIBITION.

The catalogue of the sixth International Printing, Stationery, and Allied Trades Exhibition, which opened at the Agricultural Hall on April 30th, recalls that a conspicuous feature of the 1914 show was the number of German firms showing goods. But "*Nous avons changé tout cela,*" and the present exhibition is free from any suspicion of ex-enemy invasion. This, however, does not mean that it is "all British," for both France and America are well represented. Naturally electricity looms large in such an exhibition; the advantages of the electric drive with its ease of control, cleanliness, and efficiency have made it indispensable to the printing industry. We have it on the authority of the official electrical contractors that motors representing a load of about 700 kW are in use on the stands.

Motors specially adapted to printing work are shown by Electromotors, Ltd., and the Swedish General Electric, Ltd.

Electromotors, Ltd., has upon its stand a 3-h.p. compound wound motor for operation on 110 volts at 960 r.p.m. The speed of this machine can be raised 25 per cent. by shunt regulation, and decreased 33⅓ per cent. by series regulation. A drum type controller designed to give unlimited "inching" and to control the speed is used to demonstrate the capabilities of the motor. The other machine shown is also a compound wound motor of 4½ h.p. at 630 r.p.m. The speed is capable of increase up to 950 r.p.m. by shunt control. An "Igranic" control panel is connected to this machine; this panel comprises a compound hand-operated series and shunt regulator and automatic starter with dynamic braking. The bulk of this firm's exhibit, however, is to be found in actual use upon the stands of other firms. Its motors are driving machinery for the following exhibitors: Geo. Mann & Co., Ltd., Furnival & Co., Ltd., Miehle Printing Press & Manufacturing Co., Ltd., W. H. Lockett & Co., and Crosland, Ltd.

The Swedish General Electric, Ltd., displays several types and sizes of motors suitable for printing works. The d.c. motors shown include three of the "K" type, shunt wound, interpole, variable speed machines. These have a normal speed range alteration of 50 per cent. by shunt adjustment. The sizes shown are 1 h.p., 1,250 r.p.m.; 2 h.p., 1,000 r.p.m., and 4½ h.p., 480 r.p.m. The exhibition supply is d.c., and for the operation of its a.c. machines, the company has installed a motor-generator set of 15 kVA capacity, converting the d.c. supply into a.c. at 400 V; the set operates at 1,000 r.p.m. Three examples of "Century," single-phase, self-starting, repulsion-induction motors appear on the stand; these are of .25, 1, and 5 h.p. operating at 970, 1,460, and 1,460 r.p.m. respectively. A single-phase 5 h.p. reversible lift motor with controller is also exhibited. The three-phase machines include a 10-h.p., 960 r.p.m., slip ring motor, and a 2-h.p. squirrel cage motor working at 1,410 r.p.m. The *pièce de résistance* of the exhibit is a three-phase commutator motor giving from 10 to 30 h.p. at speeds ranging from 350 to 1,050 r.p.m. (fig. 1). The simplicity and reliability of the induction motor have led to its adoption to a very great extent, but its economical speed regulation has proved a difficult problem. Regulation by means of resistance in the rotor circuit has been employed almost exclusively for some speed changes. For larger ranges of speed the a.c. is either converted to d.c. or tandem motors or multispeed motors with windings for two or more sets of poles can be used. In the type of variable speed motor exhibited, which was designed by Mr. H. K. Schrage, a Swedish engineer, the primary winding is placed on the rotor and the secondary winding on the stator. The motor also has a regulating winding, which is similar to a d.c. winding, with a commutator, and which is placed in the same slots in the rotor as the primary winding. The speed of the machine is changed by the introduction of a boosting or "bucking" voltage into the secondary winding. This voltage is taken from the regulating winding by means of the brushes on two separate rocker arms which are adjustable in relation to one another. The auxiliary voltage is varied by shifting the

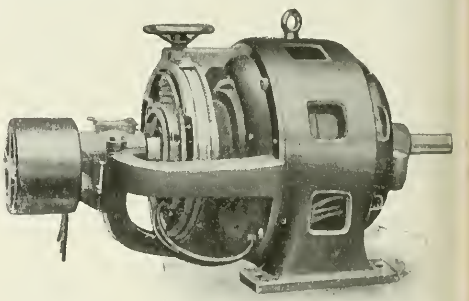

Fig. 1.—Swedish G.E. Commutator Motor.

brushes, and in this way the speed of the motor is varied in the same proportion. The brush rocker arms are furnished with geared segments, and are shifted by means of a pinion and handwheel. For the larger sizes this gear can be driven by a small auxiliary motor mounted on the top of the machine. The advantages of this commutator motor are that it can be started without rheostats with the brushes in the starting position, when the motor will run at about one-third maximum speed; regulation can be made while the machine is running under load, and the motor can give constant torque at any speed. The power factor at the highest speed is between .95 and unity.

Messrs. W. Canning & Co., Ltd., show apparatus for the electro-deposition of metals, &c. A motor-generator set shown has an input of 12 A at 220 V, giving a current of 250 A at 6 V. Plating dynamos of very strong construction are exhibited; one of these gives a current of 2,000 A at 6 V, and the others range down to a small sized machine with an output of 100 A at the same voltage. A special vat for depositing copper on cylinders is exhibited. This is fitted with gear to revolve and burnish the cylinder, while deposition is taking place. Other exhibits are resistances and shunts with brush contacts, vats for electrotype and for nickel facing stereos, &c.

Messrs. A. W. Penrose & Co., Ltd., in addition to printing and composing machines, show "Sunray" vertical arc lamps for photographic reproduction, giving a diffused powerful white light. A vacuum printing frame shown is fitted with a small exhausting motor pump. Vertical arcs for photographic purposes are also exhibited by Pictorial Machinery, Ltd.

Messrs. William J. Light & Co., Ltd., exhibit also for the Swiss firm Winkler, Fallert et Cie. This exhibit includes a number of machines operated by electric motors. A number of metal melting and casting machines are electrically heated. Among these are a rotary matrix drying drum, a flat casting box, and a linotype melting pot fitted with an automatic temperature controller.

Messrs. Witton-James, Ltd., have an exhibit comprising all types of equipment for variable speed driving with full automatic or semi-automatic control. A complete 30-h.p. motor equipment for driving rotary wet presses and calenders is shown. This consists of main and auxiliary motors. The set is put into operation by first starting up the auxiliary motor which rises to full speed when it is cut out by the action of a centrifugal clutch, and the main motor is then driven straight from the mains. The ease with which speed can be varied by a motor-driven sliding resistance, controlled by push-button equipment, is very marked. The push-button arrangement permits starting and speeding up, stopping and slowing down, as well as inching, and the interval of time elapsing between the pressing of a button and the result is hardly appreciable. By connecting up several of these push-button equipments in series the pressing of a safety button prevents the starting up of any machine in a set. A 20-h.p. "Kingsbury" variable speed motor is exhibited. This is also fitted with push-button control, allowing the machine to be operated at any speed from a slow crawl to a high maximum. The motor operates at maximum efficiency from half to full speed. A self-contained linotype machine shown is a very compact piece of apparatus. The motor is started up when the operator takes his seat by the lifting of a flap with his knees. When the operator rises the flap falls and switches the motor off. This equipment obviates the running of a large motor when only a part of the plant is required to be used. The patent electro-magnetic reel brake system shown maintains a constant web tension whatever the size of the roll of paper. The over-running of a reel is prevented by an electro-magnetic brake. The rest of the exhibit is composed of small jobbing press equipments and accessories of various kinds.

The Igranic Electric Co., Ltd., is not exhibiting separately, but its control equipment appears on a number of stands where printing machinery is shown running. For small direct current motors, from ¼ h.p. to 2 h.p., type No. 105 counter e.m.f. type, self-acting motor starter is installed. This is designed and intended to supply the need for a comparatively inexpensive automatic starter for such machines as guillotines, croppers, boring boxes, &c. It is provided with a single pole "clapper" type main switch with magnetic blow-out, and a single step of starting resistance which is automatically cut out by a second "clapper" switch when the motor has reached approximately half normal speed. The motor is started and stopped by simply pressing a button located in a convenient position on the machine. For starting and controlling the speed of electrically-driven flat-bed printing presses, the "Junior Universal" panel (fig. 2) has been widely adopted. This type of panel is made in standard sizes from ¼ h.p. to 3 h.p. The panel comprises the following: A self-acting starter of the solenoid multiple-finger type. The fingers are mounted on a revolving shaft which is operated by a solenoid and timed by an adjustable dashpot. To start the motor the fingers make contact in succession, each cutting out a section starting on full field. A shunt field regulator with 15 contacts and an external operating handle is provided to give any desired speed range. A magnetically-operated circuit breaker or "clapper" switch is interlocked with the starter in such a manner that the circuit is always closed and opened on the circuit breaker contacts and not on the starter contacts. This feature is particularly important where inching is practised. A powerful magnetic blow-out disrupts the arc. A double pole main switch for external operation isolates the starter and regulator when in the "off" position. The whole of the switchgear is contained in a totally enclosing cover with drip-proof ventilating hood and cable intake. The front and sides are easily removable, leaving the switchgear and resistance fully exposed for examination or cleaning without the necessity of disconnecting the panel or taking it down. For flat-bed machines requiring more than 4 h.p. the No. 250 "Universal" control panel is being used. This type of panel embodies the same features as those described in the case of the "Junior Universal" panel. The current carrying parts, however, have an increased capacity, and the multiple finger type starter is replaced by a solenoid-operated contact lever which moves over a number of renewable copper segments. The control panels are usually fixed on the wall or an adjacent pillar; the only portion actually on the printing press is an appropriate push button or master switch.

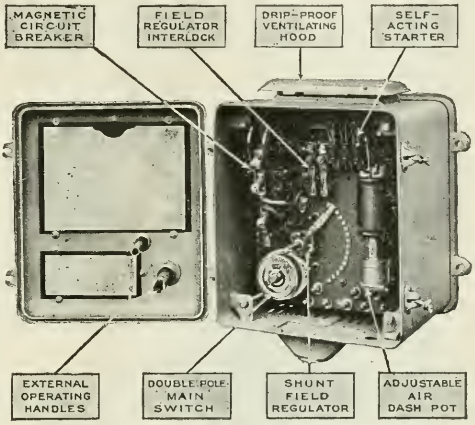

Fig. 2.—Igranic "Junior Universal" Control Panel.

Messrs. Fry's Metal Foundry, Ltd., show a number of metal melting pots each equipped with a Foster pyrometer connected up to a central indicating instrument. Among other firms exhibiting may be mentioned Messrs. Gilbey & Herman, printing ink manufacturers, who have their stand illuminated by means of the Sheringham daylight lamps and reflectors, and Messrs. Thomas & Bishop, Ltd., who exhibit "Cling Surface" belt dressing and Gale's commutator compound for the prevention of sparking.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Shadowless Lighting.

A recent issue of the *Scientific American* describes a device invented by a Frenchman, M. Verain, for giving a light without shadows in such situations as surgeries, operating theatres, &c., where shadows must be entirely eliminated. A gasfilled high-efficiency incandescent lamp is placed in a cylindrical lens cell of the same general design as the lenses of the usual mariner's lights. This lens system serves to project the rays of light sideways, where they come into contact with 50 mirrors arranged as sectors around the inside of a large metal bowl reflector. These mirrors are tilted at such an angle as to throw the reflected beams of light downward, thus forming a concentrated circle of light. The area of this circle of light may be increased or decreased by varying the distance between the light source and the surface on which the rays are concentrated; and as the light is reflected from 50 mirrors, if the surgeon's hands or instruments cut off part of the rays there are others that are not cut off, and thus supply the required illumination.

Oil Burner for Steam Boilers.

Messrs. Alexander Duckham & Co., Ltd., have recently circularised electricity works engineers, pointing out that there is plenty of fuel oil in the country, and it appears that the only obstacle to substituting it for coal in this emergency is the supply of burners. They therefore think it will interest station engineers to know that they make their own burners in a few hours out of ordinary iron pipes, at the cost of some

10s. each, without valves or flex, and find them as good as any proprietary burner that they have tried. The accompanying illustration (fig. 3) shows the construction of the burner. As to the furnace, in an emergency a rough but quite useful method is to let the burner play on a heap of fire brick; but it is preferable to build a baffle wall across the furnace, preferably chequered with open spaces, say, about 3 in. square. In lieu of a supply tank, a barrel placed a few feet above the level of the burner can always be kept filled by the fireman from the barrels in which the temporary supply is received. The company is not offering fuel oil, as its crude is of far too high a quality; these suggestions are offered simply to help in the present emergency. Notes accompanying the circular give full information regarding the installation and use of fuel oil burners, the kind of oil to employ, &c.

The illustration, with the footnotes, explains itself. We think the thanks of the electrical industry are due to Messrs. Alexander Duckham for their very useful and disinterested advice on this subject.

The "Heatrae" Boiling Ring.

A neat boiling ring has been brought out by Messrs. Electric Fires, Ltd., of King Street, Norwich, which we illustrate in fig. 1. The design is ingenious, and resembles that of the "Heatrae" fires, already described in this column; with the exception of a light cast-iron top-plate, the parts of which are free to expand without fear of distortion or cracking, the whole of the metal parts are pressed or stamped out of thin sheet. By unscrewing a milled nut, which cannot be detached, the bottom plate can be removed; it consists of a plain disk to which is pinned a polished aluminium reflector, the shallow air space between the two serving as an effective heat insulator. The heating spirals are threaded through refractory bridges, as shown in fig. 2, which are held in position by simple means with perfect freedom, but perfect security. By removing another nut, access is gained to the terminals, which are heavily insulated with mica centred by the neat device previously described. The whole of the design is pleasing from the mechanical and electrical points of view, and in operation the ring is very satisfactory, heating up quickly to a red heat. A sample which we have been using is rated at 1 kW and has proved both convenient and effective.

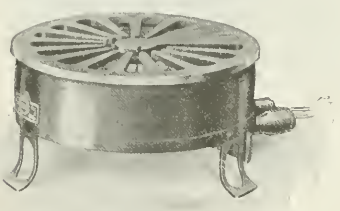

Fig. 1.—"Heatrae" Boiling Ring.

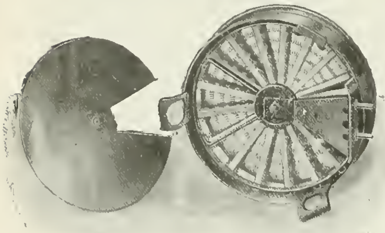

Fig. 2.—Bottom Removed, showing Heater.

A Foreigner's View.—A Dutch visitor writing to the *Newcastle Daily Journal*, expresses surprise that such a great coal-producing country as England should allow its biggest asset to be so shamefully wasted. He asks;—"What is it that has held this country back from adopting modern methods of power, lighting and heating? Engineers the world over are agreed that electricity is the most economical power that can be produced from coal, and yet in England its development seems strangely slow.

"I do not wish to boast particularly about my own country, but I cannot help mentioning the fact that practically every house in Amsterdam has electric light, and a very large number of them rely upon electricity for heating and cooking."

LEGAL.

The Nash Fish Hydrophone.

(*Concluded from page 603.*)

When the case was resumed on May 3rd, Mr. Nash went into the witness chair, and Mr. Gray asked him if he was personally familiar with the hunting of the submarines by the "Nash Fish."

Witness replied that he was, and in reply to the Chairman he said he had made about 100 trips. He did not think the submarines went more slowly or less noisily as the result of his fish.

Mr. Gray then questioned the witness as to his out of-pocket expenses in perfecting his fish, and Mr. Nash said he thought it would be about £3,000.

Sir Arthur Colefax asked witness if it was true that the Admiralty offered him a salary. Witness said that was so, but later on Capt. Fisher withdrew it.

Sir Arthur Colefax said Capt. Fisher had no authority to withdraw it, and asked witness if it was not true that he wrote stating that he wanted no salary, and that it was an honour to him to be engaged on such work. Witness replied that that was so.

Mr. R. A. Mack, one of the claimants, gave evidence as to a visit he made to Scotland in May, 1916, for experimental purposes.

Mr. Heath Brown said that in March, 1917, he was chief technical expert attached to the anti-submarine division. The Admiralty had a directional hydrophone which would be capable of dealing a serious blow to the submarine menace provided there was not the trouble of the water noise. He told Mr. Nash that if he could succeed in solving the problem of the water noise he would probably be of some use. Witness went to Poole, and Mr. Nash took him in a motor launch, behind which the "fish" was towed. The test was sufficient to show him that the water noise had been eliminated without any loss of sensitiveness. No one had up to that time, to his knowledge, solved the difficulty. He suggested to the Admiralty that fifty of the "Nash Fish" apparatus should be ordered for service at once. He came to the conclusion that the "Nash Fish" apparatus was by far the most successful device for chasing submarines during the war. After the "Nash Fish" had been accepted they had the "Porpoise" device and the American "K-tube" device. These, however, were not in use until many months after the "Nash Fish."

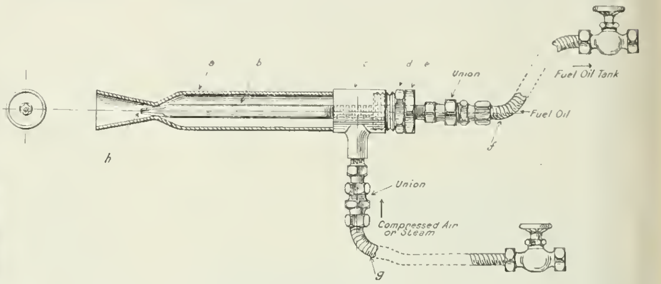

Fig. 3.—Improvised Oil Fuel Burner, Part Section.

a, $1\frac{1}{4}$-in. steam pipe swaged down to neck about $\frac{5}{8}$ in. internal diameter. *b*, $\frac{1}{2}$-in. steam pipe, drawn out to jet $\frac{1}{4}$-in. internal diameter. *c*, $1\frac{1}{4}$-in. × $\frac{1}{2}$-in × $1\frac{1}{4}$-in. steam tee. *d*, $1\frac{1}{4}$-in. × $\frac{1}{2}$-in. bush. *e*, Locknut, permitting axial adjustment of jet to neck of outer tube. *f*, Flexible connection to oil-fuel tank. *g*, Flexible connection to compressed air or steam supply. *h*, $\frac{1}{4}$-in. jet, externally fluted to centre in the neck without closing it.

Capt. Humphrey Walwyn said he was Assistant Director of the Anti-submarine Division of the Admiralty, and in that capacity was acquainted with the devices for defending our ships against the German submarines. There were several devices in use, but none of them could detect a submarine from a moving vessel. In January, 1918, he was ordered to take the command of the whole northern control, and he found that the "Nash Fish" was the only device that could locate and follow a submarine, although it was disappointing at times. Witness had been in many extraordinary submarine hunts, and the longest he remembered occupied some eighteen or twenty hours.

The Chairman: Quite apart from the "killing" of a submarine, is the hunt of value?

Witness: Undoubtedly. After a submarine had got through the barrage it was not quite so happy when it went back.

Lieut. Chas. Dickson Seropian said he was in six hunts altogether. He found the "Nash Fish" system very satisfactory for hunting submarines. His machine picked up the noise of a submarine eight miles away. He claimed that he sank two submarines. He was perfectly certain he sank one.

Other witnesses were called for the claimants, and all stated that the "Nash Fish" was the most efficient apparatus for detecting submarines.

Sir Arthur Colefax opened the case for the Admiralty by first calling evidence.

Mr. Louis Chas. Bernacchi said he was appointed to the Anti-submarine Division of the Admiralty, and he thought the "K-tube" appliance was better than the "Nash Fish."

The Court adjourned until Monday, May 9th, when the hearing was resumed. Mr. Bernacchi said he did not think there was any ground for thinking that because of the "Nash Fish" the Germans were forced to make their submarines less noisy.

Commander Sawbridge, of H.M. Navy, said he joined the submarine section of the Admiralty in April, 1918. He knew that a large number of trawlers were ordered to be equipped with the "Nash Fish," and that it was a very expensive apparatus. There was a terrific menace then, and any measures taken would have been justified, however expensive they might be.

Commander H. I. R. Trischler, R.N., one of the Director's assistants for anti-submarine duties in connection with the Admiralty, said that in a report of the trials it was stated that the "Nash Fish" was well designed; he thought it was defectively designed, and was a totally misleading device.

So far as the electrical method is concerned of turning a hydrophone in the fish, is that novel in principle?—In all our fire-control instruments we practically have the same idea.

As far as I can make out the "Nash Fish" equipment cost something between £500 and £700?—I have the amounts per trawler. I should say about £850 is the average.

Cross-examined by Mr. Hunter Gray, witness said he did not think the "Nash Fish" was of any value at all.

Were you more in favour of the porpoise?—No, I hold no brief for the porpoise; that appliance failed as badly as the "Nash Fish."

Commander Turle, D.S.O., said he had had considerable experience in the hunting of enemy submarines during the war. Compared with the S.C. tube the "Nash Fish" was unfavourable in calm weather and favourable in rough weather. At one time he thought the "Nash Fish" would succeed where the S.C. tube failed, but he found ultimately that it was less reliable than the S.C. tube.

Cross-examined: The "Nash Fish" gave a lower percentage of false bearings than other devices.

Mr. Eric B. Hughes, who took part in a number of submarine hunts, said his experience of the "Nash Fish" was that it was unreliable. The greatest trouble was the breakage of the wires. The S.C. tube was more reliable as to accuracy of bearings.

Commander Farquharson, who is now in command of the Anti-Submarine School at Portland, said that at times he found the "Nash Fish" satisfactory, but it gave bearings which were quite unreliable, and the submarine was often in the opposite direction to that given by the "Nash Fish." There was considerable cable trouble. On the whole, he did not consider the "Nash Fish" satisfactory.

Lieut. F. M. Symon also considered that the "Nash Fish" was unreliable.

At the close of the evidence Sir Arthur Colefax addressed the Commission. He said he had given Mr. Nash the credit of being industrious and ingenious, and he had not said that Mr. Nash should not receive any consideration for the work he did. But this was a grossly exaggerated claim. It started as a claim for a quarter of a million of pounds, and Mr. Hunter Gray reduced it to £100,000. It was all a question of amount. Mr. Gray opened the case as if the submarine menace was defeated by this invention. It was nothing of the kind. It played a small part, and nothing more than that, in meeting the submarine menace. It was no better than the other devices, if as good. He contended that no submarine was destroyed by the "Nash Fish." The cables and the electric appliance gave trouble, and it was not a practical device. He suggested that something in the neighbourhood of £1,000 would be a proper award in this case.

Mr. Hunter Gray, K.C., on behalf of the claimants, submitted that the evidence had clearly proved that the most powerful factor in dealing with the German submarine menace was the "Nash Fish," and it took a most important part in reducing the losses in the national shipping. When he opened his case he mentioned £100,000 as the amount of the award that should be made, and he submitted that that was about the right figure.

The Chairman said Mr. Gray had submitted one basis on which the Commission should fix their award, but there was another way, and that was to give five or ten per cent. on the amount which the Government had expended in connection with the invention. The Government had spent £175,000 on this invention.

Mr. Hunter Gray said he did not agree with the chairman that his suggestion should apply in this case.

This closed the case, and the Commission will make their award in due course.

Mate *v.* The Vulco Magneto Co.

In the King's Bench Division, before Mr. Justice Bailhache on Monday, Gordon Harold Mate, of Lee, Kent, brought an action against the defendant company, of Long Acre, London, claiming £3,500 damages for alleged breach of contract.

Mr. Le Quesne, for the plaintiff, explained that there was a contract between the parties by which the defendants agreed to sell to the plaintiff 500 Bosch magnetos at 9 guineas each. They were to have been delivered within 14 days, half of the number to be shipped to the United Kingdom within seven days. Those arrangements had been confirmed by the defendants. As a matter of fact, counsel continued, no magnetos had ever been delivered, and defendants, in answer to the claim, had raised a curious defence. They claimed to have the contract rectified on the ground that it was contained, not only in the document in dispute, but in several other letters, some of which really did not pass between the parties to the action. They further contended that the contract was partly verbal. The matter began in a sale of 500 magnetos by the defendants to the Brompton Motor Co., who in turn sold them to the plaintiff. Some trouble arose because the defendants wished to alter the terms of their agreement with the motor company. Plaintiff was asked whether he would accept the alterations, but refused. The motor company then declined to go further with the matter, and the direct contract between the plaintiff and defendants was the result. The plea for rectification, commented counsel, was really an attempt to read into the contract some correspondence which passed between the motor company and the defendants. The two terms they sought to add were that if they failed to carry out their contract they should suffer no further penalty than cancellation, and that the plaintiff should give a certificate showing that the magnetos were for commercial use only.

His Lordship, giving judgment, held that as there was really no market for the magnetos, plaintiff was only entitled to the loss of profit he would have made had the goods been delivered. He therefore gave judgment for £400 with costs.

Electrical Appliances, Ltd., *v.* Mallis.

The Lord Chief Justice, in the King's Bench Division, on May 3rd, heard an action by plaintiffs against one Mallis, a former employé, and his wife, in which an injunction was sought to restrain them from continuing libellous conduct.

Mr. Maddocks, appearing for the plaintiff company, said his clients sold a vacuum cleaner manufactured by the Eureka Vacuum Cleaner Co., of America, and the defendant Mallis was in 1915 employed by them as traveller, and was given North-West of London to travel in. After a time he expressed a desire to have the South-Western district instead, but was told that the change could not be made. He thereupon wrote a circular letter to the trade houses stating that he was about to sever his connection with the plaintiff firm because there was trouble with the staff. Then Mrs. Mallis, the defendant's wife, went to plaintiffs' offices, and bursting in upon a director, abused him until he threatened to send for the police. She subsequently wrote a letter to the Eureka Co., accusing plaintiffs of dishonourable conduct. She compiled a book descriptive of them which she published and sent to Harrods, Whiteleys, and other big firms. The book was also circulated amongst the plaintiffs' staff. She wrote: "I regret I am unable to requisition the Salvation Army band to take up its stand outside your office to play 'Lead, Kindly Light.'" She also obtained placards some feet in length upon which appeared words imputing dishonourable conduct to the company, and challenging them to bring her to justice. With this placard she paraded up and down the street outside plaintiffs' Oxford Street premises. She had a photograph taken of herself carrying the placard which she sent to the Eureka Co. Under the circumstances the only thing the plaintiffs could do was to apply for an injunction to restrain the defendants from continuing their course of conduct. The injunction had been granted, and he (counsel) had seen counsel for the defendants, and had been told by him that Mrs. Mallis was carried away by her feelings because she thought her husband had been badly treated. It was useless to ask for damages, and if defendants would give an assurance not to repeat the libellous statements and annoying conduct that would end the matter.

Mr. Harnay, K.C., for the defendants, said that his clients were prepared to give such an undertaking, to apologise for the annoyance which they had caused the plaintiffs, and to agree to a continuance of the injunction.

His Lordship agreed to the action being settled upon these terms

Application for Cancellation of Indentures.

On May 5th a local electrical engineer applied to the Sutton Police Court for a summons for the indentures of three apprentices to be cancelled. He stated that the period of the indentures was five years. After the boys had served for two years their trade union demanded that the pay of the boy over eighteen years of age should be increased to 39s. per week, and that of the other two to 31s. per week. The engineer refused to accede to this demand, and as a consequence the union withdrew the boys from his service, and the other employés also ceased work. A further threat was that the union would order its men to refuse to connect up to the electricity supply any installation carried out by the applicant. He had given notice to the apprentices to return, but they had taken no steps to do so.

The summons was accordingly granted.

BUSINESS NOTES.

Bankruptcy Proceedings.—G. Dolby, electrician, Great Grimsby.—Last day for proofs for dividend, May 21st. Trustee, Mr. J. F. Wintringham, St. Mary's Chambers, Great Grimsby.

George Edwin Leigh Wynne, trading as the Amalgamated Trading Co., 44, Surbiton Road, Kingston-on-Thames. The following are creditors herein :—

Enfield-Ediswan Cable Works, Ltd.	£100	Electric Supplies Co., Ltd.	£80
Ediswan Electric Co , Ltd.	20	Freeman Electric Co.	18
Visible Writing Machine Co.	90	Simplex Conduits, Ltd.	60
Driver, Drennan & Cooper, Ltd.	145	Sun Electrical Co., Ltd.	40
Rylands & Sons	20	Notable Electric Co., Ltd.	20
Pawsons & Leaf, Ltd.	25	Warren, V. C. H.	55
International Electric Co.	25	Pooley & Austin	30
L.P.S. Electric Co.	50	Stevenson & Rush, Ltd.	12
Grey, M. C.	120	Lancaster Engineering Co.	20
Hogg, S.	50	Electrical Conduits, Ltd.	15

L. P. Howse & G. H. B. Snell (Howse & Snell), electrical engineers, 6 and 8, Duke Street, Margate, Kent.—The public examination of these debtors was held recently at the Guildhall, Canterbury. The Official Receiver stated that the statement of affairs compiled by the debtor Snell showed liabilities of £1,873, while the net assets amounted to £623, or a deficiency of £1,250. It appeared that debtors commenced business in partnership after serving in the Army. Howse looking after the outside work, and Snell the books. Howse possessed no capital, but Snell provided a small sum, while his father advanced £50 in December last, and guaranteed an overdraft of £250 at the bank in March. At first they were successful, but their work consisted to a large extent of installation work, and they lost money over it. They were questioned with reference to certain people who were said to be partners, and the examination was adjourned.

F. E. Padmore, electrical contractor, Marlborough Road, Nuneaton.—Receiving order made May 6th, on debtor's own petition. First meeting May 19th, public examination June 13th, both at Coventry.

W. A. Davis, electrical engineer, 14, Basinghall Street, Farnley, Leeds.—Receiving order made May 5th, on creditor's petition.

S. Beckett, Jun., electrician, Bolton.—First meeting, May 24th, at the Official Receiver's offices, Byrom Street, Manchester ; public examination June 15th, at the Court House, Bolton.

A. J. Harrison (Xtra Lighting Co.), electrical and gas engineer, 4, 5 and 6, Old Market, Sunderland.—First meeting, May 18th ; public examination, May 19th, both at Sunderland.

Company Liquidations.—Pinkney & Forster, Ltd., electrical engineers and contractors, Newcastle-on-Tyne.—A meeting was held, Mr. Leslie Brown presiding, at which a statement of affairs was submitted showing a surplus of assets over liabilities. It was resolved to confirm the appointment as liquidator of Mr. Leslie Brown (Messrs. Stephenson, Smart & Co., incorporated accountants, Saville Row, Newcastle). A committee of inspection was appointed.

T. Emery's Automatic Power Generating Motors, Ltd.—Meeting called for June 6th, at 18, Adam Street, Strand, W.C., to hear an account of the winding-up from the liquidator, Mr. C. Pillow.

Submarine Motor Ship Cleaner.—First meeting of creditors and contributories May 19th, at Carey Street, W.C.

Dissolution of Partnership.—J. K. Cotton & Co., electrical engineers, 2, Water Street, Rochdale.—Messrs. F. W. Brierly, J. Sugden, A. D. Wickham, and A. Taylor have dissolved partnership. Messrs. Brierly, Sugden, and Wickham will continue the business under the same style.

Trade Announcements. — Mr. Edwin O. Chadwick has resigned his position as manager of the electrical department of Messrs. Strode & Co., after 17 years' service with them, to join Mr. Ernest Withers in the business of Waring and Withers. The style of the firm is now Messrs. Waring, Withers & Chadwick.

The Kent Electric Power Co. has transferred its offices and wiring department showrooms from Railway Street, Chatham, to 240, High Street, Rochester.

The Ivor Electrical Co., Ltd., has removed to 56, Red Lion Street, Clerkenwell Road, E.C. 1. New telephone number : "Clerkenwell 3663."

Messrs. Pettigrew & Merriman, Ltd., have removed from 7, Henrietta Street, Covent Garden, to 122-124, Tooley Street, London Bridge, S.E. 1, where they will give trade demonstrations of the "Select-o-phone" automatic telephone system. Telegrams : "Merrigrew, Tooley, London" ; telephone number : "Hop 134."

Mr. John Russ, of Maiden Lane, W.C. 2, asks that in future all communications should be addressed to him at St. Andrew's Works, Dunsmure Road, Stoke Newington, N. 16.

Catalogues and Lists.—Messrs. Hay, Maryon & Co., Ltd., 14, Bride Lane, Ludgate Circus, E.C., 4.—An extremely well-produced catalogue of water-power plant. The list deals comprehensively with all parts of the hydraulic side of hydro-electric machinery, and the illustrations of Pelton wheels, turbine runners, valves, pipe details, &c., are very good, and the descriptions full and lucid.

Economic Electric, Ltd., 10, Fitzroy Square, W. 1.—"Wireless Catalogue" (28 pages). This is a very comprehensive list, giving prices and illustrations of all kinds of wireless apparatus—tuners, valves, detectors, condensers, resistances, instruments, &c.

The Newman Electrical Co., 64, Newman Street, W. 1.—An illustrated price-sheet of "Nuco" artistic alabaster bowl fittings in various finishes ; also Schedule "C," giving revised prices of electrical accessories, including switches, fuseboards, lamp-holders, adaptors, heating apparatus, &c.

Mr. Walter Balmford, "Electric House," Whittall Street, Birmingham.—Two illustrated leaflets descrbing the "Scot" lampholder and shade carrier ; also a pamphlet describing the "British R.B." small lighting set.

Carron Co., Carron, Falkirk, N.B.—An illustrated price-list of 14 "Carron" fires in various sizes and finishes.

Swedish General Electric, Ltd., 5, Chancery Lane, W.C. 2.—An illustrated descriptive pamphlet dealing with three-phase commutator motors.

The General Electric Co., Ltd., Magnet House, Kingsway, W.C. 2.—Two show-cards dealing with low-wattage gasfilled lamps.

The company has just issued its Bulletin No. 9, "Rotary Converters," describing in detail the characteristics of the machines made in the company's works. The introduction gives general information on rotary converters, including such items as power factor correction, commutation, armature heating, &c. Section II deals with voltage regulation by reactance, and a.c. booster control. Starting and synchronising are covered by Section III, which includes notes on running the converters in parallel. In Section IV the design is described, and full particulars of the component parts are given. Rotary converter sub-stations are dealt with in the last section, and equipment and lay-out are illustrated. The illustrations throughout are very clear, and the publication is another example of the excellence of modern advertising.

Messrs. Lacy-Hulbert & Co., Ltd., 91, Victoria Street, S.W. 1.—List E L B 4. An illustrated and priced pamphlet describing the "Boreas" patent portable electric blower.

Messrs. Thomas Meadows & Co , Ltd., 10, Errol Street, Whitecross Street, London, E.C. 1.—Circular relating to packing cases specially designed to prevent pilferage.

Messrs. Watson & Sons (Electro-Medical), Ltd., Sunic House, Parker Street, Kingsway, W.C. 2. Bulletin 36 S, describing a portable transformer unit for X-ray work ; illustrated and priced.

Summer Sports.—The Tennis Section of Tucker's Athletic and Recreation Club (J. H. Tucker & Co., Ltd.) commenced the season on Saturday last, in glorious weather. The opening ceremony was performed by Mrs. T. R. Martin, supported by Mr. T. R. Martin (joint managing director), Mr. S. R. Davies (production manager), Mr W. Y. Smith, Mr. H. W. Rodgers, Mr. C. H. Walker, Mr. W. A. Wood (hon. sec., Tennis Section), and Mr. H. Pratt (general secretary). Apologies for absence were received from Mr. and Mrs. J. B. Tucker and Mr. Tranter, who wished the club a successful season, and hoped to be present at some future date. The first tournament takes place on Saturday next.

On Saturday last, Pope's Electric Lamp Co. opened their cricket season with a game against Osram Second XI at Wood Lane, and won by 54 runs, Pope's scoring 139 and Osrams' 85. For Pope's, F. Bryant was successful with both bat and ball, scoring 70 and taking 3 wickets for 41 runs, while Mr. Kenneth Pope got 28 runs and took 3 wickets for 33 runs ; Chelsom took 2 for 15.

Electricity Supply Rifle League.—The following are the results of the April matches :—Brompton 558, Hackney 557 ; St. James's 535, Hackney 538 ; Central 559, Hackney 552 ; Hackney 538, Fulham 521 ; Brompton 530, Fulham 479 ; City Co. 561, Brompton 543 ; Brompton 551, County Co., 530 ; City Co. 564, County Co. 526 ; City Co. 572, Shoreditch 571. The City Co. now heads the list with 10 points.

Failure of Compulsory Arbitration in Norway.—The Norwegian Government has decided not to renew the "provisional" Compulsory Arbitration Act, which has been in force since 1916, learns the *Daily Intelligence* of the International Labour Office. It was passed in the autumn of that year largely in order to deal with widespread disputes in the engineering, mining, and superphosphate industries, the introduction of such a measure having been the subject of agitation ever since 1909. The Act was renewable annually, and the period expired on April 1st. The decision to allow it to lapse was largely due to its unsatisfactory working in the conflicts of the past year.—*Daily Telegraph.*

The Future of Dutch Industries.—In an interview, Mr. Philips, of the Philips Incandescent Lamp Co., at Eindhoven (Holland), declares that in the long run Dutch industries will not be able to compete with the German producers if the demands of the German working men remain at the present low level. It will not only become necessary for the manufacturer to reduce the profits, but at the same time the Dutch working people must bring their living standard down to a lower level in order to prevent greater unemployment.—*Times Trade Supplement.*

Copper and Lead Prices.—Messrs. F. Smith & Co. report, May 10th :—"Copper (electrolytic) bar sheets and rods and h.o. wire, no change."

Messrs. James & Shakespeare report, May 11th :—"Copper bars (best selected), sheet and rod, £114—£2 decrease ; English pig lead, £25—30s. increase."

Book Notices.—"Electric Arc Welding." (26 pp.) Special Publication No. 7,783/2 of the Metropolitan-Vickers Electrical Co., Ltd., Manchester.—This is an example of modern publicity in which advertisement is combined with technical facts. The introduction is a comparative survey of the several methods of welding in which the utility and efficacy of the electric arc for this purpose are emphasised. The many applications of this type of welding are then enumerated, showing how it enters into every department of engineering. Notes on materials and impurities found in them and their effects are next dealt with. Then the method of procedure is explained, and particulars of electrodes, current strengths, speed and power consumption, are given in tables. The necessary electrical equipment is described in detail, and accessories are also included. The illustrations are particularly good, and bring out the points of the text very clearly.

"Aluminium Bus-bars and Connections" (16 pp.). Publication No. 171B of the British Aluminium Co., Ltd.—Although a trade publication, this pamphlet is an attempt to give an uncoloured survey of the advantages obtainable by the use of aluminium in power stations. Economy is, of course, the keynote, the other points of the superiority of aluminium over copper for bus-bars being given as :—Greater ease in erection ; less temperature rise for equal conductance, and a considerable reduction in the weight to be supported. The illustrations, with which the publication is liberally endowed, depict various large installations of aluminium bus-bars, including those installed at Birmingham, which form a splendid example of the work. Several tables are embodied in the brochure giving particulars of the current-carrying capacity, resistance, and other characteristics of various sizes of aluminium bars and connections.

"London Chamber of Commerce Thirty-Ninth Annual Report of the Council and Transactions of the Year 1920."

"*Journal* of the Institution of Electrical Engineers." Vol. LIX, No. 298. February, 1921. London : E. & F. N. Spon, Ltd. Price 10s. 6d. This issue contains the address to the Students' Section by the President.

"Electrical Handling of Materials." Vol. II. Structural Work. By H. H. Broughton. Pp. xiv + 292 ; 358 figs. London : Benn Bros., Ltd. Price 25s. net.

"Electric Welding." By E. Viall. Pp. xii + 417 ; 329 figs. London : McGraw-Hill Publishing Co., Ltd. Price 22s. net.

"Heating Systems : Design of Hot-Water and Steam Heating Apparatus." By F. W. Raynes. (Second edition.) Pp. 324 ; 158 figs. London : Longmans, Green & Co. Price 21s. net.

We have received from Messrs. Henry Frowde & Hodder and Stoughton, 17, Warwick Square, Newgate Street, E.C. 4, a list of technical and scientific books published during the present year as well as several in preparation. Prices and particulars are given.

"High-Tension Switchboards." By Henry E. Poole, B.Sc.(Hons.), &c. Pp. 114 ; 22 figs. Also "Electricity in Steel Works." By Wm. McFarlane, B Sc. Pp. 109 ; 21 figs. London : Sir Issac Pitman & Sons, Ltd. Price 2s. 6d. net each. (Pitman's Technical Primer Series.)

Technologic Paper No. 170 of the U.S. Bureau of Standards, "Pyrometric Practice." Pp. 326 ; 185 figs. Washington : Government Printing Office. Price 60 cents.—In this publication a complete treatise on the practical phases and applications of pyrometry is presented. All general methods of measurement, instruments and use and standardisation of apparatus are discussed. The paper is illustrated with photographs of modern American instruments. Many tables are included, and the treatise contains an index for ready reference.

Westinghouse Co. in Argentina.—A Government Decree authorises the Sociedad Anonima Compania Westinghouse Electric Internacional, constituted in Wilmington, U.S.A., on May 21st, 1920, to establish a branch or agency in Argentina.—*Review of the River Plate.*

Zinc.—Mr. Hoover has announced that the Department of Commerce will undertake surveys of conditions in the zinc markets of the world. He added that he did not know what could be done to help the present unfavourable situation in the United States, but it was hoped that the surveys would disclose where American zinc could be most profitably exported.—*Reuter's Trade Service* (Washington).

International Rubber Exhibition.—The fifth International Exhibition of Rubber, Other Tropical Products and Allied Industries, will be held at the Royal Agricultural Hall from June 3rd to June 17th. Sir Owen Philipps, M.P., is the hon. president, and Mr. H. Greville Montgomery is organising manager. Already 40 British and foreign countries, and over 50 associations and firms have secured space. The exhibits include rubber manufactured articles, reclaimed rubber, compounding ingredients, machinery, and appliances, &c. International congresses will be held dealing chiefly with the rubber industry.

Iron Castings.—The Birtley Iron Co., of Birtley, announce that special arrangements have been made to keep their foundries at work during any prolongation of the coal strike, supplies of pig iron and coke being assured. They are making turbine, colliery, and other castings up to 30 tons weight.

Australia and Trade with Germany.—*The Times* Melbourne correspondent reported on May 6th that it was stated in the House of Representatives that all restrictions on exports, including exports to Germany and Russia, had been removed. Imports from Germany are limited to articles such as parts of machinery which are unobtainable elsewhere.

The Coal Dispute.—Upon the whole the electrical industry seems to be carrying on remarkably well in this, the sixth, week of the dispute. Supply undertakings generally are still able to give a restricted output and limited tramway services are still available.

It has been reported in the Press during the current week that a number of well-known electrical and cable manufacturing companies have been discharging thousands of employés owing to the coal situation.

Among the less fortunately placed concerns is the Stalybridge, &c., Joint Tramways and Electricity Board, which has had to suspend the whole of its tramway services, and which, it is reported, is in a precarious position as regards electricity supply. The completion of an oil fuel installation at the Crown Point station of the Leeds Corporation enabled a greatly improved tramway service to be operated. At Nelson the tramways have been shut down, and in Bury a 50 per cent. reduction has been made.

The Birmingham Electricity Supply Department, which, until quite recently, did not consider it necessary to impose any official restrictions, has had to review its position, and restrictions are being made with a view to causing as little dislocation as possible. The tramway services have been reduced by 35 per cent.

On May 4th the Birkenhead authorities were temporarily unable to obtain coal in sufficient quantity to maintain the necessary head of steam for their generating plant. As a result the tramways were suspended for a period of two hours.

At Bradford a deputation representing the tramway employés interviewed the manager with regard to the curtailment of services which had been put into effect. The manager informed them that he was acting upon Government instructions, whereupon the deputation pointed out that the position of Bradford with regard to fuel did not justify such a drastic "cut." The town clerk stated that the Mines Department had powers to take action against the Corporation for any breach of the order. It has been arranged for a large number of the men to take their holidays now in order to avert "standing them off."

In Sheffield the tramway employés have been put on to a day-by-day agreement. Thus, if circumstances necessitate it they may be temporarily suspended. Eight thousand were added to the unemployed list during last week.

On May 3rd the Doncaster Electricity Committee announced that it had secured sufficient coal to run the electricity works for another fortnight.

The L.C.C. tramway services have been cut down a great deal, especially in the outer suburbs. On the "Underground" railways, economy is being effected chiefly by severe "cuts" in the Sunday train services, although the week-day services have also been curtailed. The general arrangement is for a later commencement, and an earlier cessation of services.

In addition to a great reduction in the Halifax tramway services, the electricity supply is being withheld between the hours of 11 p.m. and 6 a.m. The town clerk has been instructed to prosecute firms not complying with the 50 per cent. power reduction order.

The Yorkshire (Woollen District) Electric Tramways Co., Ltd., has adopted the policy of not running any cars before 12.45 p.m., and services are discontinued at 8.30 p.m., with an hour's extension on Saturdays.

The number of unemployed has reached appalling proportions, and it was stated at the beginning of the week that 5,000,000 workers had been directly affected by the stoppage, and that 2,000,000 of these were receiving full unemployment allowances. In London itself the number of people thrown out of work was reported to be upwards of 200,000.

The restricted supplies now being given have necessarily affected industrial concerns severely. All but three departments of the Helsby cable works have been closed. A quantity of coal from the works is being supplied to necessitous people in the district.

Further steps have been taken by the Government to conserve coal. On May 4th the Secretary of Mines issued an order for public lighting to be reduced to 25 per cent. of that employed on the same date last year, in the case of towns with a population of 5,000 or over; smaller towns were ordered to suspend public lighting altogether. Power for tramways and light railways is restricted by the order to 75 per cent. of the normal.

The renewed Order in Council extending for another month the conditions necessitated by the declaration of a "state of emergency," permitted the Secretary of State to institute a further extension of one hour of "summer time." It was decided later, however, that the small amount of fuel which would be conserved in this way did not justify any action in the matter.

A *Times* message dated May 10th said that a detachment of naval electricians and stokers had left Portsmouth that day for London. It was understood that they were detailed for duty at power stations if required.

Members of the E.T.U. at Greenwich refused to handle imported coal and were, therefore, dismissed. The secretary of the union stated that unless the men were reinstated the whole of the electrical services of London might be closed down.

The Glasgow Corporation has ordered large quantities of coal from Canada at the price of £2 18s. 6d. per ton (conditions not stated).

The E.T.U. and Non-Union Installations.—At last week's meeting of the Swansea Corporation Electricity Committee, Ald. Alex. Sinclair (chairman) presiding, further correspondence was read with reference to the intention of the Electrical Trades Union (Swansea Branch) to put in force a list of *bona fide* contractors for wiring purposes. The chairman explained that the law on the matter was distinct that if the wiring was approved by the local authority they were bound to carry out the connection, but the men now came in and said that if the wiring was not done in accordance with the union's regulations then they would not connect up. The Hackney Borough Council had had damages awarded against them by the magistrates before whom it was pleaded on behalf of the local authority that the reason for the default in not connecting up was *force majeure*—an act over which they had no control. The Hackney authority, however, were appealing against the decision.

Ald. Colwill (vice-chairman) pointed out that the Committee conformed to the trade union conditions in every respect, and that was all that could be reasonably expected of it. To expect the committee to watch all the outside contractors would need a little army of inspectors.

The Chairman: It would simply amount to this, that if Mr. Burr, the electrical engineer, not being on the union list of contractors, wired his own house, the union would instruct their members not to connect it up.

It was decided again to reply to the E.T.U. that the Corporation could not be expected to do more than conform to the trade union conditions as at present.

Labour and Production.—Sir Robert Hadfield, Bt., presided on May 4th at a dinner at the Grand Hotel given by the Council of the Iron and Steel Institute to the president, Dr. J. E. Stead. In the course of his speech, Sir Robert referred to the immense services rendered by Dr. Stead to the science of metallurgy, in which his name is and always will be a household word. They had with them, too, that evening the distinguished American metallurgist, Mr. J. A. Panton, whose labours on behalf of the science had been of the highest importance. Proceeding to allude to the present industrial troubles of this country, Sir Robert remarked that Judge Gary, the head of that wonderful organisation known as the United States Steel Corporation, recently stated that there must be reductions in wages on that side of the water. In this respect no one wished to see reductions in the income of our wage-earners less than did he (Sir Robert), but the present fictitious state of affairs, financially and industrially, made it impossible to get on a sound footing until some readjustment first took place. Mr. Panton had pointed out to him—and he wished the Labour leaders would remember this—that on, say, an 80 per cent. or 90 per cent. productive basis, that is in a steel works, for example, it might be possible to earn reasonable profits and pay reasonable dividends, say, a few per cent. The Labour leaders, however, little realised that if this production were dropped, even on a comparatively small scale, overhead charges, which were wages more or less, reared their heads, and what would have been reasonable profit became a serious loss.—*Daily Telegraph.*

The Safeguarding of Industries Bill.—In the House of Commons sitting in Committee on Monday, Mr. Stanley Baldwin, President of the Board of Trade, moved the resolutions for the safeguarding of British industries for a period of five years, which were published in the Electrical Review for April 8th, p. 461. Mr. Baldwin, in the course of his speech, referred to the prevailing unprecedented trade conditions throughout the world, and said that they must watch the exchanges righting themselves by the natural and probably slow process of evolution, but they had to remember that this country would starve if it were not for its industries. The Government did not propose to leave things alone. There was the great danger that if nothing was done there would inevitably come into this country unchecked a flood of foreign goods at prices with which, for the time being, it would be impossible to compete. This would cause a storm of protest from the manufacturing centres which no Government would be able to resist, and the result would be the worst thing in the world—legislation of a panic nature. The speaker went on to refer to the most specific pledges that had been given with regard to something being done for key industries. The list of scheduled industries had been cut down to the narrowest limits, and he believed that every man with a knowledge of British industry to-day would see that they had in the articles scheduled the main things which went to make the scientific foundation of British industry. The prospects of the chemical industry were illimitable, and its development was absolutely necessary in such a country as ours. In that industry, as developed in Germany, and as it was hoped to develop it in this country, there was unlimited scope for brains. In this country our brains were as good as those of any people in the world, and we wanted to lose no opportunity of affording scope for them and making fields in which they could be exercised. In the Bill the support that the Government advocated was limited to five years, because they believed that at the end of that time the Government would be in a position to see whether these industries had proved themselves worthy of the support. A committee would be set up, including members of the fighting services, in order to keep in touch with the work of all these key industries and to make an annual report to Parliament. Passing to dumping, he reminded the committee that the committee which sat under the chairmanship of Sir Henry Birchenough advised that a special import duty should be levied whenever it was established that dumping was going on on a substantial scale. It was on these lines that the Bill proposed to deal with dumping. Dumping would only be dealt with when the committee was satisfied that by dumping employment in any industry in the United Kingdom was being, or was likely to be, seriously affected. But even then the duty would be imposed only for three years or less. Food and drink were specifically excluded, and it was not intended to schedule raw materials, which were very difficult things to define.

Many members took part in the discussion. Ultimately Mr. Chamberlain said that it was hoped that the first resolution would pass on Tuesday and the second on Wednesday.

At the end of Tuesday's debate an amendment limiting the operation of the proposed Bill to one year was defeated by 289 votes to 79.

The *Manchester Guardian* publishes the following:—

The Lamp Importers' Committee are making a strong protest against the attempt of the lamp "ring" to get electric lamps included in the Key Industries Bill. They regard the attempt "as one of the insidious operations of the lamp ring in this country which was definitely stated to exist by the sub-committee appointed by the Standing Committee on Trusts," and "an attempt to crush out the independent traders and electrical engineers."

The statement continues: "The high prices charged by the lamp 'ring' for home trade are denounced by the sub-committee already referred to. These high prices make the maintenance of electric light a heavy item and tend to prevent more rapid development of the use of electricity, thus denying its convenience and hygienic value to the poorer sections of the public. This retarding of development naturally restricts the manufacturers of electrical machinery, heating, and cooking, and domestic labour-saving appliances. This, we assert, is of greater importance to the community, in view of the expansion of new manufactures and exports and the openings for trade thus offered, than a trifling increase of the 'ring' manufacturers' operatives, against which must also be set the loss of employment to ourselves, office and warehouse staffs, and travellers, which would be the result of the passing of these restrictions."

In a memorandum drawn up by the British Empire Producers' Organisation and sent to the Chancellor of the Exchequer the following reference is made to the electrical industry:—

"Electricity as power is one of the most essential raw materials and so wants special consideration. Backwardness before the war was due to two causes: (1) Free imports, (2) municipal trading. No firm could extend works according to the possible demand of the Empire as the effect of free importations in this country created a demand for every system, whilst in America and Germany there was standardisation. The result was that the output of our biggest firms was only 10 or 15 per cent. of the output of the German A.E.G. or American General Electric."

New French Companies.—There has been formed at Lille (79, Rue Gantois) the Société des Accumulateurs du Nord for the manufacture and sale of accumulators and electric mining lamps. The company has taken over works and assets of the Société anonyme électrique de Thumesnil, in liquidation, and its capital is 1,600,000 fr. in 6,400 shares of 250 fr. each, of which 4,520 are allotted to the several contributories.

The Société industrielle des Machines et Outillage has been constituted at Paris (65, Avenue Victor-Emmanuel III) with a capital of 600,000 fr. in 250 fr. shares, of which 1,200 are allotted to M. Perree Martin as consideration for assets.

The Société hydroélectrique de la Rance et de l'Arguenon has been established to work a hydro-electric station on the upper Rance, and another at Gueldo on the Arguenon, the latter using the hydraulic power of the tides. The original capital of 3,000,000 fr. will be raised to 14,000,000 by successive issues, of which 8,000,000 fr. may be in bonds; 2,000 500-fr. shares of the original issue are offered to the dwellers in the district, so that they may participate in an undertaking which closely concerns their interests.

With a capital of 200,000 fr. the Société de Production et d'Exportation Sidérurgiques has been formed at Paris (94, Rue de la Victore) for trade in all branches of mechanical and electromechanical production.

Canadian Electrical Manufacturing Industry.—The Dominion Bureau of Statistics has issued a preliminary report covering the year 1919 on the electrical apparatus manufacturing industry in Canada. Ninety-five plants are specified, of which 64 are in Ontario, 16 in Quebec, and the remainder scattered throughout the other provinces. The investment in the Province of Ontario is $25,500,000 and in the Province of Quebec $20,000,000. The total Canadian investment is $45,956,399. The value of goods turned out by the 95 factories in question was slightly less than $35,000,000.—*Electrical News.*

Foreign Trade.—April Figures.—The following are the values of imports and exports of electrical goods and machinery in April :—

	April. 1921. £	*Inc. or dec.* £	4 months, 1921. *Inc. or dec.* £
IMPORTS.			
Electrical goods, &c.	211,013	+ 107,727	+ 537,611
Machinery	1,028,778	− 854,384	− 838,902
Electrical machinery	52,157	− 34,164	− 43,051
EXPORTS.			
Electrical goods, &c.	1,436,109	+ 679,580	+ 1,981,966
Machinery	7,784,302	+3,732,639	+15,596,736
Electrical machinery	422,757	+ 239 272	+ 1,037,040
RE-EXPORTS.			
Electrical goods, &c.	25,180	+ 11,658	+ 76,776
Machinery	94,805	− 28,218	− 33,104
Electrical machinery	3,696	+ 1,724	+ 7,967

Joint Industrial Councils.—We have received from Mr. W. Arthur Jones, general secretary of the Electrical Power Engineers' Association, a copy of a letter addressed on behalf of his Executive Council to the Town Clerk of Hammersmith with regard to the recent resolution of that Borough Council to discontinue its association with the Joint Industrial Councils concerned with conditions of employment and rates of remuneration for the several sections of the Council's staff and employés, &c. Apparently the objection of the Council to taking part in the future work of such bodies is based on the fact that its connection with the various Whitley Councils places it under an obligation to apply the awards which are formulated. Mr. Jones points out, however, that "only in so far as agreements arrived at by the regularly constituted machinery in the industry are honoured, can there be any reasonable possibility of industrial peace being maintained. It is because both the Government and the public at large have recognised the necessity for industrial peace, and the importance of preventing possible disputes crystallising into antagonism and culminating in strikes, that they have consistently advocated that the old bad methods of individual bargaining should be replaced by machinery whereby all questions affecting the employés can be amicably settled around a table in a spirit of mutual trust and confidence.

"Your Council cannot but be aware that the effect of Whitley Councils in the electricity supply industry has undoubtedly been to effect a diminution in the number of disputes, and as more experience is acquired, these good results will become more apparent.

"The inevitable outcome of a secession such as your Council contemplates will lead to the moral damaging of the whole scheme, and will tend to bring about the return of the chaotic conditions which prevailed before the war.

"It may be that your Council has been obsessed with the fact that up to the present Whitley Councils have been concerned with the question of wages. Perhaps, under the circumstances, this has been inevitable. It is, however, the desire and intention of this Association that Whitley Councils in the electricity supply industry should devote their attention to the larger questions, such as the efficiency of the industry as a whole, and that they should be made a means whereby those who are engaged in the industry should make their definite contribution to its more efficient administration. The breaking up of the Councils by such action as your Council proposes to take will effectively prevent this, to the grave detriment of the industry.'

Catalogues, &c., for Chile.—In a recent dispatch to the Department of Overseas Trade, the Commercial Secretary to H.M. Legation at Santiago makes the following comments in connection with the translation into Spanish of catalogues, pamphlets, leaflets and other printed matter sent by United Kingdom manufacturers and exporters to firms in Chile :—

"The title or most conspicuous word should be in Spanish and not in English. Unless this is so, even when the subsequent material is in Spanish, very little gets read. As every firm of any standing in the country receives a mail bag full of advertising matter by each mail, it is obvious that with such a collection to choose from it is only the Spanish reading matter that will receive any attention. It is most important, therefore, that upon taking off the postal cover the most striking wording which reaches the eye shall be in Spanish. This at once places it amongst the few to be read instead of the many which are consigned to the nearest wastepaper-basket."

The Erection of Meter Boards : Trade Union Dispute.—It was recently reported that the joiners employed by the Swansea Electricity Department had, on the instructions of their society, ceased to erect meter boards, on the assumption that they were not being made under trade union conditions. Correspondence was read from the society admitting that the real facts were not clearly known, and from the firm at Treorchy supplying the boards to the effect that the trade union rates and conditions were being strictly observed. Mr. Bevan (printer) complained that the society had not first obtained the information before stopping the men. That was the sort of thing that brought trade unionism into disrepute. Mr. Clarry considered it a very high-handed action, and thought the society should be asked to apologise. Mr. Miller (joiners) said the society placed the onus upon the manufacturer to prove that the work was done under trade union conditions. It was explained that the men had not actually ceased work, as they were putting up meter boards that were made in the workshop. Incidentally, it was stated that the cost of making them had been 19s., and the price to buy them 9s. 6d. It was resolved to instruct the men to put up the meter boards in question.

LIGHTING AND POWER NOTES.

Aberdeen.—Electricity Supply.—At a meeting of the Electricity Committee, a letter from the Banff and Macduff Town Councils was read, asking that the city electrical engineer might be allowed to advise them upon the question of an electricity supply for the two towns. The Committee recommended that the Council should express its agreement.

Argentina. — Additions to Large Station. — The Compania Hispano-Americana de Electricidad, which owns two electricity generating stations in Buenos Aires with a total capacity of 110,000 kW, is putting down two more 25,000-kW turbo-generators in order to meet the increasing demand for power.

Barrow.—Direct Labour.—In connection with recent complaints received from the Secretary of the local branch of the Electrical Trades Union, with regard to wiring work which was being carried out in the borough by members of the Union and others who were normally employed at the shipyard, during their spare time, or when they were unemployed, it was decided by the Electricity Committee that Corporation wiring work should be done by direct labour.

Blackburn.—Applications for Power Refused.—The Electricity Committee has decided not to grant the applications from Billington Parish Council and Oswaldtwistle Urban District Council for the supply of power from the new station. A Committee was appointed to deal with the application of Blackburn Rural District Council.

Cost of New Station.—At a meeting of the Town Council on May 5th, Mr. L. Bates asked the original estimate for the new electricity generating station. He was under the impression it amounted to £250,000, and he believed the cost now would be nearer £800,000. The town clerk replied that the original estimates were for a much smaller station.

Bolton.—Delayed Extensions.—At a meeting of the Town Council, reference was made to the decision of the Electricity Committee to delay extensions at the Back-o'-th'-Bank Works in order to curtail expenditure. In view of the statement a year ago as to the urgency of these extensions, it was thought the public ought to be given a reason for holding them up. Councillor Roberts said the extensions were in two sections. It was only the second section which was being held up. The first would see them through the winter and well into next year. Last year the Committee sold over 30,000,000 units, but unless there was an early resumption of trade they would have to face a reduction of output of from 5 to 10 per cent.

Boston.—Provisional Order.—The Town Council has received a letter from the National Electric Construction Co., which holds the Boston Electric Lighting Order, 1915, stating that there is no prospect of proceeding with the work at the present time.

Burnley. — Mains Extensions. — Burnley Electricity Committee has authorised several extensions of electricity mains, the cost to be defrayed out of a loan of £20,000 sanctioned by the Commissioners.

The electrical engineer has reported the receipt of complaints from Reedley Hallows Council regarding the unsatisfactory electricity supply. He stated that to improve the supply it would be necessary to lay an additional feeder cable a distance of 1,200 yards, at a cost of £1,800. Consideration of the question was deferred for the present.

Canada.—Prince Edward Island.—The *Electrical News* states that the Prince Edward Island Light, Heat, and Power Co. has asked for incorporation by the local legislature, which is meeting at present in Charlottetown. The capital stock is $2,000,000, and it is planned to supply light, heat, and power to all parts of the island from one big central power house, using coal to generate electricity. The incorporators include Mr. H. A. Sanders, of London.

Carlisle.—Expert Advice.—The Electricity Committee has passed a resolution to retain the services of a consulting engineer, to be nominated by the President of the Institution of Electrical Engineers, to advise upon the present position of the electricity undertaking and make recommendations for meeting future demands upon the works.

Consett (Co. Durham).—Free Lighting.—It was reported at a meeting of the Urban District Council that for a period of 21 years from 1911 the Cleveland and Durham County Electric Power Co. was under agreement to supply free electricity for lighting the town up to 1,098,000 units; 916,699 units were still available, and on last year's basis of consumption this would be sufficient to light the district for another 21 years.

Continental.—France.—In order to meet the increasing demand for electricity for lighting and power purposes, the Compagnie Centrale d'Energie Electrique is increasing the capacity of its generating station at Rouen by the addition of two new 10,000-kW steam turbo-alternators. The output of the plant last year reached a total of 46,057,950 kW-hours.

Turkey.—La Société Ottomane d'Electricité is increasing the capacity of the generating station in Constantinople by the addition of a new 10,000-kW steam turbine and alternator. The number of clients supplied increased during last year from 12,894, representing 15,594 kW to 17,207 (18,657 kW), the output of the station during the 12 months amounting to 29,588,900 kW-hours, an increase of nearly 4,000,000 kW-hours over 1919.

Finland.—The Government is at present investigating the possibilities of generating power from the Imatra Falls on the Vuokeen River in East Finland. The idea is to connect several smaller falls above Imatra, build an embankment, and thus obtain a head of about 24 metres. The power station, with eight horizontal turbines, is to develop 150,000 h.p. The carrying out of this project will entail large excavations and blasting operations, especially as regards the construction of the canal—1 km. in length—which is to convey the vast volume of water from the granite-built embankment to the power station, and, according to the estimates made, about 700,000 cb. metres of earth and rock will have to be removed. It is estimated that all this will cost about 267,000,000 Finnish marks. At present the work is only being planned, but there is no doubt that sooner or later it will be carried out. There is already a railway to the falls, which are situated in a well-populated district, whilst the nearest port, Wiborg, is not more than 50 km. distant. The power generated will most probably be used on the railways.—*Times Trade Supplement.*

Dartford.—Loan Sanctioned.—The Urban District Council has received sanction to a loan of £12,106 for additions to the electric plant and mains extensions, and an additional loan of £4,562 has been applied for owing to increased costs.

Dublin.—Public Lighting Suspended.—The Lighting Committee has decided to suspend from May 9th to September 30th the whole of the city public lighting, arranging, however, that the order may be modified to suit, in the event of the curfew regulation under martial law (from 10 p.m. to 5 a.m.) being altered. The coal situation was the chief factor determining the action. Electric lighting in the Rathmines (Co. Dublin) district was suspended last week-end, owing to a strike of municipal workers upon a question of hours.

Egham and Staines.—Price Reduction.—The *Evening News* announces that the cost of electricity is to be reduced by 10 per cent.

Electricity District.—North Lancashire and South Cumberland.—The Electricity Commissioners give notice that the time within which objections or representations may be made or schemes submitted in connection with the above-named district has been extended from the last day in April to July 30th, 1921.

Fermoy.—Electricity Canvass.—The local Co-operative Society recently notified inhabitants that it had decided to install a generating plant at its mill premises, and wished to know how many people would take electricity. It is reported that the canvass has been successful, and the scheme is to be proceeded with.

Gosport.—Company's Inability to Supply.—Many complaints have been made by would-be electricity consumers who have had their premises wired only to be informed that the Tramway and Lighting Co. was unable to give them a supply, says the *Hampshire Telegraph.* The Act under which the company works, imposes a penalty of 40s. for each day of default. The manager of the company has explained, however, that the trouble is due to the non-delivery of new plant, owing to war conditions and labour disputes, and that when it is installed it will enable the company to supply three times as much power as it has to provide at present. For the last 18 months the plant has been running with an 80 per cent. overload.

Horbury.—Electricity Supply.—The Urban District Council has passed a resolution approving of the granting of an order by the Electricity Commissioners authorising the Electrical Distribution of Yorkshire, Ltd., to supply electricity for all public and private purposes within the urban district of Horbury.

Hull.—Seed as Fuel.—It was reported in the *National News* that a local oil manufacturing firm had offered the Hull Coal Controller 400 tons of damaged cotton-seed, suitable for fuel, and that the offer had been passed on to the city electrical engineer.

Oil Fuel.—At a meeting of the Hull Coal Emergency Committee, the electrical engineer (Major H. Bell) said that oil fuel was being utilised up to 50 per cent. of the power station's requirements, but it was two or three times as costly as coal.

Lamberhurst (Kent).—Small Water-Power Plant.—The town mill is being converted into a generating station, with motive power obtained from the river Teise, by Colonel F. G. Delamain. Electricity will be supplied to consumers in the village at 1s. per unit.

Lincoln.—Loan Withdrawal.—The *Manchester Guardian* states that the Lincoln Corporation is withdrawing its application for sanction to borrow £67,000 for further contracts in connection with the extension of the electricity undertaking.

Liverpool.—Extensions.—The City Council has approved of building operations being continued at the Lister Drive No. 1 Power Station, subject to specified conditions.

Installations Delayed.—There is a delay with regard to the installation of electricity in new houses which are being built by the Corporation, owing to the Ministry of Health declining to bear the cost. Negotiations are still proceeding on the subject.

London.—Bethnal Green.—The Borough Council has received sanction to borrow £54,143 for extensions.

Hackney.—The Electricity Committee has drawn up a revised scale of charges which the Council is asked to approve. Included in this scale is an increased minimum charge of 13s. 4d., instead of 10s. Lighting is to be charged for at the rate of 1s. per unit for any quantity not exceeding 91 units per kW demanded and 2d. per unit thereafter. The alternative charges for power are as follows:—£2 per quarter per kW demanded, and 1½d. per unit, or a flat rate of 3½d. per unit; 2½d. per unit is recommended for heating, cooking and other domestic purposes.

Manchester.—Cheaper Electricity Foreshadowed.—At a recent meeting of the Electricity Committee it was announced that a surplus was expected to be made during the current financial year, and, as soon as working costs fell sufficiently, charges to consumers would be revised and lowered.

Newport.—Issue of Stock.—The Town Council has resolved to raise £600,000 in 6 per cent. redeemable stock, the bulk of which is to be spent in new public works, including £121,982 on account of electricity supply extensions, £48,628 on account of tramways, and other sums for bridge work, &c.

Inquiry.—A local inquiry is to be held into the application of the Corporation for permission to extend its electricity scheme to the parishes of Bedwas, Malpas, and Duffryn. At present the Corporation is entitled to charge 9d. as a maximum, but it is negotiating for powers to charge 10d. if the necessity arises.

South Africa.—Government Control of Electricity Supply.—The *British and South African Export Gazette* says that although only very meagre particulars are available regarding the Bill which is shortly to be presented to the Union Legislature to deal with matters concerning the supply of electric light and power, it is already evident that the measure will not have an altogether smooth passage. Some considerable degree of Government control of electricity undertakings is proposed, and, as a natural corollary, legislation will have to be enforced to provide for the bringing of existing schemes up to one standard of efficiency. This must necessarily involve heavy expenditure on alterations and improvements, and it seems to be on these grounds that the opposition is chiefly based; the view expressed by General Smuts in a pre-election speech is that such unification is in the best interests of power development in South Africa. Though it will doubtless cause a fluttering in municipal dovecotes, it will at the same time stimulate the use of electric light and power among consumers who in the past have often been not a little critical of the treatment meted out to them by virtual monopolists, and consequently should materially increase the demand for plant and accessories, from generating machinery to domestic fittings.

Burghersdorp.—The Municipal Council proposes to borrow £12,500 for the provision of an electricity supply scheme for public and private lighting purposes.

Stretford.—Extensions Approved.—At a meeting of the Urban District Council receipt was reported of the consent of the Electricity Commissioners to the extension of the Trafford Park station by the installation of one 5,000-kW set and accessory plant, and by the necessary building extensions. Preliminary sanction has also been given to a loan in respect of the foregoing extension, as follows:—Plant, £70,000; mains and services, £30,000.

Torquay.—Consultant Called In.—Mr. E. T. Ruthven-Murray is to be asked to advise the Council as to the possibility of installing steam-raising plant on the present site. In the meantime, the electrical engineer has been authorised to repair an economiser at an approximate cost of £1,250. This renewal is necessary, in the opinion of the engineer, to carry the station through until another supply becomes available.

Walsall.—Loan Sanctioned.—The Electricity Commissioners have sanctioned the borrowing of £107,600 by the Town Council, in respect of the completion of the electricity works at Birchills.

Walton-on-the-Naze.—Proposed Purchase of Undertaking.—The Electricity Committee reported at a recent Council meeting that negotiations were still proceeding for the purchase of the local undertaking owned by the Coast Development Co. The clerk had interviewed the Electricity Commissioners, and hoped to be able to submit a draft contract very shortly. The liquidators had asked if the Council could provide financial assistance to enable the undertaking to be carried on, but it was decided not to take any action in this matter.

Weybridge.—Proposed Price Increase.—On May 3rd, Colonel T. C. Ekin, of the Ministry of Transport, conducted a public inquiry into the application of the Urban Electric Supply Co. to increase the price of electricity at Weybridge and Walton from 10d. to 1s. per unit. There was opposition on the part of the Weybridge and Walton Urban District Councils.

Whitby.—Loan.—The Urban District Council has applied for sanction to a loan of £2,300, for meters and a spare feeder.

Worcester.—Electricity for Houses.—After a great deal of discussion, the City Council decided, on May 2nd, not to supply electricity as well as gas to the houses on the Bromyard Road site.

Councillor Mrs. Edwards, a Labour representative, advocated electricity in view of the lowness of the ceilings in the houses under consideration.

Worksop.—Extensions.—The Council is contemplating the expenditure of about £24,000 on extending the electricity supply of the town. Among the works to be carried out is the provision of the necessary plant and mains to deal with a bulk supply from the Manton Colliery, which is to be taken as an alternative to extending the municipal undertaking.

TRAMWAY AND RAILWAY NOTES.

Argentina.—Railway Commenced.—His Majesty's Consul at Antofagasta (Mr. H. W. W. Bird) has informed the Department of Overseas Trade that according to the local press a start has been made by the Argentine Government at Salta on the preliminary work in connection with the railway projected to run *viâ* Huaitiquina on the frontier to Antofagasta. The plans of a French company which made the surveys some years back have been acquired.

As regards the Chilean section, which is roughly a half of the projected railway, nothing has been decided.

Belfast.—New Plant.—Owing to the increased services upon the Antrim Road route to Bellevue Gardens, it has become necessary to install additional plant at the Salisbury Avenue station, and the Tramways Committee recommends application for sanction to borrow £14,000 for this purpose.

Bradford.—Breakdown.—On May 4th the tramway services, already cut down by the fuel shortage, were dislocated on the Southfield Lane, Banktop, Queensbury, Wibsey, Bankfoot, and Wakefield Road routes, owing to failure of power in the two trunk cables at 9.15 a.m., just when cars were returning to the depôt for the suspension of the service until noon. Several cars could not be moved from the city termini, and the defects were not entirely rectified during the remainder of the day, though some of the cars were removed by an emergency electricity supply from the Odsal sub-station.

Burnley.—Grant Refused.—The Unemployment Grants Committee has refused to make a grant to the Tramway Department for the relaying of the tramway track.

Bury.—Year's Working.—For the year ended March 31st last there was a loss on the tramway undertaking of £10,872 on the Bury section, and of £1,948 and £650 on the Radcliffe section.

Continental.—Spain.—La Société des Tramways et Electricité de Bilbao has contracted with the Sociedad Hidro-Electrica Iberica for the supply of all the power necessary for the electric tramways in Bilbao. It has also sold to the Iberica Co. the 7,000-kW power station established at Burcena in 1908-11. The station, which is steam-operated, will serve as a reserve to the Iberica Co.'s water-power plants.

To remedy the growing congestion of traffic in Barcelona, which the tramways are unable to deal with, it is proposed to build an underground railway, or, as it is termed, a "Metropolitano." A company has been formed, on the board of which are some of the most distinguished Spanish railway engineering experts, assisted by M. Lorton, the director of the Paris Metropolitain. Besides relieving the local congestion, the Metropolitano will be linked up to the several railway companies converging on the city. whose through goods traffic will be speeded up by the use of the lines of the railway during the night.

Switzerland.—Owing to the mild winter and the decrease in wages and in the price of materials. the electrification of the Saint Gothard Railway is proceeding in a most satisfactory manner. It is hoped that the Bellizona-Lugano-Chiasso section will be in working order by October. The double line between Ginbasso and Sasso should be completed by the same time. By the end of the year the Erstfeld-Aarth-Goldau section and the Aarth-Goldau-Chiasso section are expected to be electrified.—*Reuter's Trade Service* (Zurich).

Dearne District.—Light Railway Scheme Approved.—The *Sheffield Independent* understands that the Ministry of Transport will confirm the Dearne District Light Railways Order, 1920. This Order authorises the Urban Councils of Wombwell, Wath-on-Dearne, Bolton-on-Dearne, and Thurnscoe, acting jointly, to construct and undertake a system of light railways connecting a number of colliery townships in the Dearne Valley. The trunk line is to be carried from the Barnsley borough boundary through Ardsley, Wombwell, Wath, Bolton, and Goldthorpe, to Thurnscoe, with branches to Darfield and Swinton. The Order limits the capital to be raised under its authority to £300,000.

Doncaster.—New Track.—After an interview by the town clerk and the borough surveyor, at the Ministry of Transport, the Tramways Committee recommends that the surveyor be authorised to proceed with the doubling of the tramway track from the junction of Cleveland Street and St. Sepulchre Gate to Balby Bridge, and that negotiations be opened for the purchase of a strip of land for the widening of Balby Road.

Durham County.—Transport Scheme.—At a meeting of the County Council, on May 4th, the Chairman, referring to the rejection of the Council's Transport Bill, said the Bill had been strangled at its birth. They were not going to take it lying down, and had made up their minds to go on preparing the ground so that they might be able in the future to provide the county with a greatly improved transport service.

Gateshead.—Option of Purchase.—The opinion of the Corporation is divided upon the question of taking over the tramway undertaking next year when the next opportunity falls due. Unofficial estimates give the amount required for purchasing the whole system as £1,500,000. Another 14-year period will elapse before the option can be exercised again.

Llanelly.—Electric Vehicles.—At a meeting of the Borough Council, on May 2nd, it was decided to seek sanction to a loan of £2,300 for the purchase of two electric lorries.

London.—Track Renewals.—Evidence of the efforts of the L.C.C. Highways Committee to make up for time lost during the war is given by a recent statement that the rate of relaying old tramway lines is now 26 miles per year, which is considerably above the pre-war average. Only about 4 miles per year were laid during the war period.

Breakdown.—On the evening of May 5th trains between Richmond and Broad Street, on the North London Railway, were held up for nearly an hour, owing, it is stated, to the breaking of a conductor rail.

Rawdon (Yorks).—Repairs Demanded.—In addition to protesting against the Leeds Tramways Committee's proposal to apply for sanction to increase the statutory maximum fare to 2d. per mile, the Rawdon District Council has called upon the Leeds Corporation to repair the tramway in the Rawdon area, and to improve the car service.

Shipley.—Abandoned Extension.—At a meeting of the District Council, on May 5th, the chairman of the Highways Committee reported that as it appeared that the scheme for the extension of the Bradford tramways through Shipley to Baildon had been abandoned, the Committee had invited tenders for the purchase of the rails and points purchased by the Shipley Council nearly 10 years ago for use on this extension. The Council confirmed the action of the Committee.

In the above matter it is hardly correct to say the scheme has been abandoned by Bradford. In 1911 the Baildon Council asked Bradford Corporation to extend the tramways from Shipley, the Baildon Council offering £50 per year for 10 years. The Corporation could not agree to this, and it was decided eventually that the Baildon Council should apply for a Provisional Order, and that Bradford should construct the line. The Order was secured, and Bradford arranged with the Shipley Council to undertake the construction of a short length of track from the present Shipley terminus to the centre of the river bridge, at a cost of £650 in materials and labour. The war held up the scheme, and Baildon Council failed to renew the Order within the time allowed.

Uruguay.—Overhead Tramway.—It is announced that a project for the installation of an aerial tramway between the Old Town district of Monte Video and the Cerro, is shortly to be presented to the Municipal authorities. The motive power for this installation would be obtained from the State Electrical Department, and it is intended that the fares shall be the same as those charged by the existing ordinary tramway between the two points named. The author of the scheme is Senor Francisco Piria. He is asking for a concession for 25 years, after which period the whole installation would become the property of the Municipality.—*Review of the River Plate.*

TELEGRAPH AND TELEPHONE NOTES.

Dutch East Indies.—Wireless Service.—It is announced from Washington that a commercial wireless service between the United States and the Dutch East Indies has been established.

France.—Wireless Invention.—Prof. Lippmann, lecturing at the Academy of Sciences, on May 9th, described an invention of MM. Abraham and Planiol for utilising ordinary telegraphic apparatus for sending, receiving, and printing wireless messages. Prof. Lippmann said that experiments made before a number of official experts between Paris and Nogent le Rotrou had given brilliant results, and that as many as 7,000 words had been automatically registered in one hour.—*Reuter's Trade Service* (Paris).

Norway.—Telegraphic Communication.—On the proposal of the Norwegian Telegraphic Board that the telegraphic connection between Finland and Norway should be *via* Petsamo, the President of the Republic of Finland has decided that the line of telegraphs through Petsamo may be used for the purposes of this connection, provided that the charges payable to the Finnish State shall be at the rate of 11 centimes per word.—*Economic Review.*

South America.—Telephone Service.—A public telephone service between Parana and Crespo (Prov. of Entre Rios) was inaugurated on April 4th. The line has been constructed by the Compania Entrerriana de Teléfonos.—*Review of the River Plate.*

New Argentine Wireless Company.—A Germano-Argentine company has been organised, under the name of Compania Radiotelegráfica Transcontinental, with head offices at Buenos Aires, with the object of establishing wireless communication between Europe and South America. It will have a share capital of 10 million pesos, of which 3,000,000 pesos of 7 per cent. preference shares and 4,500,000 pesos of ordinary shares are already on the market. The preference shares were subscribed for in Argentina, and the ordinary ones were taken by a German syndicate formed by Siemens & Halske, the A.E.G., and the German South African Bank. The board of directors is composed of principals of these companies. The new company, which has received from the Argentine Government a concession to adopt the German "Telefunken" system, will proceed with the immediate erection of a wireless station within the Argentine, in connection with the German station at Nauen. The undertaking seems to be mainly German, and has as its declared object the development of commercial relations between Germany and Argentina.—*Ingenieria Internacional.*

South Africa.—Wireless Telephony.—The Government is experimenting with wireless telephony with the view of linking the chief centres. Communication has been successfully established between Johannesburg and Bloemfontein. It is hoped to extend the system gradually, thus lessening the cost of ordinary telegraphic and telephonic working, which is unusually high owing to maintenance charges over immense distances.—*Financial Times.*

Sweden.—Ships' Wireless.—The obligation imposed by the British Merchant Shipping Wireless Telegraph Act on shipping of over 1,600 tons burden to carry a wireless outfit is meeting with opposition in Swedish merchant shipping circles. It is urged that it is difficult, or impossible, under existing circumstances to obtain both the apparatus and the trained staffs. A petition has been forwarded to the Swedish Ministry of Marine asking that steps may be taken to secure from the British authorities exemption from this obligation till the end of the current year, on proof of inability to conform to the law.

Telephone Service. — Public Call Boxes. — It is pointed out by the *Star* that if a telephone call box in many of the London railway termini is used, it is necessary to pay 4d. for a call within the 10-mile radius of Charing Cross. Yet at a call box outside the stations the charge remains at 3d., for which the following explanation is given :—The call boxes in the majority of large railway termini are "not public boxes at all," but belong to the railway companies, and the calls go through the railway companies' private exchanges to the Post Office. Until the advent of the revised charges, the call rate to the public was the same as in the Post Office's own boxes, but the railway companies have agreed to charge an extra 1d. on the minimum charge of 3d. The Postmaster-General's arrangement with the railway companies only ensures that they do not undercut the general call-box rate.

The market town of Wincanton, Somerset, is still without a telephone, local business men having refused a scheme involving a £28 a year subscription, says *The Times.*

Wireless Telegraphists. — Wage Reduction.— The Association of Wireless Telegraphists, reports the *Daily Herald*, is faced with a reduction of wages for its members of £2 per month, and has agreed to the case going to arbitration. A meeting of the Association officials with the conciliation officer of the Ministry of Labour was held on the 6th inst. to arrange for the hearing of the case, and a joint meeting of the Union and the employers to consider procedure will be held within a few days. Pending the decision of the Arbitration Court, it has been agreed that there shall be no alteration in wireless telegraphists' wages.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia. — Melbourne. — June 15th. Victorian Government Railways. 50 oil-immersed single-phase track and signal transformers for power signalling (Contract No. 33,901).*

June 22nd. One electric lifting magnet (capacity ½ ton), one 440-V motor generator.

June 29th. Supply of 1-ton platform type industrial storage battery trucks, also battery-charging equipment.

August 10th. 250 core-type impedance bonds for power signalling, with a capacity of 1,000 amperes per rail ; also 50 miles of solid insulated copper wire, No. 14 Brown & Sharpe gauge, and 50 miles of solid insulated copper wire, 16 standard gauge.

August 17th. 3,000 sets of renewals for caustic soda primary cells.

August 30th. Board of Works. Four electrical centrifugal pumps, each with a capacity of twelve million gallons daily.

Aldershot.—May 24th. Urban District Council Electricity Department. Three miles of 6,000 volt, 3-phase cable. (See this issue.)

Belgium.—Brussels. May 26th. Municipal authorities of Schaerbeek. Fifty-five section boxes and 130 junction boxes required in connection with the electricity supply system. Particulars may be obtained from the Service de l'Electricité, Hotel Communal. Tenders to the College des Bourgmestres et Echevins, Hotel Communal, Schaerbeek, Brussels.

May 27th. Supply and erection of ten electric capstans for sluice doors. Service d'Etudes et de Controle des Applications de l'Electricité, 52, Boulevard du Régent, Brussels.

Antwerp.—May 27th. Municipal authorities. Paper-insulated telegraph cables required in connection with the fire brigade service. Particulars, 1 franc, from the Service Electrique, Hotel de Ville, Antwerp.

Dundee.—Corporation. Electric lighting fittings for new City Hall and for the supply of kinematograph and appliances. Mr. Jas. Thompson, city architect.

Edinburgh.—May 26th. Electricity Department. E.h.p. and l.p. switchgear for sub-station. (April 29th.)

Corporation. Electrical work in connection with the Corporation's Wardie housing scheme (360 houses). Plans by Messrs. Robertson & Swan, architects, 29, Hanover Street, Edinburgh.

Fiji.—Suva.—June 30th. Municipal Council. One 200-kW, 480/520-V, 3-wire, d.c. generator, directly coupled to a 300-h.p. vertical Diesel oil engine, with accessories and generator panel. Specifications (21s.) from the Town Clerk, Suva, Fiji, c/o Box 2,557, G.P.O., Sydney.

Glasgow.—May 31st. Electricity Department. Cables (including small i.r. cables and flexibles) and meters for twelve months. (See this issue.)

Huddersfield.—May 28th. Electric light installation in United Methodist Church and School, Outlane. Mr. F. Roberts, Maplin Lea, Lindley Moor, Outlane.

Lochgelly (Fife).—Town Council. May 21st. Electric installation for 40 houses. Specifications from Mr. A. D. Haxton, architect, 3, High Street, Leven. Tenders to Mr. R. Small, Town Clerk.

London.— Shoreditch.—June 7th. Electricity Department. Constructional steel and ironwork building, 20-ton weighbridge, h.p. steam pipes, valves, &c., for Whiston Street generating station. (See this issue.)

Mexborough. — May 21st. Urban District Council. Electricity Department. One 750-kW rotary converter with transformer. (May 6th.)

Newcastle-on-Tyne. — May 17th. Electricity Supply Department. Half-a-mile single, l.p., lead-covered, steel-armoured main cable. (May 6th.)

New Zealand.—June 28th. Public Works Department. Ten s.p. oil-filled transformers for the conversion of three-phase current at 50 cycles, the voltage ratio being 50,000/11,000, for Waikato power scheme.*

June 28th. Supply and delivery at Lyttelton of two 50-kVA, two 100-kVA and two 200-kVA condensers in connection with the Lake Coleridge electric power supply (Section 116).*

Sale.—Urban District Council. Electricity Department. Converting plant, complete with e.h.p. and l.p., d.c. switchboards. (May 6th.)

South Africa.—July 5th. Electrification of Capetown-Simonstown and Durban-Maritzburg lines.

Southampton. — May 14th. Electricity Department. 3-phase, 6,000-V cable. (May 6th.)

Wimbledon.—May 25th. Electricity Committee. H.p. sub-station switchgear. (See this issue.)

Worcester.—The Housing Committee is inviting tenders for the installation of electric light to the 111 houses on the Northwick housing site.

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Bradford.—Electricity Committee :—

One 1,000-kVA transformer for Valley Road works sub station, £1,971.—British Electric Transformer Co., Ltd.

Tramways Committee.

Points and crossings, for renewal of track at Otley Road and Barkerend Road junction, £3,110.—Hadfields, Ltd. (Sheffield).

Canterbury.—Town Council :—

"Garrett" 2½-ton type electric street-watering van, £1,857.—Agricultural and General Engineers, Ltd.

Doncaster.—Town Council:—

Hand-operated travelling crane, £831.—Herbert Morris, Ltd.
Steam piping, £ 93.—Aiton & Co.

Edinburgh—Portobello power station:—

Pump-house foundations, £11,245.—Messrs. J. Best & Sons.

Gainsborough.—Urban District Council:—

Electric tipping waggon, £1,924.—Mossay & Co., Orwell.

Gillingham (Kent).—Town Council. Wiring 62 houses for electric lighting:—

W. McDonald, subject to conduit tubing (accepted), **£717.**
Evans Bros. (in steel conduit), £760.
A. E. Hornsby & Co., in solid-drawn tubing, £761; in Henley's system, £723.
W. J. Fosh (system not stated), £720.
W. G. James & Son (solid-drawn conduit), £731; Henley's system, £957.
A. Merritt (solid-drawn tubing), £885; as above, with welded tubing, £862; brazed tubing, £827; Henley's system, £721.

South Africa.—Cape Town.—The Corporation has recently placed an order with Messrs. Reunert & Lenz for a Babcock and Wilcox water-tube boiler, rated at 35,000 lb. of steam per hour. The price of the whole set erected, but excluding chimney and draught plant, is £20,000.

Swansea.—The Corporation Electricity Committee was informed by Messrs. Hornby & Co., agents for the Siemens-Schuckert meters, that these were already in stock in London and that the 50 per cent. tax did not apply. The firm added that in any case their prices were inclusive of all charges, they themselves being responsible for the payment of the 50 per cent. or any other tax by the Customs. On the motion of Mr. Clarry, it was decided that as no tax went to the Government the Committee purchase the British meters at 16s. per meter extra cost from Messrs. Chamberlain & Hookham, Ltd.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, May 13th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary scientific meeting.

Chemical Society.—Thursday, May 19th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

Roentgen Society.—Thursday, May 19th. At the University College, Gower Street. At 8.15 p.m. Silvanus Thompson Memorial Lecture, "Electrical Instruments and Phenomena in Physiology," by Prof. A. V. Hill, F.R.S.

Junior Institution of Engineers.—Friday, May 20th. At Caxton Hall, Westminster, S.W. At 8 p.m. Lecturette, "Liquid Fuels," by Mr. A. Arnold.

NOTES.

Swansea Salaries.—An example of the confusion attending the contrary decisions of the National and District Joint Boards was forthcoming at last week's meeting of the Swansea Electricity Committee, when a letter was read from the secretary of the District Joint Board containing a resolution recommending that the constituent bodies should reduce the salaries in the area so as to correspond with the fall in the cost of living. The chairman, Ald. Sinclair, said that this was a case in which the District Board was in disagreement with the National Board, which claimed that there should be no revision. They in Swansea followed the District Board's schedule, and the reduction in Swansea was in operation from April 1st. A letter was read from the Electrical Power Engineers' Association saying that the reduction of salaries for the quarter commencing April 1st was in direct opposition to the decision of the National Board, and entering a protest. The Committee decided to reply that the protest should be sent to the District Joint Board.

New Aerial Torpedo.—M. Demblanc, a French engineer specialising in aeronautics, has perfected a new aerial torpedo, which can be released from either an airship or an aeroplane. The weight of explosives, borne through the air on a gradually descending path by a system of sustaining planes, is said to be sufficient to make the torpedo a most formidable weapon—particularly as the inventor has fitted to the torpedo wirelessly-controlled steering planes which enable those on the aircraft from which the torpedo has been released to regulate its rate of descent, also to guide it from side to side in order to direct it accurately to any given target.—*Evening News.*

The Boy Scout Shilling Fund.—With a view of assisting the Prince of Wales's appeal on behalf of the Boy Scouts, a Shilling Fund has been opened by the Committee of the Hyde Park Dance Club. On May 24th (Empire Day) the Fund will be inaugurated by an "At Home" and "Thé Dansant" at the Hyde Park Hotel (4 to 6.30).

Particulars will appear from time to time, it being the intention to hold attractions daily from the date of inauguration for a week, the whole culminating in a grand ball to be held at the Hyde Park Hotel on the eve of Derby Day, May 31st.

The arrangements are being made with the assistance of Messrs. Tredegars, Ltd., of 7, Brook Street, W., who have placed the whole of their organisation at the disposal of the Fund Committee, and from whom invitation cards for the "At Home" may be obtained. Books containing 20 shilling vouchers, with receipts, will be issued to those interested.

Hydrotechnics at Grenoble University.—In our issue of July 2nd, 1920, we published an article by Major T. Rich, describing the exceptional facilities afforded by the University of Grenoble for the study of water-power and power transmission during the Summer Holidays. A series of Vacation Lectures, with visits to some of the numerous installations in the neighbourhood, was arranged, but, owing to the short notice, only a few students attended. Nevertheless, the satisfaction shown by those who joined demonstrated that the experiment was worth continuing. It is proposed, therefore, to hold a Vacation Course of Lectures on the Utilisation of Water-power, with some notes on Power Transmission, in the summer of 1921, arrangements being made to visit some of the interesting local installations. A preliminary programme of this course has been forwarded to us, from which it is clear that the ground will be thoroughly covered.

The lectures will be given in such a way that those who have had French lessons at a public school can follow the work without difficulty. However, a course of preparatory instruction in French for those who do not know the language sufficiently will be given during the four weeks immediately preceding the beginning of the technical course. The charges for board and lodging will vary in August next between 240 fr. and 600 fr. per month, *i.e.*, between £4 10s. and £11 per month, at the present rate of exchange.

The Hydro-electric Technical Course will in all probability be started towards August 8th or 10th, and will extend over a period of one month. The registration fee for this course will be 110 fr. (£2). The registration fee and charges for the preparatory course in French will be 200 fr. (£3 15s.).

It is proposed to throw the course open to students of the technical colleges and engineering institutions, and also to those members and associate members of the Institutions who are interested in these questions. Grenoble is the holiday centre of the French Alps, with ample opportunities for amusement, and rooms are available to suit all purses. A special electrotechnical course will be held for British students and members of institutions, if a sufficient number of them attend at Grenoble in August next. A decision on that point will be taken at the beginning of June, and in order to arrive at such decision it is particularly requested that all those intending to join should inform the Office National des Universités et Ecoles Françaises, at 45, Great Marlborough Street, W. 1, and should register on or before May 28th. The registration fee will be payable on or before June 15th.

Further particulars are to be obtained from Mr. H. Sloog, hon. sec., British Bureau, Engineering Department of the Office National, at the above address.

Service Notes.—Captain A. Reed, Tyne Electrical Engineers, who has just been appointed adjutant of that corps, was its quartermaster until recently; Wireless Telegraphist A. Dean, serving ashore, has been promoted commissioned telegraphist from the 12th ult.; Wireless Telegraphist H. Johnstone, serving with the *Vivid* at Devonport, has been promoted commissioned telegraphist from the same date; and Wireless Telegraphist A. H. Warburton, serving on the flotilla mother-ship *Maidstone*, has been similarly promoted; Warrant Telegraphist A. E. Wither has been appointed to the destroyer *Shakespeare* for wireless telegraphic duty with the Sixth Destroyer Flotilla, from May 1st.

Electricity Supply.—In a letter to *The Times* of May 11th, Alderman Beaumont, Chairman of the District Industrial Council (London area) for the electric supply industry, stated that the London electricity works were not affected by the dispute between the National Federated Electrical Association and the Electrical Trades Union. The employers were in negotiation with the unions regarding the reduction of wages in view of the reduced cost of living, and in accordance with their agreement, the matter would, if necessary, be carried before the National Joint Industrial Council, and finally to the Industrial Court.

Appointments Vacant.—Two assistant electrical engineers (Rs. 920 and Rs. 690 per calendar month respectively) for the East Indian Railway Co.; chief clerk and accountant (£320) for the Grimsby Corporation electricity department; chief assistant engineer (£250) for the Horsham Urban District Council electricity works; telegraph foreman (£440) for the Government of the Gold Coast. See our advertisement pages to-day.

The Council of the Institution of Civil Engineers is inviting applications for the post of secretary, at £2,000 per annum. The age specified is between 33 and 48, and applications have to be delivered to the President by June 11th.

Commemoration of Ampère in Paris.—Representatives of the Union of Engineers' Syndicates, and in particular of the Syndicate of Electrical Engineers, gathered at the tomb of André Marie Ampère in the cemetery of Montmartre, in Paris, on May 8th, to commemorate the hundredth anniversary of Ampère's discovery of those principles of electricity which led to many of its modern uses, and caused his name to be employed as that of the practical unit of electrical current. M. Boucherot, President of the Engineers' and Electrical Syndicates, who during the war perfected the ground telephone, which rendered great service to the French and Allied Armies, spoke at the graveside, showing how from a small beginning the use of electricity had grown till at the present time more than 50,000 skilled workers were employed in various kinds of electrical work, not including telegraphs and telephones. In paying a tribute to Ampère, M. Boucherot pointed out that not only was he a great scientist and a good citizen, but also something of a philosopher. He was much interested in psychology, and left two volumes, unfortunately incomplete, on 'The Classification of Ideas."—*Reuter's Trade Service* (Paris).

The Electrical Trades Benevolent Institution.—At the last general meeting of this Association, alterations were made to the rules, giving additional powers to the Local Advisory Committees. The necessary confirmatory meeting will be held at the Cable-Makers' Association's offices, Sardinia House, Sardinia Street, W.C. 2, on Monday, June 27th, at 2.30 p.m.

Shoe-Fitting by X-rays.—A novel X-ray apparatus, by which one can actually see whether new boots or shoes fit, has been installed in a Kensington boot-makers' shop. The purchaser of the shoes stands on the platform of the apparatus, and the X-ray view of the foot and boot is displayed to the purchaser and assistant. "The apparatus is perfectly safe for all ordinary circumstances."—*Daily Mail.*

Lochaber Water Power.—On Wednesday, last week, a Committee of the House of Commons approved of the preamble of the Lochaber Water-Power Bill, by which the British Aluminium Company is seeking powers to utilise the flood waters of the River Spey for the purpose of generating electrical energy.

Oil Fuel for the Underground.—The power stations of the Underground Railways at Lots Road and the Metropolitan Railway at Neasden are now being fitted for the use of oil fuel, and a proposal to use oil-fuel at the tramway generating station is being considered. The system adopted for the Lots Road and Neasden power stations gives the advantage of rapid conversion of existing types of coal-burning furnaces. It is known as the Scarab oil-burning system with the patent Scarab burner, and the conversion is carried out without entailing structural alterations. The conversion is being effected gradually, so as not to interfere with the work of the stations. Apart from the advantage that oil fuel is available, while coal supplies are likely to be short for some time, it is claimed that the conversion will result in considerable economies, because:

(1) Consumption is 50 per cent. less than coal.

(2) One man can do work requiring six men in the case of coal fuel.

(3) Storage is simpler and handling easier.

(4) Supplies can be obtained without fear of interruption.—*The Times.*

The Austin Motor Company.—In connection with the appointment of a receiver and manager in respect of this company, it is reported in the Birmingham papers that Sir Herbert Austin, M.P., chairman and managing director, addressed a meeting of 2,000 employés of the company in the kinema hall at the Longbridge works during the luncheon interval on April 27th, and detailed the history of the strenuous efforts which had been made during the last year to run the company successfully with a million and a half less capital than the amount which was admittedly required for such an enterprise. The negotiations now in hand would, he felt sure, result in placing the company in a more satisfactory financial position. In the meantime it had been found necessary to protect the interests of all concerned by placing the business temporarily in the hands of a receiver. He urged them to give loyal assistance to the company, and prophesied that the good sense of the English people would very shortly lead to a cessation of the coal strike and other trade disputes, whereupon an extremely bright future might be anticipated for the company.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Western Centre Dinner.—The twenty-second general meeting was held at Bristol on Monday, May 2nd, when a good audience assembled under the chairmanship of Mr. A. J. Newman to listen to an address which was delivered by the President of the Institution, Mr. Llewellyn B. Atkinson, who took as his subject "Four Great Electric Lights," namely, Faraday the discoverer, Maxwell the interpreter, Kelvin the measurer, and Silvanus P. Thompson the teacher. The President, who was in his best form, spoke to an appreciative audience for nearly two hours. Following the address a dinner was held at the Grand Hotel to enable members to meet the President. Unfortunately several members who had intended to be present found themselves unable to do so on account of the disorganisation of the railway services, and the South Wales contingent had to depart at an early hour in order to travel by the last train to Cardiff; nevertheless, a thoroughly enjoyable evening was spent.

Mr. A. J. Newman again presided, and others present included Mr. Ll. B. Atkinson, Mr. A. Ellis (immediate past chairman of the Western Centre), Mr. Nicholas Watts (president of the Bristol Society of Engineers), Prof. D. Robertson, D.Sc., Messrs. H. I. Rogers, A. C. McWhirter, W. A. Chamen, W. Collins, S. B. Haslam, W. T. Kerr, G. H. Langdon, T. E. Lewis, A. N. Moore, I. A. D. Pedler, H. T. Sully, H. S. Ellis, T. Hood, A. F. Coates, and Messrs. A. J. Ostler and C. T. Allan (joint hon. secretaries of the Western Centre), the grand total of members and guests being 58. The brevity of the speeches may be attributed to the eagerness to proceed with the capital musical programme, the songs of Miss O'Gorman and Messrs. J. G. Royce, L. Dore, and Huntingdon being greatly appreciated.

After the loyal toast, Mr. Nicholas Watts proposed the toast of "The Institution of Electrical Engineers," referring to its small beginning and subsequent growth, the responsible work it was undertaking, the value of its library, and the importance of the work of its territorial centres and sub-centres throughout the country.

Mr. Ll. B. Atkinson (president of the I.E.E.), in responding, said he was glad to find himself again amongst men of the Western Centre, the acquaintance of many of whom he had made during the Institution's summer visit to South Wales last year. They were looking forward to visiting Scotland next month, but they would never forget the success of last year's meeting. It was very gratifying to note how the president (and the Institution through him) was welcomed wherever he went; he had personally visited all the territorial centres, with the exception of the two Irish ones (he hoped that omission would be excused), and he had everywhere been well received. The membership of the Institution now very nearly approached 10,000 members of all classes—a figure to be proud of, and one which no other institution had been able to approach. Those results had been arrived at largely by the aid of the local centres and the fact that the local chairmen sat on the Council of the Institution.

The president made an appeal on behalf of the Benevolent Fund, recalling Mr. Hugman's offer, and said that they must do all they could to comply with his conditions. If they did not succeed in obtaining individual offers, they might, with the help of the local centres gather the requisite sum collectively, but in any case no effort should be spared to do all they could to help the fund, as there was no doubt that it would be needed in the years to come.

He hoped the Institution would be back in its own building by the middle of this month, when they hoped to introduce certain improved arrangements, such as keeping the library open in the evenings, making the common rooms more comfortable, &c. In the annual report of the Council which would shortly be received by members, only a brief mention would be found of the proposed charter, but they would have opportunity for discussing it at the annual general meeting; the Council would doubtless have the support of the general body of members in its application to the Privy Council. They had included in the draft charter a clause which would give members and associate members the right to call themselves "Chartered Electrical Engineers."

Mr. Arthur Ellis proposed the toast of "The Visitors," and assured them that they of the Western Centre always enjoyed welcoming visitors, because one of their aims was to create interest in the Institution and its work outside of its membership. The toast having been briefly acknowledged by Mr. J. P. Brazil, the president proposed that of "The Chairman," and referred to the success of the Western Centre and its present session.

Mr. A. J. Newman, in briefly replying, disclaimed any credit, remarking that all the members of the Centre were so keen, and he had had the assistance of such able officers, that the session could not have been anything but a successful one.

The meeting then terminated with the singing of the National Anthem.

Royal Institution.—A general meeting was held on May 9th, at which Sir J. J. Thomson was elected honorary Professor of Natural Philosophy, and Sir Ernest Rutherford Professor of Natural Philosophy.

The Friday evening discourse on May 27th will be delivered by Mr. A. Mallock on "Elasticity."

Institution of Civil Engineers.—Engineering Conference, 1921.—Arrangements have been made to continue this year the series of conferences which were interrupted by the re-building of the Institution premises and the war. The conference will be held on Wednesday, Thursday, and Friday, June 29th and 30th, and July 1st—the mornings of those days being given to discussions upon selected topics, and the afternoons to visits to engineering works. For the purpose of the meetings, the conference will be divided into seven sections:—(I) Railways, Roads, Bridges, and Tunnels; (II) Harbours, Docks, Rivers, and Canals; (III) Machinery; (IV) Mining and Metallurgical Processes; (V) Shipbuilding; (VI) Waterworks, Sewerage, and Gasworks; (VII) Electricity Works and Power Transmission. The topics to be discussed at the meetings of each section will be notified early next month, and it is intended that prints of the notes introducing the several subjects shall be made available before the date of the conference. The complete programme, including the list of visits to works, will, it is hoped, be also ready for issue early in June, and will contain particulars to enable members to decide upon the visits they may wish to attend.

The twenty-seventh James Forrest Lecture will be delivered by Sir George T. Beilby, F.R.S., Assoc.Inst.C.E., on Tuesday, June 28th.

Manchester Wireless Society.—A general meeting was held on April 27th, at which the work of the past session was reviewed and future progress discussed. On April 30th the Society conducted a ramble in the neighbourhood of Hale. Three portable sets were erected at different points, and splendid results obtained in reception from standard stations. A congratulatory message from Paris to the Luton Wireless Society was intercepted. The same evening transmission took place from headquarters, using one valve, and this was received at a point 20 miles distant. Telephony was also tried, with fairly good results, up to seven miles.

Association of Engineers-in-Charge.—Owing to the continuance of the coal dispute the Council has found it necessary to postpone the annual dinner. and all subscriptions are being returned.

A visit is to be paid to the Hammersmith Borough Electricity Works on May 21st, and early in June the works of Messrs. Fraser and Chalmers (G.E. Co.), Erith, are to be visited.

The Royal Society.—At a meeting on Friday last Prof. Albert Einstein and Prof. Peter Zeeman, amongst others, were elected foreign members.

Physical Society of London.—At the meeting held on March 22nd a paper on "A Method of Measuring Frequencies," by Messrs. B. S. Smith and G. F. Partridge, was read by the latter. A heterodyne method of measuring frequency by comparison with a calibrated valve oscillator was described. The calibration was performed by means of two valve oscillators capable of giving frequencies of, say, 1,000 per sec. and upwards. The frequency of the oscillations was raised alternately to give a beat note whose pitch was determined by comparison with a fork. Intermediate frequencies were found by interpolation on the calibration curve, and a method of checking the capacities of the oscillator condensers was described. For the measurement of acoustic frequencies the sounds were converted into alternating currents by means of a suitable transmitter.

Edinburgh Electrical Society.—The annual business meeting of the Society was held on May 6th. The treasurer submitted a satisfactory statement of affairs, which showed an increased membership over the preceding session. Prizes were presented to three apprentices, A. Clunie, D. Bee and T. Mercer, for competitive papers which they had submitted. The following were elected for the next session:—Chairman, D. S. Munro; and vice-chairman, J. Stark.

Association of Teachers in Technical Institutions.—On Monday next the annual conference will be opened at Cardiff, and it will extend until Wednesday. Amongst the papers to be read are the following:—"A National Scheme of Technical Education," by Mr. C. Coles, B.Sc., and "Apprenticeship in its Relations to Technical Schools and Industries," by Mr. R. James, Wh. Ex. Resolutions will be considered urging the necessity of a Royal Commission on the whole field of technical education, pressing for the speedy bringing into force of the Education Act of 1918, advocating an increase in the number of scholarships available at Day Technical Institutions, and calling for amendments of the Teachers' Superannuation Act of 1918. An attractive programme of social gatherings and visits to places of interest has been arranged.

Societe des Ingenieurs Civils de France.—A summer meeting of the British Section will be held in France between June 18th and 24th. It has been decided that, in the same way as in 1920, participation in the tour will not be confined to the members of the British Section, and that members of recognised British Engineering Institutions or engineers in general will be welcome.

A copy of the programme and full particulars of the meeting can be obtained from the Hon. Secretary, 45, Great Marlborough Street, W. 1. The meeting will embrace visits to Verdun, Nancy, Metz, and the ironworks and factories of the Lorraine area. Ladies are cordially invited.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Following upon his election as Speaker of the House of Commons, the Right Hon. J. H. Whitley, M.P., has resigned the Joint Presidency of the Industrial League and Council which he has held for so long in conjunction with the Right Hon. G. H. Roberts, M.P. Viscount Burnham, C.H., has consented to become Joint President in his stead.

Mr. H. E. Blain, C.B.E., assistant managing director of the Underground Group of Companies, has been retained by the Transportation Commission of Toronto to advise that city on its transportation problems, and is sailing for New York in the *Adriatic* on May 18th. Mr. Blain will be joined later by Mr. C. S. Louch and Mr. J. L. B. Lindsay, the comptroller and accountant, and the assistant secretary and treasurer, respectively, of the Underground Group, and the party will then make a tour of many of the important cities of the United States to study transportation methods.

Sir William Slingo, the new British Controller-General of Peruvian Posts, Telegraphs, and Wireless Communications under the concession recently granted to the Marconi Co., of London, arrived at Lima, last week, says *The Times*, and is taking charge immediately.

Maidenhead Town Council has increased the salary of the electrical engineer (Mr. Milton), according to a formula recommended by the A.M.E.E. (approximately £621).

We regret to learn that Mr. L. L. Robinson, borough electrical engineer. Hackney, has recently undergone an operation. The Council has granted him two months' leave.

Mr. H. Payn has been appointed engineer and manager to the Northwood Electric Light and Power Co., Ltd. in succession to Mr. E. J. Smallpage. During the past few months, Mr. Payn has been in charge of the company's extension scheme.

Mr. Stainer Hutchins, of Davenham, Cheshire managing director of Electro Bleach and Bye-Products, Ltd., has joined the board of directors of the Lawes' Chemical Manure Co., Ltd.

The Emperor of Japan has conferred the Order of the Rising Sun upon Sir James McKechnie, of Messrs. Vickers, Ltd., Barrow-in-Furness.

Obituary.—Mr. H. G. Munro.—The death is announced of Mr. Hugh George Munro, O.B.E., secretary of the Electric and Ordnance Accessories Co., Ltd., Birmingham, at the age of 41. The funeral took place at Yardley old church on Friday last. The firm was represented by Mr. W. Dallow, and Mr. R. Phillips attended on behalf of Messrs. Vickers, Ltd. (London).

Will.—The late Mr. Bertram Blount, F.I.C., F.C.S., left £4,817.

NEW COMPANIES REGISTERED.

Reeve & Bayman, Ltd. (174,494).—Private company. Registered April 30th. Capital, £10,000 in £1 shares. To take over the business of electrical and mechanical engineers, carried on by W. T. Reeve and W. G. Bayman at Plymouth as "Reeve, Bayman & Co." The permanent directors are: W. T. Reeve, 11, Boons Place, Plymouth; W. G. Bayman, 40, Hill Park Crescent, Plymouth. Qualification: £100. Solicitor: B. H. Chowen, Westwell Chambers, Westwell Street, Plymouth. Registered office: 13, Russell Street, Plymouth.

Power & Lighting Supplies Co., Ltd. (174,477).—Private company. Registered April 29th. Capital, £5,000 in £1 shares. To take over the business of electrical and mechanical engineers carried on by H. Challis-Sowerby, G. F. Jones, and R. H. Homer, at 5, Cathedral Yard, Manchester, as the "Power & Lighting Supplies Co." The first directors are: G. Rigby, "Runnymede," Broughton Park, Manchester; H. Challis-Sowerby, "The Nook," Swinton Park, Manchester; J. Price, 102, Banner Cross Road, Sheffield. Qualification: £100. Secretary: G. F. Jones. Solicitor: J. E. M. Crowther, 23, Abingdon Street, Westminster. Registered office: 5, Cathedral Yard, Manchester.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Brierleys' Premier Welding Co., Ltd.—Particulars of £500 debentures authorised April 13th, 1921, whole amount issued, charged on company's property, present and future, including uncalled capital.

Lincolnshire Motor & Electric Traction Co., Ltd.—Satisfaction in full on April 1st, 1921, of debenture dated October 19th, 1919, securing all moneys and liabilities due from company to bankers. Particulars of £5,000 debentures, authorised April 1st, 1921; whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital.

W. R. Sykes Interlocking Signal Co., Ltd.—Particulars of £5,000 debentures authorised April 20th, 1921, whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital.

New Lowca Engineering Co., Ltd. (in liquidation).—Satisfaction in full on February 17th, 1921, of first mortgage debentures dated April 3rd, 1908, securing £12,500.

Campbell & Isherwood, Ltd.—Mortgage on certain land in Bootle, Lancs., dated April 28th, 1921, to secure all moneys due or to become due from company to Bank of Liverpool and Martins, Ltd.

Aladdin Renew Electric Lamp Corporation, Ltd.—Issue on April 28th, 1921, of £1,500 debentures, part of a series already registered.

W. T. Glover & Co., Ltd. (56,124).—Return dated April 4th, 1921. Capital, £214,850 in £1 shares (100,000 preference and 114,850 ordinary). All shares taken up. £117,000 paid. £97,850 considered as paid. Mortgages and charges: Nil.

Wycombe Borough Electric Light & Power Co., Ltd. (53,133).—Capital, £50,000 in £5 shares. Return dated April 19th, 1921. All shares taken up and paid for in full. Mortgages and charges: £50,000.

Electric Zinc Co., Ltd. (127,838).—Return dated December 31st, 1920. Capital, £2,000,000 in £1 shares (400,000 preference and 1,600,000 ordinary). Seven ordinary shares taken up. Nothing paid. Mortgages and charges: Nil.

W. S. Laycock, Ltd. (68,203).—Return dated January 6th, 1921. Capital, £150,000 in £1 shares (100,000 ordinary and 50,000 preference). All shares taken up. £50,007 paid. £99,993 considered as paid. Mortgages and charges: £221,000.

CITY NOTES.

Brush Electrical Engineering Co., Ltd.

Mr. E. Garcke presided at the annual meeting held on Monday at 88, Kingsway, W.C. He said the accounts again reflected the prosperous condition of the company. The amount carried forward was subject to E.P.D., not only for 1920 but also for previous years, no settlement of the amount payable having yet been arrived at. The question of what was the liability of the company in that respect was a difficult one, and might take some time yet to adjust. The amount carried forward was considerably in excess of their liability. It was a great relief that the E.P.D. had been abolished. They would not be liable for any such duty in respect of the profits made since January 1st this year. The gross profit on trading was £285,328, compared with £223,000 in 1919. The expenses, of course, were higher; general charges were £30,391, compared with £25,000. Maintenance of buildings and plant had cost £40,500, compared with £36,500. Interest charges amounted to £24,500, compared with £16,500; and for depreciation they had written off £13,000 as against £10,000. At the end of 1919 they carried forward £85,568, and that was reduced by £10,841 in respect of additional remuneration to the directors. The issued capital showed a large increase as a result of the issues made last year. They had had to provide for the largely increased volume of business, necessitating extensions of buildings and plant and a larger lock-up in stock of materials and of work in progress. The magnitude of the increased business could be best seen by the figures representing the item of stock. In 1918 it amounted to £145,000; in 1919 to £314,000; and now it was close on £600,000. The amounts owing to them had also increased. At the end of 1919 they had owing to them £90,000, and at the end of 1920 the outstanding amount was £226,000. One of the great difficulties of a rapidly extending business was to provide for the extension of the buildings and plant and working capital. In normal times these difficulties would not be onerous, but in the present state of the money market and of trade generally, these matters required very careful handling. However, they had not done badly. In July last year they issued an offer of 339,000 £1 ordinary shares at par. The issue was not underwritten; nevertheless, it cost them £15,500 for printing and various other expenses which were high but unavoidable. 248,075 shares were allotted in response to applications received, and, having regard to the not too propitious state of the money market at the time, he thought he might say that the issue was very well received by the public. One of the objects they had in mind in making the issue was to provide houses for some of their workpeople, owing to the general shortage of accommodation in the town; but as they did not get all the capital required, they had left that scheme temporarily in abeyance, and had had the less hesitation in doing so because since then conditions had changed to some extent. The town authorities had made progress with their own housing scheme, and there had been some lack of employment in other industries, which made the shortage of houses less pronounced. It was probable, however, that a little later they might have to revive the scheme, but at the moment capital expenditure for other purposes was more important. He thought they might regard the present position with satisfaction, and might look forward to the future with confidence. The specialities they controlled placed them in a favourable position, notwithstanding the prevailing depression in most branches of industry. Their order books were well filled, and there had been a gratifying increase in the demand for their Brush-Ljungström turbo-generator plant for electric power production. They began manufacturing the Ljungstrom turbine in 1914. The orders in hand to-day represented in horse-power more than the total they supplied in the whole of the period from the commencement of manufacture to the end of 1920. That gave some idea of the growth of the business. They hoped that the large new factory now under construction at Falcon Works, Loughborough, to be devoted to the manufacture of turbo plant, would enable them to cope better with the demand. He referred at the last meeting, to their difficulties in carrying through large contracts—which necessarily took months to execute—due to the fluctuating markets for materials, and the uncertainty of labour costs which compelled them to stipulate for price adjustment clauses. In that respect the position had improved, as they were now able to take the risk of making contracts at firm prices, which was a more satisfactory basis both for their customers and themselves. In 1920 the after-effects of the moulders' strike were severely felt; and in a lesser degree the coal strike of last autumn, and a dispute with the Electrical Trades Union were adverse factors. Those recurring labour troubles made it difficult and often impossible to keep faith with customers in the matter of delivery to contract dates, and were cumulative in the prejudice they created, as the uncertainty attending completion naturally militated against orders being placed. The export trade position was far from satisfactory, and the nation was already suffering heavily by loss of much of its foreign business. The first need to-day was to bring about reductions in the prices of commodities. Failing such reductions, that trade, which was so vital to the prosperity of the nation, could not be held in face of competition from countries where wages had not advanced in the same proportion, where the restriction of output was recognised as an error, and where the exchanges were so much in favour of the foreign buyer. Those conditions were a serious handicap to all engaged in the manufacturing industries of this country, and could only be met by bringing prices more into line with those offered by their competitors abroad. If that could be accomplished by means of increased production per head, rather than by the alternatives of lower wages or longer working hours, so much the better. One thing was certain, viz., that their foreign trade would gradually be lost unless some amelioration of the prevailing conditions was possible, while the home trade would also languish under the burden of high prices. In that connection, and apropos of the controversy in the coal mining industry of which they were now the victims, he would like to point out how largely the cost of coal entered into the price of all manufactured goods. That was especially true of the engineering industries, so dependent on steel and iron, which could not be produced at a reasonable cost without cheap coal. That was the real crux of the matter. Out of all the torrent of talk about nationalisation of the mines, national pools, national wages boards, &c., the cold economic fact emerged that, in order to export their coal and the manufactures of which it was the basis, it must be raised at a cost enabling it to be profitably sold in competition with foreign coal of equal quality —otherwise no solution of the present dispute could be permanent. But while fundamental economic facts were ignored on one side, they were relied on too exclusively by the other side. On the general question of labour disputes, he felt that every section of the community and every individual member of it—the Government, the employers, the employed and the consumers—should concentrate on the search for a permanent wage principle which recognised not only the economic rights of the capitalist, of the labourer, and of the consumer, but also the human or moral factors involved in the problem, as a substitute for the system of settling wages by the attrition of supply and demand of labour. The common phrase one heard was that "We must have it out." Quite so. But, as Mr. Clynes had said, "It is better to think it out than to fight it out." So long, however, as the employers were under the delusion that economic laws were the only laws of nature entering into the situation, and so long as the employed made the mistake of ignoring the rights and interests of the community as a whole, so long would the relations between capital and labour be adjusted by physical means. The report was adopted.

Calcutta Electric Supply Corporation, Ltd. During the year 1920 the units sold were 38,820,839, against 31,881,770 in 1919. The houses connected increased by 1,218 to 11,505. The gross revenue was £398,382, against £359,949 in 1919, and the net revenue was £263,482, against £237,206 in 1919. The profit for the year, including interest on money on deposit, was £270,160, and £45,699 was brought forward, making £315,859. This is to be dealt with as follows: Debenture interest accrued £4,579; preference dividend £24,750; income tax and E.P.D. £32,749; interest on consumers' deposits £1,385; writing off total costs of debenture issue in 1920 £24,793; reserve for taxation £83,000; to reserve fund £5,000; depreciation and renewals fund £43,760; insurance fund £3,000; retiring gratuity fund £2,000; dividend on ordinary shares 10 per cent. for the year and a bonus of 1 per cent. (£48,457); carried forward £42,386. The ordinary shareholders obtain, in the interim and proposed dividends, the relief granted in respect of income tax and super tax paid in India, which for the year 1920 is equivalent to about an additional 1 per cent.; and with effect from July 1st, 1920, preference shareholders have received their dividends free of all taxation on income, both British and Indian, up to 6s. in the £. It is proposed to grant to the staff in India a bonus equivalent to 2 per cent. of the net Indian profits, in respect of service during 1920. The expenditure on capital account during 1920 amounted to £338,937, the total outlay to December 31st last being £1,764,844. The demand for electrical energy continues to increase, and satisfactory progress has been made in meeting it. An issue was made in July, 1920, of £500,000 of 5 per cent. first mortgage convertible (registered) debentures, free of income tax. The issue was fully subscribed.

Johnson and Phillips, Ltd. Mr. W. Claud Johnson presided at the annual meeting on May 5th. He said that the profit for 1920 was again nearly £10,000 more than in 1919. Referring to the balance sheet, he said that they had expended during the year £63,408 on additions to buildings and plant. The amount for sundry debtors, £342,560, showed an increase of about £130,000, which was the natural consequence of a very largely increased business, and the same remark applied to the stock in trade and work in progress figure, which now stood at £563,356, an increase of nearly another £100,000. The profits earned during the year were very satisfactory, and the same dividend was to be paid on the increased capital as was paid last year on a much lower figure, although the new capital was not received until well towards the middle of the year, so that they had only had the benefit of it for just over six months. The profits must also be considered satisfactory from the point of view that the year under review was one of exceptional difficulty from the manufacturing standpoint. At the same time it was very pleasing to be able to report that their order books at the end of the year were as full as it was considered safe for them to be, some of the departments having from eight to ten months' work in hand, which included large and important Government contracts, so that the prospects for the current year might be considered highly satisfactory. Orders were still coming in, in spite of the troubled times they were passing through, which fact, he thought, warranted their looking forward with the fullest confidence to the future, as it seemed a clear indication of an early trade revival in which the electrical trade was bound to take the lead. The depression in trade, which set in during the closing months of 1920, and unfortunately still continued, had been felt by the electrical industry to a much smaller extent than by other branches of industry. That was largely due to the increasing recognition of the fact that in the extended application of electric power lay the chief hope of reducing production costs in every direction. Further, the fact that for a long time past the demand for their manufactures had exceeded the supply prevented their suffering losses due to depreciation in the value of stocks. Proceeding to refer to the resolution to be proposed at the extraordinary meeting to increase the borrowing powers of the company, he said that since its formation in 1905 £277,477 had been spent on additions to plant, machinery, and buildings, and during the same period £146,130 had been spent on repairs and maintenance of the property, and £119,500 written off for depreciation out of profits. Those outlays had been necessary to keep the works and plant up to date, and were justified by the results obtained. To maintain that position it had recently been necessary to obtain financial assistance from their bankers. They now wished to put their finances on a more solid basis by the creation of £350,000 of new debentures which would enable them to redeem the balance of the first debentures and pay off the £50,000 second debentures, also to repay their bankers' advances and provide further working capital to enable them to tackle the ever-increasing volume of business which was offered to them, and for which they were now fully equipped. They proposed to create £350,000 8 per cent. first mortgage debenture stock in multiples of £1 each redeemable in 25 years by a sinking fund to be created and applied in redeeming such debentures by 23 equal annual drawings commencing in 1923. They might have made a preference share issue, but having regard to the high rate of interest which was being paid by other industries for such issues they would have had to pay 10 per cent. interest at least, and that would have been a permanent drag on the business, whereas they would have an opportunity of paying off the debentures as they did in the case of the old debentures, only the remnants of which remained to be paid off, and so secure to the shareholders the full benefits of profits made. There was a further very interesting fact he would like to mention, which in these troublesome times was important, and that was, their relations with their workpeople were most satisfactory. They were one of the first businesses in the country to start a works committee, and it had always had the most beneficial results.

Mr. John Macgregor seconded the adoption of the report.

Replying to questions, Mr. Macgregor said that practically the whole of the £563,000, at which the stock stood, represented material which would be used in orders which were already in hand, and which had been taken at a profit.

Answering questions with regard to the proposed new debenture issue, the solicitor explained that the reason some of the money would be applied in paying off the existing 5 per cent. debentures was that it was not possible in these days to raise a substantial capital issue as a third charge. The question of underwriting the issue had not yet been settled, but the shareholders would have the first right of apply for the debentures.

The report was then carried.

Subsequently the meeting passed the necessary resolution for altering the articles of association and giving the directors power to make the new issue.

The Ever-Ready Co. (Great Britain), Ltd. The report for the year ended March, 1921, states that the amount available for appropriation, after writing off depreciation, is £21,101. The directors recommend, in addition to the interim dividends at the rate of 7 per cent. per annum on the preference and ordinary shares for the period ended September, 1920, final dividends at the rate of 7 per cent. for the half year ended March, 1921, on 102,007 preference shares, fully paid, and on 31,636 preference shares (12s. 6d. paid), plus interest at 7 per cent. per annum on payments in advance. During the year the company acquired the lease for 86 years of one of its factories situated at Carysfort Road, Stoke Newington, at a cost of £5,500 as shown in the accounts. The saving in rental is £480 per annum, and the company's surveyor reported that the erection cost at the time of purchase would have amounted to £13,000 apart from the leasehold value of the ground. In May, 1920, the company offered for subscription to the shareholders 40,000 7 per cent. cumulative participating preference shares at par and 31,636 were applied for and allotted. During the year the company completed the purchase of the additional manufacturing undertaking referred to in the circular letter of May, 1920. Meeting: June 1st at the Works, at Holloway.

The British Thomson-Houston Co., Ltd. The report for 1920 states that the greater part of the extensions to the Rugby works, begun during 1919, was still uncompleted, owing to the various causes which had retarded building operations generally throughout the country. New buildings which had come into occupation at the Willesden works had materially increased their manufacturing facilities there. The changes which were necessary to make the Birmingham works suitable for their purposes were being carried into effect as rapidly as possible. The profits for the year, after deducting all expenses and charges other than interest on debentures and loans, and after making provision for all estimated taxation for the year, were £470,470, plus £208,431 brought forward, making £678,901. From this there is deducted interest on debentures and loans, £179,990. There is to be appropriated for depreciations, reserves, &c., £210,000. The directors recommend that dividends be paid as below, leaving to carry forward £225,892. The dividends recommended are on the old and new shares for the respective times that they were outstanding during the year, and are as follows:—£400,000 old preference shares (since converted into ordinary shares) for eight months at 4 per cent., £10,667; £1,500,000 new preference shares for one month at 7 per cent. (free of income tax), £8,750; £400,000 ordinary shares for 12 months at 6 per cent. (free of income tax), £24,000; £773,500 ordinary shares for four months at 6 per cent. (free of income tax), £15,470; £826,500 ordinary shares for one month at 6 per cent. (free of income tax), £4,132; total, £63,019. In the last annual report the directors recommended that dividends aggregating £250,000 should be declared payable out of the capital reserve account. This was carried out by distributing £250,000 of £1 ordinary shares, of which £210,000 represented accumulated dividends on the old preference shares, and £40,000 dividends on the old ordinary shares. It was also duly approved that the share capital of the company be increased to £4,000,000; £2,000,000 in £1 ordinary shares, and £2,000,000 in £1 preference shares. Of the 2,000,000 ordinary shares, 400,000 replaced the 40,000 ordinary shares then outstanding of the par value of £10 each; 400,000 replaced the 40,000 preference shares outstanding of the par value of £10 each; while 250,000 were distributed in respect of capital reserve account, as stated above, so that when these transactions were completed, ordinary shares to the extent of £1,050,000 had been issued, and there were no preference shares outstanding. During the year there were issued at par the balance of the ordinary shares, amounting to £950,000, thereby completing the total issue of £2,000,000 ordinary share capital. There were also issued during the year, at par, £1,500,000 preference shares, leaving £500,000 to be issued hereafter. The directors have followed their usual practice of making reserves to cover risks in connection with bad debts and other contingencies. The directors record their high appreciation of the manner in which all departments of the company have discharged their duties during the year. Pressure of work has been very heavy, notwithstanding the fact that towards the end of the year the volume of orders began to show signs of decreasing. Annual meeting: London, May 18th.

The Charleroi Electrical Works. The report for 1920 of the Ateliers de Constructions Electriques de Charleroi states that, thanks to their entirely modern equipment, the works at Charleroi and Ruysbroeck were now able to deal with the whole domain of electrical manufacturing. The works constructed the most varied types of machines from the motor of ½ h.p. to the most powerful alternator, together with all the necessary high and low-pressure apparatus. During the year the company embarked on the production of large motors of from 15,000 to 20,000 h.p. for the direct driving of rolling mill trains, which had formerly to be obtained by the iron and steel industry from other countries, and on the other hand, development took place in the construction of winding engines for collieries, and of sets of motor-driven centrifugal pumps for mine drainage. The bulk production of small motors was organised at the new works of Ruysbroeck, where was also installed the department for railway and mine signalling apparatus, which was capable of constructing apparatus for the electrical operation of signals and points for the most important railways. Concerning the cable factory the report mentions that to the manufacture of armoured cables for all pressures and of telephone cables, there was added the production of signalling cables with multiple conductors, while the productive capacity in rubber-covered wires and cables was notably increased. The orders booked in 1920 exceeded 120,000,000 fr., and this permitted of the new year being begun with a well-stocked order book, which it was hoped would enable the company without too many difficulties to overcome the serious crisis through which the industry was passing at present. Including the balance of 209,000 fr. brought forward, the accounts show net profits of 10,296,000 fr., permitting of the payment of a dividend at the rate of 5 per cent. on the paid-up share capital from January 1st, 1914, to December 31st, 1920. The number of workpeople employed increased from 2,344 in December, 1919, to 3,600 in the same month of last year, and the directors add that a pension fund has been established for the employés, the company paying in an amount equal to that paid by the workers.

Madras Electric Tramways (1904), Ltd. Mr. A. M. Quill presided at the annual meeting on May 4th. He said that a strike had prevailed from January 26th to February 4th, and increased wages and allowances had been granted. One of the conditions of the settlement was that the employés would, under no circumstances, in the future, cease work without referring their grievance to the Labour Commissioner or other authority whom Government might appoint, should the management and the Tramway Union fail to reach a settlement themselves. They considered this arrangement of great value, but on the eve of the Duke of Connaught's visit to Madras, on January 10th last, a complete stoppage of work again occurred without even a complaint being formulated. As similar measures were subsequently adopted in other parts of India, it was obvious that the stoppage was inspired by political motives. The management in Madras, having inquired the nature of the men's grievance, was informed that the union demanded the reinstatement of two men who had been discharged several months earlier. The records of these men, however, showed that, if anything, they had been treated with too much indulgence. The appointment was also demanded of an official (in whose selection the union was to have some voice) through whom dismissals should only be made. It was, of course, impossible to share with the union any question of discipline, and in reply to a proposal to refer the question to arbitration, the board indicated that while they were willing to refer questions of wages, conditions of labour, or of principle to arbitration, they could not refer any question of management or discipline. Accordingly the strike went on until February 26th, when the men returned to work unconditionally. The effect of the stoppage would, of course, be reflected in the accounts for 1921. In addition to the strike early in 1920 a partial stoppage of the employés of the Madras Electric Supply Corporation, Ltd., which serves the tramways, occurred between May 26th and June 22nd, during which period they had a restricted service of cars running. Notwithstanding these labour difficulties, the traffic receipts for 1920 showed an increase of 16.6 per cent. on 1919. The balance from running account, after providing for cost of maintenance and all expenses in Madras, was £40,893, compared with £26,986 for 1919. The increase was almost entirely accounted for by the difference in exchange. In fact, the entire increase of 16.6 per cent. in traffic receipts was absorbed in increased cost of running, an experience which was probably common to all tramway undertakings. In the latter part of last year the Madras Government authorised them to make increases in fares up to 50 per cent. It was decided to exercise these powers partially, and on March 14th last the three principal stages of As. ½, 1, and 1½ were increased to As. ¾, 1¼, and 1¾ respectively. There had not been time to obtain reliable data regarding the effect of the increase. After reviewing the assets, the chairman said that the additions to the balance sheet amounted to £30,840, representing, chiefly, the Mount Road extension. They had practically completed their work, but until further progress had been made with the strengthening and widening of the bridges by Government, the line could not be opened for traffic.

Indian Electric Supply and Traction Co., Ltd. Mr. J. G. B. Stone, presiding at the annual meeting, on May 4th, said that they had again increased the number of units sold in all departments, except under the heading of special contracts, where, owing to the temporary stoppage of the mills due to labour unrest, they had a figure of 793,240 units, against 1,110,000 units in the previous year. The total number of units for 1920 in all departments was 4,334,724, against 4,067,923. In spite of labour unrest and delay in getting the necessary renewals for machinery and plant delivered in Cawnpore, they had secured the best results so far obtained by the company. The results of their small tramway were slightly more satisfactory. Good progress had been made with the new power house in course of erection, and the new 6,000-kW plant was now in course of shipment. They hoped to have effective use of the station early in the new year. There was already a demand for the whole output. The profits in Cawnpore showed an increase of Rs. 95,209. The earnings of the company were £35,188, against £27,932 in 1919. Of the increase £1,537 was due to the higher rate of exchange. The average rate of exchange for the year on remittances sent home was just over 1s. 10d.

London and Suburban Traction Co., Ltd. Lord Ashfield presided at the annual meeting on the 5th inst., at Westminster. He said that they had not had a successful year. Tramways throughout the country reached an unremunerative condition some months ago, not through neglect or incapacity in management, but due to the fact that while all payments had moved upwards with the rise in economic levels receipts had by the maximum powers legislation been held almost at the old level. The increases in fares authorised last year caused a steady advance in earnings. The traffic receipts of 1918 were £1,054,000; of 1919, £1,370,000; and 1920, £1,566,000, representing a growth in two years of 48 per cent. In the same period expenses only increased 46 per cent., so that there was a slight gain in net receipts. Now that expenses were once more falling, the tendency shown in these figures would become much more marked, and the results much more satisfactory; as indeed the results for the first three months of this year indicated. While he would not like to commit himself to the statement that the tramways were now out of trouble, he confidently looked forward to some appreciable advancement in their fortunes, and he was confirmed in this expectation by the results which had come before him month by month since January of this year. The first three months of this year showed a substantial gain on the results for the three corresponding months of 1920.

Babcock & Wilcox, Ltd. The net profit for the year 1920 was £497,468, plus £123,225 brought forward, less £2,100 directors' bonus voted last May. The preference dividend of 6 per cent., less tax, the second preference dividend of 5 per cent., less tax, and 16 per cent. free of tax on the ordinary shares being provided for, £150,000 is to be put to reserve and £10,000 to the Staff Pension Fund, leaving £99,828 to carry forward. The extensions at the works to provide for greater output and to make good the reduction in output occasioned by the alteration in working time to 47 hours per week are now completed. This has entailed a large outlay. The output of the workmen is still on the average below pre-war standard, and the continual interruptions, through trade disputes, militate against the business. The coal strike has caused a stoppage of the works in certain departments. New offices at London and Renfrew have been completed and occupied, and more workmen's dwellings have been completed during the year. New orders are just now somewhat difficult to obtain, owing to the high cost and the financial conditions that prevail. The construction of the large works of the Sociedad Espanola de Construcciones Babcock & Wilcox in Spain is now completed, and these works are in operation and well supplied with orders.

Pernambuco Tramways & Power Co. Mr. Follet Holt presided over an extraordinary general meeting on the 6th inst., at which a resolution was passed increasing the borrowing powers of the company by £650,000. The war held up their operations, and it was necessary to revise their position. More capital was required, and the fares must be increased to meet the additional labour costs and the fall in the milreis. In order to carry into effect the improved conditions of their concession they must complete the tramways to obtain improved fares. They had also to meet the indebtedness to their bankers and for essential materials supplied, which had accrued during the bad period through which they had passed, and also provide the funds for completing the lighting and power supply of the city, which was a most lucrative branch of their business. The electrification and equipment of the old steam tramline could not be delayed. In its present condition it was very expensive to operate and maintain, and electrification would bring immediate benefit. They had laboured under this burden of inadequate fares for the last six years, but now saw daylight, and believed that with the completion of the works their revenue from all sources would place the future of the company on a progressive and satisfactory footing. In spite of adverse circumstances the tramway and electric light and power system had shown satisfactory expansion. In 1915 they carried 15,000,000 passengers and last year over 32,000,000. In the same years the number of consumers of light and power had increased from 100, who consumed 175,000 units, to 3,000 consumers, who purchased 2½ million units. With normal exchange and normal values for fuel and material this expansion would have led them to a very satisfactory revenue. There was ample room for more development. The public wanted more cars and more light, and what the company wanted was higher fares, and these they would obtain when they had carried out their share of the bargain.

Dutch Wire & Cable Works. The directors of the N.V. Hollandsche Draad en Kabelfabriek, of Amsterdam, reporting on the past year, state that, owing to the developing depression, the results obtained in 1920 did not reach expectations. It was proposed to pay a dividend at the rate of 8 per cent. on the ordinary shares, as compared with 68 per cent. in 1919 (18 per cent. in cash and 50 per cent. in gratis shares). In forming an opinion of the amount of the dividend it was necessary to bear in mind in addition to the larger nominal capital, that the valuation of the stocks had been taken on the basis of pre-war prices, except in the case of rubber which, in consequence of the further fall in prices, had been entered at the lowest quotation in December. Through the return of former competitive conditions it was necessary, as before the war, to hold large stocks of manufactures in order to be able promptly to effect deliveries, both in Holland and abroad, and considerable amounts had, therefore, been written off the cost prices of these stocks by the operation of this method of valuation. As to the present and future development of the company, the directors point out that the depression prevailing in all markets, both in Holland and abroad, rendered it difficult to conclude new business, and in this connection it is submitted that leading foreign competitors had the advantage of easier labour regulations and lower exchange, and the cheaper labour costs associated with it, thus causing sale prices to be greatly depressed. On the other hand, the raw materials, which formed a considerable part of the value of the manufactures, were derived from countries having a sound currency, so that competition on unequal conditions remained limited to the costs of labour and general expenses. The net profits amounted to 284,000 fr., as compared with 2,090,000 fr. in 1919.

Swedish Companies. The shareholders in the *A.B. Induktor* have adopted a resolution to reconstruct the company.

The accounts of the *A.B. Elektrostalverk* show a small loss for 1920, which has been carried forward.

The report of the *Elektriska A.B. Volta*, which was reconstructed last year, states that the expectations of the passing away of the crisis which started after the conclusion of peace, of which indications manifested themselves in the later months of 1919, were completely disappointed during 1920. The year opened with a strike extending over two months, and this was not followed, as was expected, by an upward movement, but by a depression in the second half which practically paralysed all industries. The value of the turnover amounted to 1,900,000 kr., as compared with 2,490,000 kr. in 1919, and the stock of orders at the close of the year represented 305,000 kr. Owing to the heavy fall in prices in all departments, considerable amounts were written off for depreciation of stocks and of machines (1,577,000 kr.), and the directors report a loss of 2,295,000 kr. for the year on share capital of 6,500,000 kr.

The directors of *Nya Luth & Rosens Elektriska A.B.*, of Stockholm, which is the successor of the old company which was liquidated in the spring of 1920, have issued their report for last year. Although the undertaking was taken over by the new company as from the beginning of 1920, the new management first started its activity in June. The report states that the economic situation was found at that time to have become worse for the company, partly on account of the strike at the workshops for two months in the first quarter of the year, and partly because orders had to be accepted in the second half of 1919 to a great extent at prices below the costs of production with the object of ensuring continuity of working in the shops. These orders had to be executed in 1920 when the cost of labour and materials was considerably higher. Under these circumstances it was a commanding necessity for the new management to undertake a thorough reconstruction and curtailment of the administration which had swollen out to an excessive extent during the favourable situation of trade, and also to adopt measures for reducing the general expenses. In connection with this the company's branches and subsidiaries were reorganised, of which the report gives particulars. At the same time special attention was devoted to increasing the productive capacity of the shops in Stockholm and ot the foundry at Eskilstuna. All these measures rendered it possible to equalise the losses incurred in the first half of the year, which closed with net profits of 19,066 kr., which sum has been carried forward to 1921.

Rangoon Electric Tramway & Supply Co., Ltd.—As from April 1st, 1920, the control of this company was transferred to Rangoon. The accounts for 1920 show a gross profit, including transfer fees, &c., of £99,663, and after providing for debenture charges, allowing £3,115 for depreciation of sundry assets in Rangoon, transferring £27,500 to reserve for renewals, paying £4,150 Indian income tax, and deducting other charges, the net profit is £37,642. The directors recommend a dividend on the ordinary shares of Rs. 1-8 per share for the year (free of all income tax to shareholders domiciled in India or Burma), leaving £9,302 to be carried forward, against £4,360 brought in. Owing to fluctuation in the rate of Indian exchange, the board took counsel's opinion regarding the payment of dividends, and were advised that these payments could only be paid legally at the current rate of exchange. Since then dividends have been so calculated. It is on this account that the present dividend recommended on the ordinary shares will be declared in rupee currency. Warrants for the dividend on the ordinary shares will be posted in Rangoon on May 31st.—*Daily Telegraph.*

Jarrow & District Electric Traction Co., Ltd.—Total revenue for 1920 £16,532, an increase of £505. After deducting expenses, and adding £4,620 brought forward, the balance is £7,215. A dividend of 5 per cent. is to be paid on the ordinary shares, and £4,219 carried forward. The price of electricity supplied to that portion of the company's undertaking within the borough of South Shields was increased to 1.75d. per unit as from April 1st, 1920. The South Shields Corporation having refused to entertain the company's proposal for mutual through-running of cars on the tramways of the Corporation and the company, the Minister of Transport has been requested to exercise his powers under Section 5 of the Ministry of Transport Act, 1919, to order through-running, and, in default of agreement between the Corporation and the company, to settle the terms of such through-running.

Stock Exchange Notices.—The Committee has ordered the undermentioned to be officially quoted:—

Newcastle-upon-Tyne Electric Supply Co.—£500,000 4½ per cent. consolidated first mortgage debenture stock (redeemable).

Newcastle-upon-Tyne Electric Supply Co., Ltd.—134,834 5 per cent. preference shares (non-cumulative) of £1 each, fully paid, Nos. 1,359,502 to 1,442,951 and 1,443,952 to 1,495,335.

London Electric Supply Corporation, Ltd.—£100,000 4 per cent. first mortgage debenture stock (redeemable).

Yorkshire Electric Power Co.—80,306 ordinary shares of £10 each, fully paid, Nos. 1 to 45,380, 45,501 to 53,203, 53,302 to 53,343, 53,499 to 54,398, 55,396 to 65,353, and 66,254 to 82,576; and £230,000 5½ per cent. redeemable debenture stock.

Application has been made to the Committee to allow the following to be officially quoted:—

English Electric Co.—£1,250,000 8 per cent. six-year secured notes.

Gateshead & District Tramways Co.—Total revenue for 1920 £125,238. After deducting expenses, including £3,000 for renewals, and adding £3,659 brought forward, the balance is £35,525, out of which £10,215 is put to reserves, and £3,034 to mortgage sinking fund. The preference dividends of 6 per cent. and 5 per cent. are paid, and 10 per cent. is recommended on the ordinary shares, carrying forward £2,018. Capital expended during the year, £22,721.

Adelaide Electric Supply Co., Ltd.—Interim dividend on the ordinary shares for the half-year at the rate of 12 per cent. per annum., free of British tax.

Switzerland.—The Société pour l'Industrie de la Schappe, of Basle, is declaring a dividend of only 8 per cent. for last year, as compared with 20 per cent. in 1919.

New Steel Works in India.—At the annual meeting of Messrs. Fairbairn, Lawson, Combe, Barbour, Ltd., last week, the chairman referred to the works that through a specially formed company they were putting down in India. Considerable progress had been made with these Indian works, though, for reasons beyond their control, and principally delay in the delivery and fabrication of the necessary constructional steel work, progress had not been quite so rapid as they would have desired. The cost, however, would exceed what they, relying necessarily on expert advice from, and estimates prepared by consulting engineers acquainted with Indian conditions, had anticipated. In addition to increases on these estimates, they had to reckon with the fall in the rupee. They were assured that these works, when completed, would be the finest in India, and they believed that they would have a great future. They would be under the expert management of Major Alan Combe, who was brought up at their Belfast establishment.

Bath Electric Tramways, Ltd.—Mr. J. B. Hamilton presided at the annual meeting on May 5th. He said it was inevitable if business was to continue that costs would have to be reduced, and as the cost of living came down wages must also do so. They received permission last July to increase fares, and the result was an advance of £7,200, but this was not sufficient to off-set the extra cost of wages and materials. Fuel alone during the year cost over 24 per cent. more than in the previous year, though the tonnage consumed was less. A short time ago they adapted their furnaces at the power station so as to burn a lower grade fuel. The accounts this year did not include the motor business and foundry, these having been transferred to a separate company. It was exceedingly difficult to make any forecast as to the future.

Craigpark Electric Cable Co., Ltd.—During the year ended March 31st, there was a net profit of £15,677 after providing for E.P.D. and corporation tax, plus £2,926 brought forward, making £18,603. Out of this £2,000 is put to depreciation of buildings and machinery, £6,000 to reserve; 6 per cent. is paid on the preference shares for the year, requiring £2,850; a dividend of 12½ per cent. is to be paid on the ordinary shares, absorbing £4,687; leaving £3,066 to carry forward, subject to payment of directors' fees. The death is recorded of Mr. Donald MacLean, who was recently appointed a managing director, after serving with the company since its inception. Meeting held at Glasgow yesterday.

Northern General Transport Co., Ltd.—The company possesses a fleet of 102 motor vehicles, and the gross traffic receipts again show an increase, chiefly due to the larger number of vehicles in service. The investments in the Gateshead, Tynemouth, and Jarrow electric traction companies stand in the books at cost (£405,812). Dividends for the year 6 per cent. on the preference and 10 per cent. on the ordinary shares; carried forward, £17,853.

Siemens Bros. & Co., Ltd.—A final dividend is recommended of 1s. per share, making 10 per cent. for 1920, free of tax. The directors propose to increase the authorised capital by the creation of 1,000,000 10 per cent. £1 cumulative preference shares and to issue 300,000 of the same to all the existing shareholders by way of bonus, in the proportion of one fully-paid preference share for every five shares held.

Tynemouth & District Electric Traction Co., Ltd.—After paying 5 per cent. on the cumulative preference shares for the year and 10 per cent. on the ordinary, £8,794 is to be carried forward.

Submarine Cables Trust.—Net revenue for the year ended April 15th £35,052, plus £67 brought forward. After providing £9,195 to meet payment of the coupons, £25,905 has been transferred to redemption fund, leaving £19 to carry forward.

Melbourne Electric Supply Co., Ltd.—Interim dividend on the consolidated ordinary stock for the half-year at the rate of 10 per cent. per annum, free of British tax.

Western Union Telegraph Co.—Dividend of 1¾ per cent., less tax, on the common stock for the quarter.

Cleveland & Durham Electric Power Co.—After putting £5,000 to reserve and paying £32,665 to debenture interest, &c., £5,360 is to be carried forward.

Swansea Improvements & Tramways Co.—Dividend on 984 preference shares at the rate of 6 per cent. for 1920, and on 4,016 preference shares at the rate of 5 per cent., carrying forward £2,099.

Newcastle-upon-Tyne Electric Supply Co.—Messrs. Lazard Bros. & Co., Ltd., have purchased £250,000 4½ per cent. first mortgage debenture stock in this company at 70 per cent., and they are offering it for sale at 71½ per cent., less a brokerage of ½ per cent.

Anglo-Argentine Tramways Co., Ltd.—The directors recommend (subject to audit) the payment of a dividend of 5½ per cent. on the cumulative second preference shares in satisfaction of the arrears to December 31st, 1916.

STOCKS AND SHARES.

Tuesday Evening.

The Stock Exchange had been looking forward to an early settlement of the coal strike, but Tuesday afternoon's markets were disturbed by extraordinary rumours as to the possibility of there being an immediate extension of the trouble which might involve railwaymen and the transport workers. The effect was to dim a brightness which has been fairly general over the markets. It brought down the prices of the War Loan and of oil shares, thus upsetting investment and speculative securities alike. The coming of Whitsun has combined with these rumours to circumscribe the volume of business, and the Stock Exchange once more adopts a waiting attitude.

This week's introduction of the Railway Bill in the House served as a strengthening factor in advance, its effect being particularly noticeable upon the Undergrounds. District ordinary stock has gone up to 17, and Underground Electric £10 shares rose 7s. 6d. to 2⅜, while the Income Bonds strengthened to 73½. Central London stocks are better. London General Omnibus 4½ per cent. debenture is up 1 to 68. London and Suburban Traction ordinary went back to half-a-crown.

Doubtless the details of the Bill will be public property before these notes are published, but it may be of interest to recall that the Stock Exchange expectation in regard to the railway grouping was that all the London (local) lines would be merged into one group, the idea being that, by such means, working expenses would be reduced, competition lessened, and savings effected in various ways. So far as the tubes are concerned, this particular aspect of the matter will scarcely come into play, because competition has been practically eliminated, and it may be reasonably assumed that working expenses can scarcely be reduced except through the medium of a fall in wages. The railway companies have already come to a preliminary and amicable arrangement with their men, on the wages question, when de-control of the railway industry shall take place i August. It is, indeed, this aspect of the matter which has helped to strengthen prices as much as anything else.

With the possibility of cheaper money, investment stocks are still in demand. Central Electric Notes have advanced to 4 premium. City of London Electric new preference are 9d. premium, and the new ordinary stand at 1s. 3d. premium. Other new issues which have come out just lately are decidedly better. The Auckland 6½ per cents. offered not long ago at 100 are 3½ premium, and the appetite of the public for such investments is insistent. Debenture stocks of all kinds, and preference shares as well, are brought into the survey of those who have money to put into Stock Exchange securities. The strike-extension fears laid a check upon the buoyancy that gave signs of developing, but prices of these stocks are well maintained.

It is worth noticing that, within the last few days, attention has turned to the shares of the various Indian electric concerns. There are not many of these; nor is there any appreciable amount of floating stock on offer. The buying movement has already reduced the available amount of stock in the market, and of the following quotations it may be said that, while we take the middle prices in the Stock Exchange Official List, a seller of to-day would probably find it no difficult matter to realise at these figures, while purchasers would have to give more, provided they were able to get the shares at all. These are some of the chief shares quoted :—

Calcutta Electric Supply ordinary	4⅝
Calcutta Electric Supply preference	3¾
Calcutta Electric Trams ordinary	4¾
Calcutta Electric Trams 5 per cent. preference ...	2¾
Calcutta Electric Trams 4½ per cent. debenture ...	84½
Delhi Electric ordinary	7s.
Delhi Electric preferred	8s.
Indian Electric Supply ordinary	15s.
Indian Electric Supply 7 per cent. preference ...	16s. 3d.
Madras Electric Supply	13s. 6d.
Madras Electric Supply 6 per cent. preference ...	13s.
Madras Electric Tramways 6 per cent. preference	2⅜
Madras Electric Tramways 5 p.c. debenture stock	84½

London electricity supply shares are all steady, and business is very quiet pending more definite development in connection with the Electricity Supply Bill. Those who are interested in the market are watching, of course, with close attention the various phases of the 1921 Bill, and further interest has been aroused by the combating of the idea that the Bill seeks nationalisation, or even semi-nationalisation, of the industry. A memorandum prepared by Mr. Leslie Gordon, hon. secretary to the Conference of Local Authorities owning electricity undertakings in Greater London, sets up a useful standard at which the Bill should aim, namely, to "stop the wasteful system of persisting in an inefficient and costly supply in many parts of the area by excessive capital expenditure on existing unsuitable generating stations."

Chelsea ordinary at 3¼ and Charing Cross preference at 3 are both ⅛ up. County of London 4½ per cent. first debenture and second debenture at 67½ and 66½ are about a couple of points higher.

Siemens shares improved to 25s. middle. The company announces a final dividend, making 10 per cent. free of tax for the year. At the same time it is announced that powers are to be sought, at the meeting on May 23rd, for the creation of one million 10 per cent. preference shares, of which 300,000 are to be offered as a bonus to holders of the ordinary shares in the proportion of one preference to five ordinary now held. The news came as a surprise, and, at first blush, the market was not altogether pleased at the idea of an amount so substantial being placed in front of the ordinary capital. Cromptons at 16s. 3d. are 1s. 3d. to the good.

Babcock & Wilcox are a little easier at 2 7/16, and English Electrics lost 6d. at 13s., although the preference at 14s. 6d. are better. Telegraph Constructions hardened to 20¼, and the Cable group throughout is very firm, with rises in Anglo-American deferred, Eastern ordinary, Globes and Eastern Extension shares. Marconi's, after being 2 11/16, reacted to 2⅝, the preference shares being quoted at the same figure, while Marconi Marines are 28s. 9d. News from Mexico is a little more definite, but the various utility bonds and shares have not moved. The chairman of the Mexican Railway Co., who has recently returned from a visit to the country, reports that the capital presents a more prosperous appearance than at any time during the last twenty years. The United States Senate is again considering the question of recognising the present Government of Mexico, but it is assumed that a good deal more money will have to be spent before existing plant can be regarded as up-to-date and adequate.

The rubber market is lifeless, and amongst armament shares, a drop in Vickers to 13s. 3d. stands out as conspicuous after the previous rise to 14s. in the price of the shares. The iron and steel group had been tolerably firm until the rumours already mentioned in the first paragraph came into circulation. These caused slight reactions in most of the leading prices.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend		Price		
	1919.	1920.	May 10, 1921.	Rise or fall.	Yield. p.c.
Brompton Ordinary..	12	12	6	—	£10 0 0
Charing Cross Ordinary ..	7	8	3⅞	—	10 6 6
do. do. do. 4½ Pref...	4½	4½	3	+ ⅛	7 10 6
Chelsea..	4	6	3¼	+ ⅛	9 4 8
City of London	18	14	1 3/16	—	11 16 0
do. do. 6 per cent. Pref...	6	6	17/-	—	7 1 2
County of London	8	8	7⅝	—	10 8 10
do. do. 6 per cent. Pref...	6	6	8	—	7 10 0
Kensington Ordinary	7	9	4⅛	—	10 18 2
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref. ..	6	6	2¾	—	10 18 2
Metropolitan	6	7	3⅜	+ ⅛	10 7 4
do. 4½ per cent. Pref. ..	4½	4½	3 1/16	–	7 7 0
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	6	7	2½	—	9 2 10
South Metropolitan Pref... ..	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	5⅛	—	9 15 2

TELEGRAPHS AND TELEPHONES.

	1918	1919			
Anglo-Am. Tel. Pref.	6	6	78½	—	7 12 10
do. Def...	33/6	1½	16	+ ¼	9 7 6
Chile Telephone	8	6	5¼	— ¼	6 6 8
Cuba Sub. Ord.	7	7	7⅛	—	9 6 9
Eastern Extension	10	10	16⅜	+ ⅛	6 2 2
Eastern Tel. Ord.	8	10	162½	+1	6 8 0
Globe Tel. and T. Ord.	8	10	16⅜	+ ⅛	6 2 2
do. do. Pref.	6	6	9	—	6 13 4
Great Northern Tel.	22	22	22¾	+ ¾	9 13 4
Indo-European	13	10	30	+1⅜	6 6 6
Marconi	25	25	2⅝	—	—
Oriental Telephone Ord.	10	12	2⅛	—	*5 13 0
United R. Plate Tel.	8	8	6⅛	—	6 10 8
West India and Panama	1/3	Nil	9/16	—	Nil.
Western Telegraph..	8	10	16½	—	*6 1 3

HOME RAILS.

	1919	1920			
Central London Ord. Assented ..	4	4	45½	+1	8 15 10
Metropolitan	1¼	1½	25½	— ½	5 17 6
do. District	Nil	Nil	17	+1¼	Nil
Underground Electric Ordinary ..	Nil	Nil	2⅜	+ ⅜	Nil
do. do. "A" ..	Nil	Nil	7/-	+1/-	Nil
do. do. Income ..	4	2	73	+1½	2 14 5

FOREIGN TRAMS, &c.

	1918	1919			
Anglo-Arg. Trams, First Pref. ..	Nil	6½	2⅜	—	10 9
do. do. 2nd Pref. ..	Nil	Nil	3	—	Nil
do. do. 5 % Deb. ..	5	5	61½	+2	8 2 8
Brazil Tractions	Nil	Nil	31	—	Nil
British Columbia Elec. Rly. Pfce.	5	5	55	—	9 1 10
do. do. Preferred	2½	5	54½	—	*8 14 0
do. do. Deferred	Nil	8	51½	—	*11 17 6
do. do. Deb. ..	4½	4½	58½	—	7 5 4
Mexico Trams 5 per cent. Bonds..	Nil	Nil	42	—	Nil
do. 6 per cent. Bonds..	Nil	Nil	23½	—	Nil
Mexican Light Common	Nil	Nil	11½	—	Nil
do. Pref.	Nil	Nil	18	—	Nil
do. 1st Bonds	Nil	Nil	68½	—	Nil

MANUFACTURING COMPANIES.

Babcock & Wilcox	15	15	2 7/16	— 1/16	6 3 0
British Aluminium Ord.	10	10	16/3	—	12 6 2
British Insulated Ord.	12½	15	1 9/16	—	9 12 0
Callenders	25	15	1½	—	10 0 0
" 6½ Pref.	6½	6½	17/6	—	7 8 7
Crompton Ord.	10	10	16/3	+ 1/16	12 6 2
Edison-Swan	10	10	12/-	—	—
do. do. 5 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	17/-	—	11 15 4
English Electric	—	8	13/-	—6d.	12 6 2
Do. Pref.	—	6	14/6	+6d.	8 5 6
Gen. Elec. Pref.	6½	6½	19/-	—	6 16 10
do. Ord.	10	10	23/9	- 9d.	*8 8 0
Henley	25	16	1 7/16	—	10 8 8
do. 4½ Pref.	4½	4½	3¼	—	6 18 6
India Rubber	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	1 11/16	—	9 9 8
Siemens Ord.	10	10	1¼	+ ⅛	*8 0 0
Telegraph Con.	20	20	20¼	+ ¼	*5 18 4

* Dividends paid free of Income Tax.

SUBMARINE CABLE TELEGRAPHY.

Oscillatory Circuit Signal Conditions: Some Graphs, Tables, and Scales.

By **EDWARD RAYMOND-BARKER.**

(*Continued from p.* 576.)

23. Already the thought will have occurred to the reader that, considering the unsymmetrical sequence of electrical + and — impulses involved in the use of the customary equal-time dot-dash "cable code" for message traffic through a long submarine cable, the obtaining from the sending battery and transmitter, of an unfailing series of complete cycles or waves of alternate + and — sign, under the conditions here described, clearly is impossible. Likewise in the double-current *Morse* style of signalling now (in order to simplify Creed auto-typing requirements at terminals) coming extensively into use on certain amplifier-and-relay-linked cables, there certainly is a succession of current reversals, but the said sequence is unsymmetrical owing to the difference of duration in "dashes," as compared with "dots."

24. The fact is that only in General Squier's method of transmission with an unbroken current of alternating sine-wave electrical impulses, is an unfailing succession of complete cycles present. These regularly alternating sine-wave impulses of *rigidly uniform and equal time value*, constitute a system of symmetry absolute, excepting in so far as *amplitude* is varied in fulfilment of General Squier's conditions for control of "dot," "dash," and "space."

25. Here, one may mention that, in general practice, in the working of a cable, or series of cables, linked by Brown, Muirhead, "Dipper," or other cable relays, a test slip, or perforated band, to enable all stations to make any re-adjustments necessary, is occasionally run through a terminal transmitter. One of the main features of the said test slip which includes various standard types or series of signals, is a long series of reversals, each *positive* signal, and its corresponding *negative* reversal (or *vice versâ*), constituting—as has been shown—a complete wave or cycle (∼).

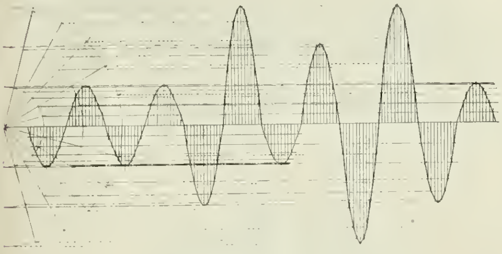

FIG. 3.

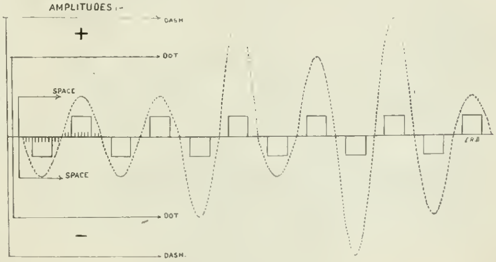

FIG. 4.

When Squier's unbroken alternating sine-wave current is the medium of signal transmission, special test slips are no longer necessary, the reason being that, in this system, the cable is ever "alive" and pulsating with equal-time + and — alternations varying in amplitude, but always constituting a truly symmetrical frequency. Fig. 3 is a graph showing the formation, in Squier's true sine-wave alternations, of the letters "A P." Fig. 4 also gives time-values for corresponding ordinary square-top impulse battery transmission, with "earth" intervals shown normal—though these last may be adjustable and varied, as in Muirhead's auto-transmitters.

26. True it is that Squier's excellent transmission conditions are, to a certain very limited extent, approached by John Gott's 2-power inverse-current method[*], in which equal-time contact signals alternate in polarity, but vary in amplitude. In another field of work Pierre Picard[†] had previously obtained relative symmetry by his momentary impulse electrical alternations respectively at start and at finish of each contact signal, whether long or short, with zero potential intervals—a system which revolutionised the working on many submarine cables of moderate KR, and brought into being, *inter alia*, the Paris-Algiers multiplex Baudot.[‡] One does not like to dogmatise on these matters, but one would have thought "Picard" would be very usefully suitable under circumstances as sketched in the latter portion of 23.

27. Coming now to "A" (paragraphs 7, *a*, *b*, and *c*), one is faced with the desirability of synchronic coincidence between (*a*) the sending station's frequency in terms of complete cycles transmitted per second—which, in 20, we have seen to be l.p.m. ÷ 30 — and (*b*) the natural period of free electrical oscillations in the receiving oscillatory system at the other end of the cable, as shown in fig. 5 (simplex connections) and fig. 6 (duplex connections).

28. In the electrical oscillatory circuits embodied in figs. 5 and 6, the main factors to be considered are K = capacity, in microfarads, of receiving condenser, and L = inductance in henries of a Brown, a Heurtley, or a Muirhead inductance shunt. Regarding other symbols, H.R.S. = high resistance shunt on K; S R = series resistance (non-inductive) added to L; R = receiver; S = receiving shunt.

29. Admirably illustrated and tabulated matter cognate to the mutually influential action and co-operation between K and L — as well as to the parallelism to be found between electrical and corresponding mechanical conditions — is to be found in Chapters II, III, IV and V of Dr. C. V. Drysdale's "The Foundations of Alternate Current Theory."[§]

30. All that is required now, for comparison with the signalling frequency "*l.p.m.* ÷ 30" given in 20, is an expression giving the frequency of electrical oscillations (∼ per second) present in the oscillatory circuit of reception, as shown in fig. 5 and fig. 6. Frequency, under these conditions, is the reciprocal of T the natural period, in fraction of a second, of each complete oscillation or cycle ∼.

31. Dr. H. W. Malcolm, on p. 62 of his book, "The Theory of the Submarine Telegraph Cable,"[‖] mentions that "The *natural* period of the free oscillations is fixed by the constants of the circuit. Let T be the periodic time; then—

$$T/\sqrt{KL} = 2\pi \text{ and } T = 2\pi\sqrt{KL}.\text{"}$$

32. Or $T = \dfrac{\sqrt{KL}}{1/2\pi}$, when K is expressed in farads.

33. Or $T = \dfrac{\sqrt{KL}}{1{,}000 \times 1/2\pi}$, when K is expressed—as it will be in this instance—in microfarads.

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[*] See "Alternating-Current Cable Telegraphy," by E. R.-B. in the ELECTRICAL REVIEW, August 20th, 1915.

[†] See "The Sounder in Submarine Telegraphy," by E. R.-B. in the ELECTRICAL REVIEW, February 28th, 1913.

[‡] See letter from Mr. H. H. Harrison, in *The Electrician*, April 25th, 1913.

[§] London, Edward Arnold, 1910.

[‖] Benn Bros., Ltd., 8, Bouverie Street, E.C. 4.

34. The frequency of the oscillations (~) per second—as stated in 30—will be the reciprocal of T the periodic time.

35. So this frequency = $\frac{1{,}000 \times 1/2\ \pi}{\sqrt{\mathrm{K\,L}}}$.

36. We are now able—in fulfilment of conditions and requirements mentioned in 30—to state the proportion thus :—

$$l.p.m. : 30 :: 1{,}000 \times 1/2\ \pi : \sqrt{\mathrm{K\,L}}.$$

37. This proportion enables one to obtain L in henries suitable for a given K in microfarads, or *vice versâ*.

38. In the first instance, let K be fixed. It is required to know, for a given K and for a given signalling speed in *l p m.*, what is the self-induction or inductance which, in co-operation with K, will give in the electrical oscillatory circuit of reception a frequency equal to the signalling frequency.

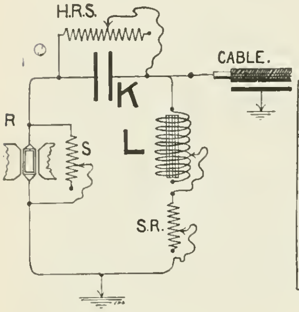

Fig. 5.

39. $l.p.m. : 30 :: 1{,}000 \times 1/2\ \pi : \sqrt{\mathrm{K\,L}},$

40. $l\,p.m. \times \sqrt{\ \ \mathrm{L}} = 30 \times 1{,}000 \times \cdot 1/2\ \pi.$

Dividing both sides by *l.p.m.*,

41. $\sqrt{\mathrm{K\,L}} = \frac{30 \times 1{,}000 \times 1/2\ \pi}{l.p.m.}.$

42. Squaring both sides and dividing both sides by K,

$$\mathrm{L} = \frac{1}{\mathrm{K}}\left(\frac{30 \times 1{,}000 \times 1/2\ \pi}{l.p.m.}\right)^2$$

$$= \frac{1}{\mathrm{K}}\left(\frac{4{,}774\cdot7}{l.p.m.}\right)^2 \text{henries.}$$

43. In the second instance, let L be fixed, while one requires to know the inductive capacity in microfarads K, which, in co-operation with L, and with a given signalling speed in *l.p.m.*, will give, in the electrical oscillatory circuit of reception, a frequency equal to the signalling frequency.

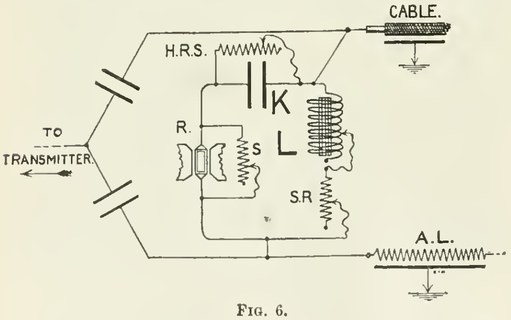

Fig. 6.

44. Reverting to 42 : By dividing both sides by L, and proceeding as before, one obtains :—

45. $\mathrm{K} = \frac{1}{\mathrm{L}}\left(\frac{4{,}774\cdot7}{l.p\,m}\right)^2$ microfarads.

46. Obviously the expression $\left(\frac{4{,}774\cdot7}{l.p.m.}\right)^2$ may be worked out once and for all for every conceivable value of *l.p.m.* that possibly may be required. The several numerical equivalents may be tabulated for future use and reference, as shown in Table II. Any one of these equivalents, on being divided by any particular K (or multiplied by the corresponding reciprocal, as most convenient for slide-rule work) will give the required L. Likewise, dividing it by a known L will give the required K.

47. Table III gives, for speeds 100, 200 and 300 *l p.m*, the relative inductances L severally for nine different capacities K.

48. Table IV gives, for speeds 100, 200, and 300 *l.p.m.*, relative capacities K severally for nine different inductances L.

49. These tables may be used conversely.

l.p.m	$\left[\frac{4774\cdot7}{l.p.m.}\right]^2$	l.p.m	$\left[\frac{4774\cdot7}{l.p.m.}\right]^2$	l.p.m	$\left[\frac{4774\cdot7}{l.p.m.}\right]^2$
100	2279·7	325	215·83	550	75·364
125	1459·0	350	186·10	575	68.951
150	1013·2	375	162·12	600	63.326
175	744·40	400	142·48	625	58.361
200	569·93	425	126·21	650	53.959
225	450·32	450	112·58	675	50.036
250	364·76	475	101·04	700	46.525
275	301·46	500	91·190	725	43.372
300	253·30	525	82·711	750	40.529

Table II.

K mfds	l.p.m.=100.	l.p.m.=200.	l.p.m.=300.
	L(henries) = $\frac{\left[\frac{4774\cdot7}{l.p.m.}\right]^2}{K}$	L(henries) = $\frac{\left[\frac{4774\cdot7}{l.p.m}\right]^2}{K}$	L(henries = $\frac{\left[\frac{4774\cdot7}{l.p.m}\right]^2}{K}$
20	113·99	28.496	12·665
30	75·991	18·998	8·4435
40	56·993	14·248	6·3326
50	45·595	11·399	5·0661
60	37·996	9·4990	4·2218
70	32·567	8·1418	3·6186
80	28·496	7·1241	3.1663
90	25.330	6·3326	2·8145
100	22·797	5·6993	2·5330
	KL=2279·7	KL=569·93	KL=253.30

Table III.

L Henries	l.p.m.=100.	l.p.m.=200.	l.p.m.=300.
	K (mfds) = $\frac{\left[\frac{4774\cdot7}{l.p.m}\right]^2}{L}$	K (mfds) = $\frac{\left[\frac{4774\cdot7}{l.p.m}\right]^2}{L}$	K (mfds) = $\frac{\left[\frac{4774\cdot7}{l.p.m.}\right]^2}{L}$
5	455·95	113·99	50·661
10	227·97	56·993	25·330
20	113·99	28·496	12·665
30	75·991	18·998	8·4435
40	56·993	14·248	6·3326
50	45·595	11·399	5·0661
60	37·996	9·4990	4·2218
70	32·567	8·1418	3·6186
80	28·496	7·1241	3·1663
	KL=2279·7	KL=569·93	KL=253·30

Table IV.

50. A booklet of tables, on the model of Tables II, III, and IV, may be worked out and compiled, suitable for any possible requirements that may arise in the working of any cable station, or any chain of cables.

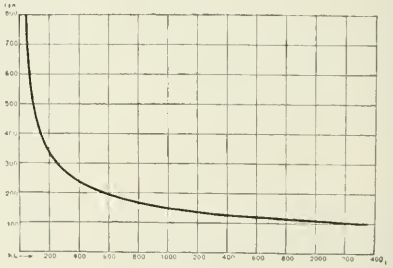

Fig. 7.

51. Figures at the base of Tables III and IV illustrate how the product of the correct K and L for any given oscillatory frequency, at any given signalling speed, is always a certain fixed value. A curve illustrating this is shown in fig. 7, in which ordinates are *l.p.m*, and abscissæ the uniform sequence of products K L.

(To be concluded.)

Belgian Electrical Progress.—In the report of the Société des Ateliers de Constructions Electriques, of Charleroi, for last year, which has just been issued, it is stated that the company is now giving employment to 3,600 workmen, as against only 2,443 when the war broke out in August, 1914. The works are now turning out all classes of electrical material from motors of ½ h.p. up to generators and motors of no less than 15,000 to 20,000 h.p., the latter being a development in connection with the electrical driving of rolling mills in iron and steel works, these large motors for the metallurgical industry in Belgium having hitherto been imported. Developments have also taken place during the past year in connection with the construction of electric welding, engines and pumps for collieries, electric signalling apparatus for railways and mines, while extensions have also taken place in the cable factory where all types of electrical and telephone cables are now being produced.

THE DAYSOHMS LOW-PRESSURE A.C. WELDER.

On the invitation of Messrs. Daysohms, Ltd., we recently visited their laboratory to see a demonstration of their new arc-welding set, which is a development of the Daysohms automatic current limiting regulators already described in our pages.

For the purpose of electric arc welding it is not necessary that the current should be mechanically regulated through its whole range, as shown in the previous descriptions of the regulators. To enable an arc to be struck and subsequently drawn out with as little as 50 volts on open circuit, it is essential that for an instant, when the arc is being struck, there should be very little choke in series, but as soon as the arc is established a relatively greater choke must be introduced in series to stabilise it, and keep the current within the desired limits.

In the case of hand-operated electrodes it is impossible to maintain exact current and voltage values, through and across the arc. Under the same electrical conditions the average values of these factors will vary with various makes of electrodes, various thicknesses of work with the same electrode, and also with various operators doing the same work with the same type of electrode. Also, owing to the unavoidable variation of the length of the arc due to the hand of the most skilled operator, and a bubbling of the molten metal and slag forming the terminals of the arc, and also owing to the inherent tendency of an arc to set up rapid variations of its own, the instantaneous variations of the voltage wave across the arc vary widely from the impressed voltage wave. Rapid variations of a duration of 1/2,000th sec. and less have been observed with an oscillograph.

It is also impossible for an operator to maintain an arc and read an ammeter at the same time, without varying the current he is taking from that he would be taking when only welding.

In consequence of the above facts, it is considered quite unnecessary to install either a voltmeter or an ammeter *provided* a regulator which can be simply and continuously set between the maximum and minimum current values is used. Under these circumstances the weld itself is the best indicator of whether the correct electrical values are being used.

In the Daysohms low-pressure a.c. arc welder there is one adjustment only, the hand-screw shown in fig. 1. A fraction of a turn frees the screw, and it may then be slid up or down the slot and clamped at any point, turning the average value of the current down or up precisely as a gas flame may be varied.

The construction and operation of the machine is as follows: The electromagnetic portion consists of a stator and rotor wound as a two-pole machine; the stator and rotor windings are connected in series with one another and in series with the arc. There are rather more turns on one member than on the other. In one position of the rotor, when the stator and rotor coils are all in one plane, the choke introduced in the circuit is due to the *difference* between the stator and rotor windings, and is quite small; this is the position for striking the arc. When current flows there is a torque set up between the rotor and the stator. This torque is to some extent counterbalanced by a fixed spring, and the speed at which the rotor can turn is regulated by a fixed dash-pot.

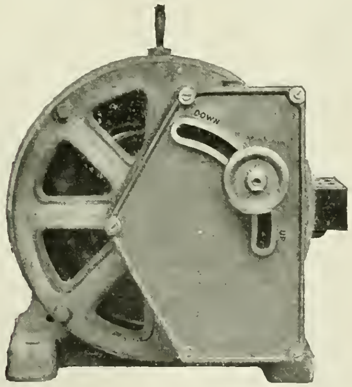

Fig. 1.—The Daysohms A.C. Welder.

If the rotor can revolve 180 deg. the choke increases as it turns until it reaches a value due to the *sum* of the turns on the stator and rotor windings, and the current and pressure across the arc are reduced to the lowest value; the amount to which this reduction can take place is set by the position of the hand screw.

This hand screw terminates in a pin projecting into the case, against which an arm fixed to the rotor shaft can engage; the position of the pin fixes the angle through which the rotor can rotate, and, therefore, the amount to which the current will be reduced. This is the only adjustment.

On striking the arc, a very considerable torque is set up between the rotor and stator, and the rotor would deflect so rapidly that there would not be time to volatilise the small bit of electrode required to set up the arc; a dash-pot is, therefore, provided to control the speed at which the armature deflects, and as the torque at striking is the same, irrespective of the ultimate current that the regulator is set for, the dash-pot is set, and does not require any regulation.

This dash-pot, however, plays a more important part in the regulation; the piston is provided with a valve so that it retards the rotor in one direction only, and it is free to return as rapidly as possible to the zero position under the pull of the controlling spring, with the result that when the arc is struck the pressure across it is reduced at a speed controlled by the dash-pot, but if, owing to the spluttering of the arc, its resistance is suddenly raised, the rotor can drop back and raise the voltage, catching the arc, as it were, before it goes out.

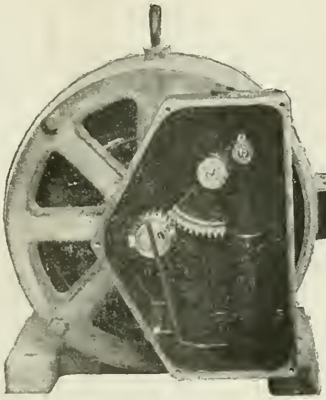

Fig. 2.—Mechanism of Welder.

At the time of our visit various electrodes were employed, and excellent results were obtained, demonstrating that the welder was capable of working with 40 to 60 volts on open circuit, according to the type of electrodes used. Once set to suit a particular job, the welder needs no attention, and several welders can be fed from a single transformer.

Russian Industry under the Bolshevist Rule.—The Russian railways are in a disastrous condition; on all sides is to be noted the lack of fuel and rolling stock. The track and bridges are in a shameful state. Repairs to track are made from material removed from branch-lines or even from other main-lines. Passenger trains run at a speed of 5 to 14 kilometres per hour. The Government has installed locomotive works at Sormorow, Kolumnad, and Brjansk, steel-plate works at Wykas, and wagon shops at Twer and Moscow. These works have promised to undertake a definite amount of work during a certain period. The Sormorow plant, for example, was entrusted with the production, under six months, of eight new locomotives, heavy repairs to 30 locomotives, and the manufacture of a certain number of spare parts. The works, which employs some 8,500 workers, simply did the following:—New locomotives, none; locomotives repaired, 14; and about 80 per cent. of the number of spare parts promised. The results from the other factories were similar, and their reports show unanimously that the cause of this is lack of fuel and lack of competent workmen. An equally deplorable condition exists in river transport. The fleet of oil boats on the Volga consists of 190 vessels—a totally inadequate number. Information from other industrial centres indicates that the diminution in the number of skilled workmen is general throughout Russia. The greater part of the operatives are now either working on the land or have been turned into public servants, of which there is one to every seven inhabitants. It is obvious that the representatives of the Bolshevist Government are well aware of the complete breakdown of its methods, as can be seen by the concessions on a large scale which they are conceding to foreign capitalists. The capitalists, nevertheless, who have entered into negotiations do so at great risk, seeing that the Bolshevist Government, whatever may be its intentions, will find it exceedingly difficult to fulfil its guarantees.—*Ingenieria Internacional.*

MAGNETOS FOR INTERNAL-COMBUSTION ENGINES.

By A. E. WATSON, A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

(*Concluded from page* 599).

Sparking should be independent of the material of which the contact points are made, whereas only certain metals, such as platinum and iridio-platinum, which do not form oxides when heated, can be employed, and even with these metals the sparking is largely affected by the condition of the points themselves, and can be greatly increased by the presence of small traces of dirt and impurities. The problem is not so much the suppression of true sparking as that of the condenser preventing local heating of the points which would tend to vaporise the metal and make conditions favourable for the production of an arc. Such local heating could be reduced by using a large number of turns in the primary winding, and actually sparking is thus diminished beyond the value at present customary, and true sparking sets in of an appearance quite different from that of the arcing usually known by this name. At present these conditions are not employed, as the voltages to which the insulation of the condenser and contact breaker would be subjected are considerable.

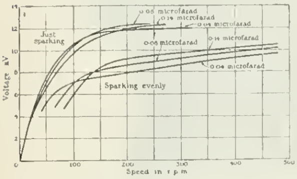

Fig. 7.—Effect of Condenser Capacity on Low-speed Voltage Curves.

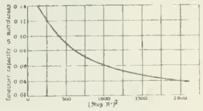

Fig. 8.—Effect of Varied Condenser Capacity on Sparking.

Fig. 7 shows the way in which the secondary voltage of a given machine changes with variation in condenser capacity, and fig. 8 shows the intensity of sparking at the points in terms of the condenser capacity, the sparking being determined by observing the image of the contact breaker on the ground glass of a camera, and finding the size of iris diaphragm which would just render it invisible. The capacity required to render a machine quite sparkless is considerably greater than that which gives the highest voltage for a given low speed, hence the capacity fitted is a compromise.

Depending upon the characteristics of the spark-gap and the machine, there will be a speed at which the flux change at break will be sufficient to raise the capacity of the secondary circuit to the breakdown potential of the gap. Provided the flux-change is only just sufficient to enable this voltage to be attained, the spark will be a capacity spark, and oscillatory, of extremely high frequency and short duration, as the circuit in which it flows has little or no inductance. Consequently, very large currents may exist in it, although only for a brief period of time, and it is undoubtedly this first white spark which produces ignition of the charge. After the passage of the initial spark, we are left with a certain proportion of the working flux still distorted and a further quantity of energy available. This energy is now communicated to the secondary circuit, but as the passage of the initial spark has left the spark-gap in a highly conducting condition, the discharge will follow the law governing the decay of current in an inductive circuit.

Although the flame which follows the initial spark is valueless from the point of view of ignition, it is particularly important that at all speeds the flaming portion of the spark shall have died out and that the secondary current shall have ceased before the primary circuit has been closed again. Unless this is the case, the flux in the armature core will not have been able to re-form, and consequently the energy available in the succeeding spark will be correspondingly reduced.

To make extinction as complete as possible we, therefore, require to use as long a cam as possible, keeping the contact points open for the greatest possible angle consistent with the provision of the short-circuited winding necessary for producing field distortion. The additional spark-gaps sometimes inserted in the secondary circuit and provided in all jump-spark distributors increase the total resistance of the spark-gap circuit and thereby reduce the spark duration. There are undoubtedly certain conditions of operation in which a jump-spark distributor will give more satisfactory ignition than one in which the distributor rotor makes actual metallic connection.

The inductance of the secondary winding can be controlled by modifying the shape of the pole-tips, and also to a slight extent by changing the number of secondary turns. To obtain a satisfactory compromise between all the factors involved is difficult, but the following principles will form a basis for the correct relationship between them :—(*a*) The number of secondary turns to be the least which will satisfy low-speed conditions. (*b*) The reluctance of the flux path to be such that under the worst conditions of high speed and maximum flux distortion the point of maximum B H is not exceeded. (*c*) The duration of open circuit of the primary winding to be as large as possible, *i.e.*, the points should be held open from the sparking position until the axis of the H armature is across the pole-faces or slightly beyond this position. This in most machines corresponds to a duration of "make" of 100 deg. and of "break" of 80 deg., the break occurring at approximately 10 deg. past the mid-position of the armature. These angles have been standardised by all the British magneto manufacturers.

Curves 1 and 2 in fig. 3, p. 599, show the effect of incomplete spark extinction in reducing the output of the same machine, fitted in one case with a cam opening for 80 deg. and in the other for 12 deg. Fig. 9 shows the "utility" figures for a similar pair of machines. A short-cam machine will tend to miss alternate sparks, and it can frequently be made to give either positive or negative sparks at will; fig. 10 shows the results of tests made on a machine which was liable to missfire on alternate gaps, and in which an electromagnet was fitted in place of the ordinary permanent magnet. Thus putting a better magnet in a magneto may not always be a cure for missfiring but may even make it worse.

The author summarises the results of his reasoning as follows :—

(1) *Low-speed voltage.*—Dependent upon available magnetic energy, primary resistance, speed of rotation, number of secondary turns, energy losses, and condenser capacity. Increases with increasing speed up to a limiting value, which increases with increase in available magnetic energy.

(2) *Utility.*—At high speeds proportional to magnetic potential of distorted field and inversely proportional to number of secondary turns. At low speeds dependent upon speed and primary resistance.

(3) *Energy in initial spark.*—At high speeds proportional to available magnetic energy. Dependent upon losses in iron of armature, &c., and to a certain extent on condenser capacity. If losses were absent the energy would be independent of the voltage, but, owing to their presence, the energy decreases as the voltage is raised. At low speeds it is dependent upon speed and primary resistance.

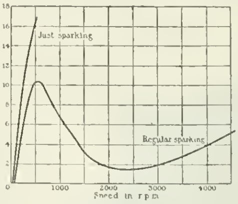

Fig. 9.—Utility Test on Short-cam Magneto.

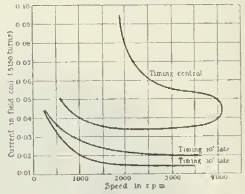

Fig. 10.—Effect of Incomplete Spark Extinction.

(4) *Total energy in spark and flame* follows the same law as the energy in the initial spark, but is greater in value. Theoretically the total energy may be twice that in the initial spark. This energy is approximately that stored in a magnetic field of value $2B$ at a potential of H and is $2BH/(8\pi)$ or $BH/(4\pi)$. If, instead of allowing this field to collapse suddenly, we maintain the potential H until $B=0$, additional work $BH/(4\pi)$ will be done upon the field, and the total available energy will be $BH/(2\pi)$.

(5) *R.M.S. value of current in secondary circuit.*—Depends upon characteristics of magneto itself and also to a very large extent upon the spark-gap resistance. A magneto may be made to give almost any reading desired upon a hot-wire ammeter, by altering the constants of the circuit. In particular, adding capacity to the terminals will increase the reading several fold.

Discussion in London.

The President (Mr. Ll. B. Atkinson) commented on the fact that such a piece of apparatus as the magneto should have been built up on empirical lines, not without much experimental work, of course, but empiricism was the hallmark of the Continental machine. Localised products of that nature were frequently of a high quality, but often when attempts were made to manufacture them elsewhere many alterations in method became necessary. The paper showed clearly how quickly research work could improve an article, and had resulted in the production of a British-made magneto the equal of any in the world. The paper was very clearly written.

Mr. C. C. Paterson explained that the author was one of the small band of men who had had to face the elucidation of the whole technique and theory of the subject and at the same time produce an enormous output of magnetos. He agreed with the paper; the characteristics and design of the magneto were not governed by the conditions necessary to produce ignition as energy was unimportant from the point of view of ignition. Practically all the energy a magneto had to furnish was expended in counteracting the leakage which always existed in the plugs, cable, &c., so that the necessary potential between the plug points could be built up. Together with Dr. Campbell he had shown that as regarded actual ignition, the quantity of electricity passing between the points of the plug was unimportant; whether a spark was "fat" or otherwise had no effect on the power obtained from the engine. Only about 1/70th of the energy supplied by the magneto, or about 1/1,000th joule, was required solely for the purpose of ignition. The first portion of the discharge, which lasted for about one-millionth of a second, did the work, and into it most of the energy should go; the rest of the energy which followed was not required.

Dr. N. W. McLachlan discussed the determination of the efficiency of magnetos, and pointed out that Dr. T. Jones had shown that, under ideal conditions, the ratio of the electrostatic energy stored in the secondary to the electromotive energy stored in the primary winding just before the contact points opened gave an efficiency of about 20 per cent. The speaker's own experiments indicated that the whole of the loss was due to hysteresis and eddy currents in the iron, and he suggested that more information on that point could probably be obtained by building the armature laminations into a non-metal frame. There was one oscillation of low frequency and high amplitude and another of lower amplitude and a fairly high frequency; inductance depended on the value of those two frequencies, and a decrease in inductance meant a smaller secondary peak voltage, and, therefore, less efficiency. They were chiefly concerned with the maximum voltage a magneto gave, not its rate of rise, and if it was high enough the necessary ionisation at the gap was a function of the pressure and its time of application. Nevertheless the voltage required to produce the necessary ionisation was greater the more rapidly it rose and, therefore, for any given plug leakage there must be a compromise between the maximum pressure and its rate of rise.

Prof. E. W. Marchant regretted that information he had intended to give the meeting had not come to hand. The most important part of the paper was its indication of the importance of minute and detailed testing of materials, and new steels would probably revolutionise the industry. Oscillograph records of the p.d. in the spark gap and the current flowing in the primary circuit of a magneto working with different gas mixtures indicated that there were large differences in the peak voltage under different working conditions.

Mr. J. F. Kayser compared the advantages of various magnet steels, saying that the demagnetising rates of two steels should first be determined, and then the flux of the two magnets. Dividing the total energy of a tungsten-steel magnet by the maximum energy per cu. cm. of a cobalt-steel magnet would give the necessary value for obtaining the same result. The original area of the tungsten magnet multiplied by the flux density at which it worked divided by the flux density at the point at which the cobalt steel would give its maximum available energy gave the new cross sectional area necessary. Magneto manufacturers made an unnecessary amount of fuss about remanence, which was useless practically, but interesting academically. The only criterion of magnetic worth was BH maximum.

Capt. A. B. Burgoyne explained that research work at Farnborough was still "going strong"; a good deal of practical experimental work was done, and the Air Ministry was anxious to assist manufacturers to meet the requirements of the Air Service, in which conflicting and special conditions were met with. It was a much stiffer problem to produce apparatus to operate successfully on aircraft. A higher voltage was necessary, and the magneto had to operate in air of rare density and low temperature, though the magneto itself might be exposed to considerable heat. It was also necessary to electrically screen off the wireless gear and, therefore, metal-braided h.p. cable had to be used, thus introducing additional leakage. A specification drawn up by the Air Ministry in conjunction with the Magneto Manufacturers' Association laid down that a magneto must fire a plug having a leakage of 200,000 ohms, whilst running at 3,000 r.p.m. Moreover, it must function properly after running over 48 hours in a saturated atmosphere, while after operating at a temperature of 120 deg. F. it must run for 500 hours and give satisfactory performance at 200 r.p.m., obviously more severe conditions than the author's utility test. After testing machines of almost every make, his considered opinion was that any British magneto was superior to the best American one; French and German machines ran closely to each other, but while the "Bosch" was of excellent workmanship, and ran well under bad conditions, much attention having been paid to detail, its design was bad, and electrical performance indifferent. The workmanship of the British magnetos was often poor, though they were at least equal to the "Bosch." The size and price of magnetos should be reduced by the extended use of cobalt steel.

(*To be continued.*)

JOINT ELECTRICITY AUTHORITIES.

London and Home Counties District.

In connection with the local inquiry which the Electricity Commissioners are to hold at the Institution of Electrical Engineers on June 14th and following days into the reorganisation of the existing supply of electricity in, and the formation of a Joint Electricity Authority to control, the above-named area, six schemes have been submitted by interested authorities for consideration at the inquiry. The following are abstracts of the schemes.

L.B. & S.C. Railway Co.'s Scheme.

The London Brighton & South Coast Railway Co. ("the Brighton Co.") is working parts of its London and suburban lines by electric traction. Prior to the war and subsequently considerable progress has been made in the work of equipping the remaining portions of such lines for similar working, and the Brighton Co. anticipates that this work will be completed in the near future. For the purpose of electrically working the first-mentioned parts of its London and suburban lines the Brighton Co. is taking from the London Electric Supply Corporation, Ltd. ("the Supply Corporation"), over 16,000,000 Board of Trade units of electricity per annum, and when the electrification of its London and suburban lines is complete it will require a supply of energy estimated at about 125,000,000 units per annum.

The Brighton Co. is under contract with the Supply Corporation to take from it up to 30,000,000 units per annum, and (subject to certain special provisions) the contract cannot be determined before December 31st, 1926. A comparatively small quantity of the electricity supplied to the Brighton Co. is used for purposes other than electric traction.

It is of vital importance that an adequate supply of electricity should be constantly available at the lowest possible cost for working such lines, and the Brighton Co. considers that this can best be effected by the following scheme:—

The Brighton Co. would arrange, or co-operate with the Supply Corporation in arranging, for the erection and equipment of a large generating station on a suitable site, which it is proposed should contain sets of 25,000 kW. each generating at a frequency of 25 periods, and that it should have an ultimate capacity of about 125,000 kW. The Brighton Co. and the Supply Corporation will agree so to operate their respective generating stations that any spare plant installed will be used to the best mutual advantage. After meeting its own needs the Brighton Co. would sell the surplus energy on reasonable terms to the Supply Corporation and to other authorised undertakers adjoining or near its railway.

G.E. Railway Co.'s Scheme.

The Great Eastern Railway Co. is, by the Great Eastern Railway Act, 1903, empowered to work by electrical power the traffic on its railways and on railways leased to or worked by it, and for that purpose to lay down apparatus and to make the necessary alterations in those railways and in any of its stations and works.

The company's scheme consists in the construction of a generating station, and to install generating plant up to the total capacity of approximately 120,000 kW, and to subsequently extend the installation of generating plant as required, up to the total capacity of the site which is approximately estimated at 225,000 kW. The G.E. Co. is advised that the load necessary for the electrical working of its railways is, both as regards size and load factor, such as to enable the proposed generating station to be economically installed and operated. The system of supply will be three-phase at 50 cycles per second. The main transmission pressure will be 33,000 volts, and the secondary local transmission pressure (if required) 6,600 or 11,000 volts.

Under powers contained in the Great Eastern Railway Act, 1915, the company acquired certain land at West Ham lying between its railway at Thames Wharf and the river Thames and Bow Creek, one of the principal objects of acquiring such land having been with a view to its special suitability as a site for the erection of a proposed generating station for the purposes of working the company's railways by electric traction in accordance with its statutory powers. It is proposed that the generating station should be constructed and operated by the G.E. Railway Co., and the company is prepared, so far as it is or may be authorised, to assist generally in promoting the efficient and economical supply of electricity within the district by the supply of any surplus energy for use by other railway companies associated with it or by the Joint Electricity Authority or authorised undertakers to the best mutual advantage.

Poplar Borough Council's Scheme.

The draft scheme submitted by the Metropolitan Borough of Poplar, E. (Mr. J. Horace Bowden, M.I.E.E., being general manager and chief engineer of the electricity supply undertaking) proposes to modify the area already delimited by the Electricity Commissioners, and that a Joint Electricity Authority to be called "the East London and District Electricity Authority" shall be established for the district, which shall consist of (*a*) twenty-two members of the Councils of all local authorities being authorised undertakers and distributors within the district; (*b*) seven members of the Councils of all local authorities having the right to purchase the whole or part of the undertaking of any authorised undertakers within the district; (*c*) three members of all County Councils partly within the district; (*d*) three members representative of large consumers within the district, who shall be appointed by the Minister of Transport, and (*e*) two members representative of labour employed in the supply of electricity within the district, who shall be appointed by the Minister of Transport.

After dealing with administration and powers, the latter including the manufacture of gas and the supply of hot water, steam, electrical apparatus, &c., the scheme sets forth the technical proposals as under [see Electrical Review, January 21st, 1921, p. 93]:—

The system of supply to be three-phase a.c., having a frequency of 50 cycles per second. The main primary transmission pressure shall be from 30,000 to 33,000 volts between phases, and the local secondary transmission pressure shall be from 6,600 to 11,000 volts between phases.

It is not proposed that any of the existing generating stations should be discarded immediately, but that they should remain in being so long as economic conditions justify; having regard to any cheaper and more reliable supply which may be available either by the interconnection of the various existing generating stations or from new capital stations proposed to be erected, but so soon as possible after the establishment of the Electricity Authority, the Authority shall appoint an advisory committee or committees of the engineers of all participating authorised undertakers which shall forthwith prepare to advise the Electricity Authority on the most efficient organisation of the finance, control, co-ordination, and operation of the existing generating systems in the prescribed area as will best secure convenience of administration and economy of production.

It is proposed that the existing generating stations within the district shall be inter-connected forthwith, and inter-connection shall be carried out in groups; in each group one station shall be selected as a primary supply station, and another as a secondary supply station; the selection will be based upon the most economic plant within each group. All the remaining stations within each group will close down during hours of "light load"; the primary and secondary stations will supply alternatively over each week-end light-load period, and the primary station will supply during night light-load periods. The existing generating stations within the district on the north of the Thames already inter-connected are those of the metropolitan boroughs of Hackney, Poplar, Shoreditch, and Stepney; the latter also supplying all the electricity requirements of the metropolitan borough of Bethnal Green. The North Metropolitan Electric Power Supply Co.'s generating station at Brimsdown is inter-linked with the generating station of the metropolitan borough of Hackney, and the same company supplies in bulk to the metropolitan borough of Stoke Newington.

It is proposed to extend inter-connection to the metropolitan borough of Islington to complete the group in the metropolitan area of the district, and to form a separate group by laying inter-connecting mains between the generating stations of the county boroughs of West Ham and East Ham, and the Urban District Councils of Barking Town, Ilford, Leyton, and Walthamstow. From the latter group the undeveloped areas of Wanstead and Woodford and others could be supplied. On the south of the Thames it is proposed that all authorised undertakings within the district shall be grouped in a similar manner.

The erection of a new capital station is proposed at Dagenham on a site which offers exceptional facilities for the delivery of materials, for coal handling, and for ash disposal. The capacity of the proposed initial station is 100,000 kW, the site being capable of accommodating an ultimate capacity of 400,000 kW. The preliminary drawings have been prepared, and together with the consultant's report, will be submitted to the Commissioners.

It is not proposed that any works shall be constructed by the Ministry of Transport under Section 18 of the Act.

It is not proposed that any existing generating station used solely for (*a*) railways or (*b*) tramways shall be immediately included in this scheme, but it is desirable that no such stations shall be extended provided that the Electricity Authority can prove to the satisfaction of the Commissioners that it (the authority) can meet the requirements. It is also desirable, having regard to the standardisation of frequency, that as the existing 25-cycle and 33⅓-cycle plant becomes obsolete, 50-cycle plant shall be substituted therefor, and the necessary supply taken from the Electricity Authority. All new supplies for railways and tramways within the district (or beyond with consent of the Commissioners) shall be provided by the Electricity Authority.

The remainder of the scheme deals with the financial arrangements proposing that the Electricity Authority may, with the sanction of the Commissioners, borrow money, provide a reserve fund, and adjust the charges made for electricity supplied so as to meet deficiencies or *vice versa*.

(*To be concluded.*)

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Wiring of Ferro-concrete Factories.

I will only occupy your valuable space to make the following remarks:—

1. I have already explained why I joined in this correspondence, and it should be clear that it was not out of prejudice against C.T.S. cable. I may add that I am not unimpressed by the good accounts given of this system of wiring.

2. The buildings with which I am concerned are not of ferro-concrete, but of corrugated iron or brick. Neither are they factories within the meaning of the Factory Acts, but they are subject to such conditions generally as local authorities care to impose. The last paragraph of my letter in your issue of April 15th should have made it clear that my remarks did not apply to the proper subject of this correspondence.

3. With regard to the question of fire hazard, I only raised this in the first instance as a possible reason for "Inquirer's" original remark.

If the experience of "Two Phase" is a common one, there would appear to be some reason for his condemnation of screwed conduit. I should like, however, to draw his attention to a letter in your issue of March 25th, from which it is apparent that the authorities at Vancouver consider that screwed conduit should alone be permitted in that part of the town where the most valuable and modern houses are located, and it is added that this is considered the only system that comes up to the requirements of modern fireproof buildings.

I do not pretend necessarily to uphold the last statement, and it is quite possible that the use of C.T.S. may not have come into so much prominence there as here.

The experience of other readers who have had fires on their effects on various systems of wiring would, I should think, be interesting and valuable. Perhaps some insurance officials would be so kind as to remark upon it.

A. C. Purday.

Croydon.
May 3rd, 1921.

Telephone Cables for use on Power Schemes.

With reference to Mr. Riley's letter in your issue of April 29th, I would point out that my figures for the cost of solid impregnated paper-insulated cables were based on the use of a thickness of insulation between conductors and between conductors and sheath of 80 mils. This because it is usual for this type of cable to be ordered "in accordance with the B.E.S.A. standards."

I am aware that this thickness is unnecessary and, in my article, gave the reasons. This type of cable is uneconomical, and its use can rarely be justified even with the thickness of insulation deemed necessary by Mr. Riley.

With regard to the transmission distances given in the article, I should have stated that they referred to type 2 cable (loosely insulated with impregnated paper), and are therefore not directly comparable with either of the series of figures given by Mr. Riley. I admit that they are low when compared with his, but much depends on the allowances made and the standard of speech aimed at. As it is obviously impossible to give figures which would cover every case, those quoted were intended only for general guidance. Speech transmission over longer distances could only be dealt with satisfactorily when details of a scheme were known.

Your Contributor.

Charging for Idle Current.

In your issue No. 2,267 Mr. E. W. Dorey says that a sine meter would have to be fitted with some sort of ratchet mechanism, so that it might run backward for a leading power factor. This is not so. Since the meter integrates E.I. sin $\phi\ dt$, it will naturally run backward if ϕ is negative.

Your correspondent also calls the tariff I described my tariff. This, too, is not correct; the tariff I described is one that has been adopted by a leading power company. I quite agree that this tariff is more severe on customers with very bad p.f. than the tariff he suggests, which is generally known under the name "Midland Tariff." He will find a discussion of the principle on which this tariff is based at the end of my book on "Electrical Engineering," and he will see that I am in favour of it because it is just to the supply company as well as to the consumer. The trouble is that this Midland

Tariff does not permit of rewarding a customer with a leading p.f. Mr. Dorey says that "a bonus for leading p.f. is unquestionably desirable." With a tariff based on the ratio of two cosines this policy can easily be applied; will he make a suggestion how it can be applied under the Midland Tariff?

Gisbert Kapp.

Birmingham.
May 9th, 1921.

I have read with interest the letters of Prof. Kapp and Mr. E. W. Dorey, following on the article by Mr. Carrothers in your issue No. 2,262.

I agree with Mr. Dorey that a two-part charge, whether based on kVA or kW demand, is sound in principle. The running charge only should be altered in proportion to the power factor, on a scale similar to that proposed by Prof. Kapp.

This can quite satisfactorily be accomplished by the insertion of an ordinary 3-phase meter in series with the main meter, but connected with the "slow" phase reversed. The average power factor of the three-phase load over any period can then be found from the well-known formula $\tan\phi = \sqrt{3}\,\frac{w_1 - w_2}{w_1 + w_2}$, the main meter giving $w_1 + w_2$ and the reversed meter giving $w_1 - w_2$. This method has the merit of requiring ordinary meters only, and any slight inaccuracy of the meter due to reversal of the "slow" element will not be serious, as the charge based on it will be a very small proportion of the total charge in ordinary cases.

I have used this method with success both from my own and the consumers' point of view, and have made a scale on my slide-rule which gives $\cos\phi$ direct from the ratio w_1 / w_2 ($w_1 / -w_2$ where $\cos\phi$ is below 0.5).

If leading power factors are anticipated, then the "fast" element of the meter can be reversed to give a positive integration on the meter.

J. D. Watson.

Aberdeen.
May 8th, 1921.

The Maintenance of Intercommunication Telephones.

I am one of those extraordinary persons who find pleasure in shouldering contractors' troubles with intercommunicating telephones, by taking their systems over in their name and maintaining them at a contract price. It would be interesting to know if there is another firm that has built a successful business in this branch alone of the electrical trade.

The average wireman not being conversant with the internal circuit of the intercom. 'phones and switchboard, finds it difficult to locate a fault; with this on the contractors' minds, I had a pleasant reception from them.

The B.E. Co.
G. Theobald.

London.
May 7th, 1921.

Transformers and Changed Frequency.

Your reply almost solves "Kilowatt's" problem, by saying: "If the frequency is halved the flux is doubled"; but the voltage ratio would probably change a good deal if the transformer were not liberally designed for iron.

On half-rated frequency, in order to double the flux in a saturated core, an enormous magnetising current would be necessary. Then owing to the large R.I. drop, only a much diminished e.m.f. is available for transformation.

H. Howwitz.

London.
May 7th, 1921.

[We avoided details in our reply, for the sake of brevity, and dealt only with the broad principles, using the words "roughly speaking" advisedly. In practice the iron losses would be seriously increased on the lower frequency.—Eds. Elec. Rev.]

A Peculiar Phenomenon.

In your issue of April 29th, Mr. James A. Lang states as follows: "Notably in the X-ray tube, where green rays are given off at the same time as the X-ray."

In 1915 I was doing a large amount of X-ray work, and was using Muller's tubes. The green light (or rays) was given off as stated in Mr. Lang's letter. However, when Muller's tubes could not be obtained, I was supplied with tubes which, I believe, were of British make. On using the latter tubes the light (or rays) was distinctly of a bluish colour.

I should be pleased if any reader of the Electrical Review could give me the theory of this difference in the colour of the visible light, in two different X-ray tubes. My theory is that the type of glass of which the tube is made is responsible; but why?

H. E.

Halifax.
May 4th, 1921.

Cables for Hot Situations.

I should be pleased if you or any of your readers would advise me of the best cable to use to stand a temperature of not less than 105 deg. F. dry air (sometimes considerably more). Permanence is essential.

R. A. H.

Water-tube Boilers.

With further reference to Mr. Cauthery's article on water-tube boilers in the Electrical Review dated April 1st, and the letter from Mr. A. Murray, our experience is that it is not safe to exceed one half a 1/32nd density for water-tube boilers, as we have found serious troubles to be experienced if this density is much exceeded, due to priming and pitting or corrosion of the tubes. The chemical action on the steel plates is greatly increased at high densities. As regards blowing down to reduce density, of course if the feed water is so pure that at the end of the run and when the boiler is due for cleaning, the density of the boiler water does not exceed the limit above mentioned, then there is no necessity to blow down at all; but as soon as the limit of density is reached, sufficient water should be blown out daily so that no further concentration takes place. If the make-up water is suitably softened, no appreciable scale will be deposited. We do not of course imply that the density above mentioned should be maintained by blowing out, with a leaky condenser. The only remedy is to repair the condenser as soon as possible. Serious damage may, however, be done to the boiler before the leakage is noted.

We know of a number of electricity stations where the boiler water is not allowed to exceed one quarter of a 1/32nd density, as they find from practical experience that this gives the best results. We are putting on the market a densimeter gauge for indicating the density of boiler water continuously. This does away with salinometer tests, and is a reliable safeguard against overheating due to excessive density. This gauge is recommended by all the boiler insurance companies.

Porter Water Softening Co.
W. H. Porter.

Flixton, Manchester.
May 9th, 1921.

Dynamic and Potentiometer Control for Cranes.

I should be pleased to hear the views of any of your readers on their experience of the electrical control of the hoisting motion of electric cranes.

Several of the leading controller firms are favouring a system of plain series hoisting and dynamic or potentiometer control for lowering depending upon the load on the hook. It is in connection with the lowering side when using a drum reversing controller and having no mechanical braking that I desire information.

It would appear that to lower the hook light (no load) a current equal to full-load hoisting is taken from the line on the first notch and 50 per cent. full-load current on the last notch, also full-load current is taken from the line with half and full loads, but in the case of half load about 10 per cent. current is taken from the line on the last notch, and current is generated back into the line to the extent of 20 per cent. on the last notch with full-load lowering.

The speed of lowering is interesting. With no load the speed on the last notch is 140 per cent. (approximate), and at full load the speed is 170 per cent. (approximate) of the full-load hoisting speeds.

The arrangement of the circuit when lowering is that of a shunt motor, and the speed is determined by the values of resistance in the branches. I should be pleased to hear how these values are fixed and what would be the effect of varying the resistance in the field and armature (1) when the motor is being driven down (no load) and (2) when the load is driving the motor (¼ to full load). With contactor equipments, I understand, load discriminators are fitted.

Drum Control.

May 8th, 1921.

Mme. Curie's American Visit.—Mme. Curie has left Paris for the U.S.A., where she is to receive a gift of one gramme of radium, valued at £32,000. According to *Science*, the following societies have appointed committees to arrange for the reception of Mme. Curie: The American Chemical Society, American Electrochemical Society, American Sections of the Société de Chimie Industrielle, and the Society of Chemical Industry, and the Chemists' Club of New York City. A luncheon is to be given in her honour at the Hotel Waldorf Astoria on May 17th, and President Harding, in subscribing 50 dollars to the Madame Curie Radium Fund, wrote: "I am so anxious about the success of the programme to present to this distinguished woman a gramme of radium that I would like to have a small part toward making the necessary provision."

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

11,560. "Electro-magnetic switches or contactors." Metropolitan-Vickers Electrical Co., Ltd. April 21st. (United States, April 23rd, 1920.)

11,562. "Lead for arc lamps." W. H. Argill. April 21st.

11,565. "Electric irons." H. H. Berry and W. J. Markham. April 21st.

11,568. "Electric cooking devices." S. Knevkosky. April 21st. (Czecho-Slovakia, May 14th, 1920.)

11,569. "Tuned high-frequency amplifiers for radio-telegraphy." C. T. Hughes. April 21st.

11,599. "Electric devices for heating fluids." E. A. Dinmore. April 21st.

11,602. "Magnetos." A. Christmas. April 22nd.

11,619. "Transmitting apparatus for automatic telephones, &c." A. Lambot. April 22nd.

11,647. "Electrical show-case and advertisement holder combined." E. E. Bayley and H. McReynolds. April 22nd.

11,660. "Slipper trolley heads for electric traction." Brecknell, Munro and Rogers, Ltd., and H. L. Rogers. April 22nd.

11,666. "Electric heaters." W. Hayhurst. April 22nd.

11,667. "Electric current transformers." Ferranti, Ltd., and A. H. Higgs. April 22nd.

11,668. "Sparking plugs." T. J. Puplett. April 22nd.

11,673. "Amplifier for electric circuits." Soc. des Telegraphes Multiplex (Systeme E. Mercandier, H. Magunna). April 22nd. (France, April 24th, 1920.)

11,679. "Electric arc lamps." S. B. Ausas. April 22nd.

11,682. "Protective devices." British Thomson-Houston Co., Ltd., and A. S. FitzGerald. April 22nd.

11,700 "High-frequency telephony." R. B. Ransford (Naamlooze Vennootschap Nedenlandsche Radio Industrie). April 22nd.

11,732. "Electrodes for resistance welding processes." R. F. Woodburn. April 23rd.

11,782. "Means for controlling or regulating electric arc lamps, voltage regulators, &c." F. M. Lewis. April 23rd.

11,783. "Vacuum electric discharge tubes." E. C. R. Marks (Siemens and Halske Akt.-Ges.). April 23rd.

11,799. "Method of compressing water for power purposes and generating electricity." J. Worthington. April 25th.

11,807. "Electrical distribution fuse boards, fuse boxes, &c." W. L. Barber and Midland Electric Manufacturing Co., Ltd. April 25th.

11,815. "Electric lamps." W. E. Bladon. April 25th.

11,817. "Electric connections." E. P. Hall. April 25th.

11,821. "Accumulator charging board." G. A. H. Wootton. April 25th.

11,829. "Method of manufacture of laminated magnetic masses with cooling vanes for electric machines." P. Ehrmann. April 25th. (France, April 4th, 1919.)

11,833. "Combined oil indicators and ignition switches for internal combustion engines." A. E. Eyles and K. Rotherham. April 25th.

11,837. "Insulated electric wires, &c." Callender's Cable & Construction Co., Ltd., L. V. Gibson, and M. A. S. Warburg. April 25th.

11,844. "Electric contactor controllers." R. F. Baerlocher. April 25th.

11,857. "Dynamo-electric machines." G. A. Juhlin and Metropolitan-Vickers Electrical Co., Ltd. April 25th.

11,863. "Measurement of temperature by electrical resistance thermometers." C. E. Foster. April 25th.

11,865. "Device for dimming electric head lamps on motor cars." C. Killelea and Vandys, Ltd. April 25th.

11,874 "Search lights or head lights." H. Breitbart and Pallas-Zenith Ges. April 25th.

11,877. "Means for heating filaments of thermionic devices." Ges fur Drahtlose Telegraphie. April 25th. (Germany, April 27th, 1920.)

11,890. "Electric heating." A. H. Pehrson. April 25th. (Sweden, April 26th, 1920.)

11,907. "Electrically-heated kettles, &c." W. W. Soutter and W. Soutter and Sons, Ltd. April 26th.

11,911. "Primary and secondary batteries." J. T. Niblett. April 26th.

11,920. "Flexible electric conductor." G. Marshman. April 26th.

11,932. "Method of operating discharge tubes or electric gas lamps with glow discharge." F. Skaupy and Studien Ges. fur Elektrische Beleuchtung. April 26th.

11,934. "Commutator or ignitino timer for motor cars." H. L. Pitt. April 26th.

11,943. "Electric burglar alarms." G. Kirk. April 26th.

11,945. "Electrically-heated vaporiser for internal combustion engines." F. J. Reed and J. S. Reed. April 26th.

11,955. "Electro-magnetic machines." E. S. Carey. April 26th.

11,966. "Electric power-transmission and braking systems." British Thomson-Houston Co., Ltd. (General Electric Co.). April 26th.

11,981. "Electro-pneumatic relays for organs, &c." J. H. Compton. April 26th.

12,005. "Means for mounting and driving magneto-electric machines on motor vehicles." A. M. Allen and R. B. North. April 26th.

12,008. "Rotors of turbo-alternators." Brush Electrical Engineering Co., Ltd., and C. C. Sutton. April 26th.

12,009. "Electric lighters for cigars, &c." A. Zecchini. April 26th. (Italy, April 26th, 1920.)

12,010 "Plug box for electric installations." W. Sack. April 26th. (Germany, May 21st, 1920.)

12,014. "Ventilation and cooling of electrical machines." H. C. E. Jacoby. April 26th.

12,015. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. April 26th. (United States, April 26th, 1920.)

12,023. "Combined ignition and lighting magneto generators." J. Bradley and Villiers Engineering Co., Ltd. April 27th.

12,047. "Electrical transformer tanks having oil bath, &c." Ateliers de Constructions Electriques de Charleroi Soc. Anon. April 27th. (Belgium, October 20th, 1920.)

12,051. "Electric connectors." E. W. Patterson (Dictograph Products Corporation). April 27th.

12,052. "Cable supports." E. W. Patterson (Dictograph Products Corporation). April 27th.

12,059. "Electrically-operated warning signals." D. McGregor. April 27th.

12,071. "Electric sewing machine cabinet." W. Fairweather (Singer Manufacturing Co.). April 27th.

12,076. "Means to prevent use of telephones." C. Monk and H. Yallop. April 27th.

12,105. "Telegraph systems." Western Electric Co., Ltd. April 27th. (United States, April 27th, 1920.)

12,114 "Electric resistance welding." F. A. Cramer and H. Marryat. April 27th.

12,124 "Reflectors for searchlights, &c." X. Bullinger. April 27th. (Germany, May 21st, 1920.)

12,125. "Electric lighters for cigars, &c." A Zecchini. April 27th.

12,131. "Speed controlling devices for railway, tramway, &c., trains." E. Rodolausse. April 27th. (France, April 27th, 1920.)

12,137 "Telephony." C. E. Prince and S. Turner. April 27th.

12,138. "High-frequency telephone systems." Ges. fur Drahtlose Telegraphie. April 27th. (Germany, May 20th, 1920.)

12,140 "Electric heaters." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). April 27th.

12,143. "Sound amplifiers for talking machines, and manufacture of same." A. Benoit, H. H. Duchesne, and J. L. Mathieu. April 27th.

12,145. "Rheostats." Metropolitan-Vickers Electrical Co., Ltd., and N. E. North. April 27th.

12,148. "Static frequency changers." Ges. fur Drahtlose Telegraphie and M. Osnos. April 27th.

12,154 "Laying electric wires in conduits, &c." L. Greger and F. Zachhuber. April 27th. (Germany, November 19th, 1920.)

12,170. "Electric mercury vapour lamps." A. Cohen. April 28th.

12,181. "Electric welding." W. Langdon-Davies and A. Soames. April 28th.

12,187. "Electric terminal couplings." W. J. Polyblank. April 28th.

12,197. "Thermal switches." W. K. Barker and S. G. Jones. April 28th.

12,211. "Electric light shades or reflectors." F. Noke. April 28th.

12,213. "Sound amplifiers for gramophones, &c." T. W. Price. April 28th.

12,224. "Electrically-operated signal." J. H. Combs. April 28th.

12,227. "Protective devices for polyphase electric currents." N. G. Langrish and Metropolitan-Vickers Electrical Co., Ltd. April 28th.

12,231. "Pendant chains for electroliers, &c." F. C. Shrimpton and G. S. Shrimpton. April 28th.

12,238. "Method of mounting terminals of electric heating elements, &c." Electric Fires, Ltd., F. L. Newhouse, and C. H. Smith. April 28th.

12,249. "Cord grip holders for electric wires." J. Y. Fletcher April 28th.

12,258. "Cases for electrical apparatus." British Thomson Houston Co., Ltd. (General Electric Co.). April 28th.

12,270. "Electric switches." Metallurgique Electrique. April 28th (France, October 29th, 1920.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1914.

12,157. "Electric gasfilled glow discharge lamps." Lederer. May 19th, 1913.

1919

23,700. "Distribution connected with single-phase alternating current systems." A. M. Taylor. September 26th, 1919. (Cognate application 2,858 20.) (161,602.)

24,480. "Electrically-heated melting and other furnaces." Morgan Crucible Co., Ltd., and C. W. Speirs. October 7th, 1919. (161,603.)

25,052. "Electric furnaces." M. R. Tremboin. March 24th, 1916. (133,954.)

25,088. "Electric rail and other metal body bonds and like connecting devices." British Insulated & Helsby Cables, Ltd., and J. W. Astley. October 14th, 1919. (161,607.)

28,844. "Wireless transmission of sound." E. C. Hanson. September 7th, 1915. (135,504.)

29,723. "Electric discharge apparatus." Western Electric Co., Ltd. (Western Electric, Inc.). November 28th, 1919. (161,619.)

1920.

793. "Electro-magnetic clocks." B. M. M. Moulin (née Chenard) and M. P. Favre-Bulle. January 9th, 1920. (161,650.)

809. "Wireless telegraph calling devices." W. H. Nottage and T. D. Parkin. January 9th, 1920. (161,652.)

878 "Electric plug connecting appliances." T. W. Jefferson and T. W. Jefferson, Ltd. January 10th, 1920. (161,659.)

887. "Electric switches and like apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). January 10th, 1920. (161,661.)

1,007. "Wireless direction-finding means for aircraft." H. R. G. van de Velde and J. M. Furnival. January 12th, 1920. (161,667.)

1,386. "Electrical condensers." Firm of R. Bosch. March 15th, 1915. (137,856.)

1,474. "Magnetos." N. C. F. Jenson and M. J. E. Tilney. January 16th, 1920. (161,696.)

1,612. "Construction of electric fire." H. J. Dean-Osgood. January 19th, 1920. (161,703.)

1,627. "Circuits of ignition systems of internal combustion engines." M. S. Conner and C. C. Pockette. January 19th, 1920. (161,704.)

1,635. "Electrical method of reproducing distant scenes visually." B. F. S. Baden-Powell. January 19th, 1920. (Cognate application 23,133 20.) (161,706.)

1,650. "Electrically-operated pumps." Merryweather & Sons, Ltd., J. H. Osborne, and C. H. Bown. January 19th, 1920. (161,707.)

1,714 "Magnetos." J. H. Tournayre. June 28th, 1919. (Patent of addition not granted.) (146,921.)

2,061. "Spark plugs." F. Hachmann. January 22nd, 1920. (161,720.)

3,156. "Electric fires." H. H. Berry. February 2nd, 1920. (161,745.)

3,168 "Submarine telegraphy." K. C. Cox. February 2nd, 1920 (161,746.)

3,186. "Electric induction apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). February 2nd, 1920. (161,748.)

3,270. "Methods of constructing electric resistance grids." C. E. Ogden. March 21st, 1919. (140,753.)

3,471. "Regulating systems for electric circuits." British Thomson-Houston Co., Ltd. (General Electric Co.). February 4th, 1920. (161,755.)

3,567. "Dynamo-electric generators for use in motor vehicles and like lighting and ignition systems." E. A. Watson and C. L. I. Manufacturing Co., Ltd. February 5th, 1920. (161,758.)

4,078. "Electric lamps." A. Konieczny. February 10th, 1920 (161,768.)

4,560. "Tramway rail beds." H. M. Dugeon and A. C. Baker. February 14th, 1920. (161,775.)

6,638. "Electric switch devices for preventing unauthorised starting and running of internal combustion engines." L. S. Crabb. March 4th, 1920. (161,798.)

7,147. "Electric storage batteries or accumulators." G. R. N. Minchin and Pritchett and Gold and Electrical Power Storage Co., Ltd. March 9th, 1920. (161,804.)

7,523. "Switches for electric signalling systems and like uses." R. Blunt and H. F. Mitchell. March 13th, 1920. (161,806.)

8,316. "Spark plugs." O. A. Stahl. March 20th, 1920. (161,812.)

8,421. "Apparatus for electric welding and cutting." J. A. V. Morse. March 22nd. 1920. (161,815.)

9,616. "Electrical resistance apparatus." C. J. Margerison and F. J. Shenton & Co., Ltd. April 6th, 1920. (161,827.)

9,809. "Sparking plugs for internal combustion engines." T. B. Broad and S. J. Plumber. April 8th, 1920 (161,828.)

13,517. "Means for detecting and indicating defective sparking plugs in the ignition systems of internal combustion engines." S. le F. Varvel. May 17th, 1920. (161,852.)

14,290. "Electrical systems containing X-ray or like apparatus." H. Pilon. August 19th, 1915. (143,860.)

15,912. "Trolley heads for overhead electric traction." H George. June 12th, 1920. (161,866.)

16,630 "Commutators for dynamo-electric machines." Siemens-Schuckertwerke Ges. June 27th, 1914. (145,467.)

18,153. "Electric amplifying devices such as thermionic valves." Siemens and Halske Akt.-Ges. October 25th, 1916. (145,777.)

19,814. "Armature cores for dynamo-electric machines." V. G. Apple. March 8th, 1918. (147,786.)

20,405. "Electrodes for electric searchlights." Optische Anstalt C. P. Goerz Akt.-Ges. September 24th, 1918. (148,450.)

23,183. "Magnetos having rotating armatures." Fabriques des Montres Zenith. November 6th, 1919. (153,562.)

29,780. "Electric furnaces." E. L. Smalley. October 21st, 1919. (152,686.)

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HOW ENGINEERING COSTS HAVE RISEN.

AN important paper, comparing pre-war and post-war production costs in the engineering industry, was read before the Royal Statistical Society on April 19th last, by Mr. R. J. A. Pearson, M.Sc., M.Inst.C.E., M.I.Mech.E., and published in our contemporary *Engineering* on April 29th. The subject is one the importance of which is scarcely capable of exaggeration, and the essential fact of price increase touches—if that is the right word—all sections of the community. Systematic investigations of the reasons for price increase have been undertaken by individual firms, and some useful facts were collated and published in tabular form in last July's issue of *BEAMA* by Mr. Frank Walker. We had not, however, until we read this paper, come across any attempt to reduce the facts to a scientific system, acting according to discoverable laws, and capable, therefore, of being used to estimate the future as well as to guide the immediate present. Since Mr. Pearson does not pretend to exhaust the subject, it would, we think, be well if it were taken further, preferably by a paper before the Institution of Electrical Engineers, where it could be discussed fully by those actually engaged in the production of the material and apparatus dealt with.

Four grouped items of cost cover all the expenditure of any industrial establishment, viz., direct wages, direct material, standing charges, and running charges, and since direct wages can be ascertained readily, it is convenient to express the remaining items as percentages of the amount represented by that cost group. Direct material, including sub-contracts, need not be considered under the head of costs, and this item, after receiving mention, is not further dealt with. Indirect material, indirect wages, interest, depreciation, rent, rates and taxes, advertising, insurance, and other expenses incidental to the manufacture and sale of goods, go to make up the oncosts, or those costs which do not vary directly with the amount of the product made.

The ratio between pre-war and post-war rates of wages is shown to vary considerably, in inverse proportion to the degree of skill of the worker affected. The limiting values tabulated by Mr. Pearson are 334.5 and 188 per cent. That is to say, the man who, before the war, was paid £1 per week has risen to £3 6s. 11d., and the man who received £2 18s. 8¼d. is now paid £5 10s. 2½d. Mr. Pearson reckons that the cost of supervision has increased in the ratio of 100 to 175, but here we think he has decidedly overestimated the increase. If design and sales staffs are included, the estimate is certainly on the high side, and this is borne out by the financial results of some of the concerns to which this paper might be applicable. Commercial charges, before the war, bore a certain ratio to works cost, and in many instances that ratio has continued to be used right up to the present time, with the result that commercial expenses have been considerably over-absorbed, and profits have been vouchsafed to those who never knew what it was to pay a dividend.

An important point, which, as the author remarks, has hardly been sufficiently appreciated, is the levelling of the percentage between indirect and direct wages for different classes of work as contrasted with pre-war conditions. In repetition work the ratio has fallen from 200 to 133, but in miscellaneous work, such as most of our larger engineering factories are concerned with, the ratio has risen from 75 to 112. This must have a most serious effect upon the prices that British firms are able to quote for electrical plant, for instance. Further, since the capital cost of manufacturing plant has about trebled, and rates of interest on borrowed money have about doubled, the amount of interest payable in respect of a machine has gone up in the ratio of something like one to six.

It is clear, as we have pointed out in these columns on numerous occasions, that overhead charges fall as the number of articles made increases. In other words, total costs are reduced as the load factor is increased. If output is doubled, however, it is too much to expect that running charges (other than direct labour) will remain absolutely constant, and Mr. Pearson makes the interesting deduction that running charges vary as the square root of the direct wages. This is modified by his observation that where a new department is in process of development a straight-line relationship exists between running charges and direct wages until the supply of standard accessories and stock becomes established.

Tables are given which show most clearly the difference that is made to profits by even a small falling-off in output. We have emphasised over and over again the fact that production means profit, and ca' canny, whoever practises it, means scarcity, dearness, loss, and dissatisfaction all round; and those who still have any lingering belief in the amount of work there is to go round being a finite quantity, which must be spread over the whole field of the workers, will do well to consider the matter in the light that Mr. Pearson sheds upon it. An enormous increase on the amount of the pre-war net output is required to produce the same percentage of profit, and this means that the capital locked up in work in progress has been correspondingly multiplied—a fact which is causing disquiet to even the largest and wealthiest industrial concerns at the present time.

The timely warning is given that the management must avoid becoming enslaved by some elaborate costing system, and that intelligent use should be made of the figures and results obtained. It is evident, however, that manufacturing costs must be reduced if the British nation is to continue in the forefront of industrial progress; and while we are of the opinion that there will have to be some fall in wages, we believe that increased intensity of effort is required from all. It has frequently been stated that this has notably diminished since the introduction of the shorter week, and instanced therefore as an example of the perfidy of labour, who promised that output should not suffer for that reason. We know, however, of cases where it has been definitely established that the production per man per hour is greater now than at any previous time, and we believe that with the keener competition that must henceforth exist in the labour as well as all other markets, the necessity for everyone to put his best foot foremost will be generally realised. Some are inclined to say that there are to be found, even now, in the middle of the coal stoppage, signs of revival in trade. We doubt this, although it is remarkable to see what a tremendous amount of business awaits more settled conditions, and nothing else, before it can be placed. The demand is there, as we have said before, and buyers are just holding off until prices have fallen, or have shown unmistakable signs of having hardened. Which of these two things will happen it is hardly possible to say. Conditions are far too unstable for prophecy to be safe. We still continue to pay income tax at the rate of 6s. in the pound in order to pay ourselves interest at the rate of £5 14s. per cent. A lot of time and patience will be required from us all before things settle down, but two things are certain. One is that the needs of the world are far from being satisfied. The other is, that that nation will gain the most, not materially only, but spiritually too, whose members work hardest and most intelligently with their brains and with their hands; are not afraid to give a little more than they get; and are prepared to carry into practice the good old copy-book maxims relating to patience and industry.

The Electricity Supply Bill.

In view of the strong opposition that is being organised to the Electricity (Supply) Bill in Parliament and in the lay Press, it is evident that the passage of the Bill will be far from peaceful; in fact, as the Government is chary of promoting contentious legislation, it may be doubted whether this Bill, which represents the third attempt to make good the deficiencies of the Act of 1919, will stand any chance of passing into law during the current session. Its failure to do so would undoubtedly be a calamity to the electrical industry.

One of the arguments advanced against the Bill is that it involves a nationalisation or "semi-nationalisation" of the electricity supply industry. If that allegation had a solid basis, it would obviously be applicable to the principal Act, and not to the Bill, which merely provides for the execution of the principles that were embodied in the Act. Again, it is urged that it introduces a "hybrid" form of nationalisation that is unprecedented. This is not true, even with regard to this country; moreover, the essential characteristics of the "Joint Authority" scheme are to be found in active operation in France and Germany, where the system of industrial and financial collaboration of municipalities and companies under State control has been in successful operation for years. A more dangerous charge, under the existing conditions, is that it constitutes an attempt to legalise the pledging of the rates on behalf of speculative trading; this argument requires some hardihood to put forward at this date. By the Act of 1882 authority was given to pledge the rates for the purpose of trading in electricity supply, which was at that time a vastly more speculative business than it is now. It has, in fact, ceased to be speculative; the business is there, without a doubt; customers are waiting metaphorically in queues for electricity, and to talk about it as "speculative" is pure nonsense—especially as those who raise that cry are quite willing to take up the "speculation." The position is quite plain: the ratepayers, backed by the Government, have long supported the policy of trading in electricity; they are now faced with the urgent necessity of developing that business as it ought to be developed, and if they refuse that responsibility, the alternative is for them to stand aside and let the concessions be granted to companies. We believe that this would be the best outcome in the public interest; but we cannot endure to hear the companies hypocritically denounce the Bill on the ground of "speculative trading" whilst they are hoping to secure the trade themselves. Attempts are being made to confuse the issues, and to represent that companies and municipalities are in the same boat; that co-operation is all that is necessary to fulfil the purposes of the 1919 Act, without Joint Authorities, and above all, without the Bill—but we have seen what the co-operative spirit amounts to, and it is evident that nothing effective will be done without this Bill, except in certain districts.

It is clear that the purpose of the opponents of the Bill is to wreck it, and with it the whole scheme of Joint Authorities; they wish to leave nothing of the 1919 Act but the Electricity Commissioners with power to make recommendations and draw up reports—in a word, the "nerveless figurehead" to which we have previously referred.

It is alleged that the local rates may be involved to the tune of 50 millions sterling. This is a gross misstatement: in the first place, a still greater expenditure on the security of the rates will be necessary if the local authorities are left to provide the extensions which are so urgently needed, and which they are bound to make in order to meet their statutory obligations; and in the second place, the demand for increased supply is already in existence and clamouring to be satisfied—there is nothing speculative about the business, and there is no reason to anticipate any call upon the rates at all. To suggest that "£50,000,000 may go on local rates"—the words used by the *Daily Mail*—is worse than disingenuous; it is false, for the reference is to capital outlay, but it is made to appear that the sum named would have to be met out of the rates. It has even been stated in a financial paper that the omission of the financial clauses proves that the Act of 1919 was a "hasty, hotchpotch measure," whereas it was examined with minute care by a Committee of the House of Commons over a period of months.

There is some truth, however, in the suggestion that the municipalities may refuse to accept the financial responsibility imposed upon them, if we may judge by recent indications. If so, they will have only themselves to blame if the supply industry passes from their hands. They welcomed the complete Bill of 1919 with open arms, and would have had it made even more oppressive to the companies by denying them representation on the Joint Authorities. If they now reject the financial clauses, they stultify their previous attitude and throw the whole business into the hands of the companies—for the Government will unquestionably decline to shoulder the burden, a blessing for which we are truly thankful. State control is inevitable, and may well be salutary; but State ownership and operation is synonymous with economic disaster and technical stagnation.

The case of London is unique, in that it is impossible to solve the problem of its electricity supply without the necessary financial powers. Schemes have been submitted to the Electricity Commissioners by various parties to which these powers are indispensable, and unless they are granted, the inquiry which is shortly to be held, and which is sure to be protracted and expensive, will be a waste of time and money. The reform of London's electricity supply depends on the passing of the Bill. The only alternative is the purchase of the undertakings concerned by the London County Council when the time matures, and in the meantime the industry will languish and London will be handicapped.

Further capital outlay is inevitable in all the industrial areas, and is urgently necessary; the Joint Authorities will decide how it can be expended to the best advantage, and they will act at every step under the control of the Commissioners and of Parliament, whose sanction is necessary to every scheme. Hence it is absurd to speak of the expenditure as "uncontrolled."

In dealing with these great questions, all political considerations should be excluded; the matter in each case should be settled on sound engineering and economic lines, and the Commissioners have shown, in the case of the North Wales district, that it is their intention to carry out this policy.

It is true that the Bill is capable of amendment, and one of the most important directions in which improvement is called for is in connection with the system of charging for electrical energy. At present it is obligatory to offer a flat rate per kilowatt-hour, a system which has repeatedly been shown to be unsuitable to the existing conditions, and the subject has recently been fully discussed by the Institution of Electrical Engineers. All parties are agreed that a multipart tariff is essential, without the short-circuit of a flat rate, and it is to be hoped that steps will be taken to provide in the Bill the necessary authority to charge on this basis.

In conclusion, we earnestly hope that the Bill will shortly become law. We have no fear that it will be used to prejudice the interests of the companies, which cannot be dispossessed or bought out compulsorily so long as they carry out their obligations. We anticipate that, where companies possessing the necessary powers exist, the Commissioners will entrust to them a due share of the work of electricity supply, and that in all their actions they will keep in view the prime necessity of a cheap and abundant supply of electrical energy throughout the whole country.

Are We Downhearted?

Does Mr. Walter Runciman, formerly President of the Board of Trade, and now President of the Association of Trade Protection Societies of the United Kingdom, imagine that he is going to do any good by prophesying that Britain will not regain her position in the world within a period of ten years? We have little faith in prophets who hazard guesses of this kind. When the war was at its height there were always some to say that it would be "all over by Christmas," and their optimism was as useless as was the gloom of the pessimist who foretold a struggle of long duration, and consoled us with the assertion that "the first seven years of a war were the worst." And we are as little inclined to-day to pay serious heed to those who predict a rapid fall in the cost of living, almost countless points in a few months, as we are to place the slightest confidence in those who gloomily predict a long-drawn-out continuance of our present adversity, and affect to possess some exceptional means of fixing the date when we shall once again—if ever—be on the flood tide of prosperity.

The situation, of course, is bad, everybody ought to know that it is so, but we shall only make things worse than they are, or than they need be, by uttering forecasts which add to depression of spirit, and suggest that there is plenty of time to spare before enterprising men can proceed to repair the breaches in the wall. Sir Arthur Steel Maitland, formerly of the Overseas Trade Department and subsequently associated with the Federation of British Industries, has just returned from a journey to South America and other countries, where he has been considering the possibilities of British trade. We have not yet taken advantage of the opportunities that were ours at the close of the war, but Sir Arthur says: "The chance, however, is still ours," though naturally it will grow less week by week and day by day. He writes a letter to *The Times* (May 14th), which we consider a very useful addition to the discussion on the coal controversy which is at the moment the chief obstacle in the way of our taking advantage of the export trade opportunity that still remains open to us.

If Mr. Runciman were chairman of an electrical manufacturing or engineering company instead of being personally more intimate with coal and shipping matters, he might take a different view of some sections of our national trade. While the coal struggle is in progress its consequences are adding considerably to the number of the electrical and engineering unemployed, but that is not because there is not work for them to do. Many of our manufacturers have plenty of business in hand, and there is plenty more to follow when confidence is restored and financial stringency is relieved. We believe that the placing of many millions of pounds' worth of electrical and allied contracts cannot be long deferred, and the healthy activity of the electrical industry will have a direct and indirect effect of an exhilarating kind upon other industries. The natural and inherent possibilities of electricity acting simultaneously both as the pioneer and as the servant of mankind are so great that every electrical man ought to be an optimist. Unfortunately, however, we cannot escape the consequences of the narrowness and folly of the extremist, the striker, the slacker, and the wrongdoer, who hinder the progress of the trade upon which their daily bread depends. If only we could secure the cordial co-operation of employers and employed in seeking the full development of the electrical industry in the interests of all, there would be little need for fear, and no need for gloomy prophecy. Would to Heaven that we would all settle down to our own particular tasks in the great work of setting the electrical industrial house in order instead of busying ourselves with clamouring for our individual rights, regardless of the best interests of the whole!

THE ROYAL SOCIETY'S SOIRÉE.

On Wednesday evening, last week, a representative gathering of Fellows and guests of the Royal Society assembled at Burlington House, Piccadilly, being received by Prof. Charles Sherrington, M.A., M.D., president, on the occasion of the first of the two annual conversaziones that are held by the Society. As usual main interest centred on the exhibits, and demonstrations constantly attracted attention during the evening; one noticed, however, nothing very novel of an electrical character.

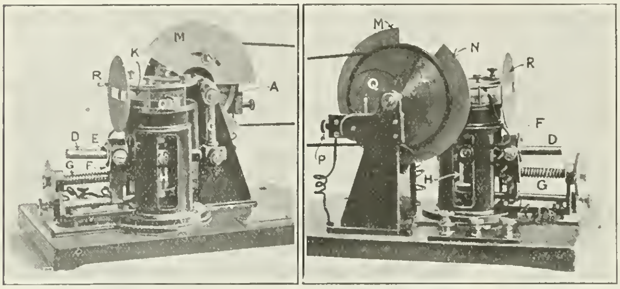


Fig. 1. Fig. 2.

Cloud Expansion Apparatus.

One of the most interesting exhibits was the latest improved pattern of cloud expansion apparatus by means of which the tracks of α and β rays and X-rays were continually demonstrated. It will be remembered that Mr. C. T. R. Wilson described his original cloud expansion apparatus, as used for this purpose, before the Royal Society in April, 1911, and at that time the Cambridge Scientific Instrument Co. undertook the production of the device. The manufacture, however, of this class of apparatus was entirely stopped by the war.

Lately Mr. Takeo Shimizu, of Japan, while working at the Cavendish Laboratory, Cambridge, considerably modified Mr. Wilson's original apparatus, and the Cambridge & Paul Instrument Co., Ltd., is now putting the improved design upon the market. In Mr. Wilson's original apparatus only a single expansion was obtained, and it was thought to be necessary to give a comparatively rapid expansion in the working chamber, which was obtained by connecting the space under the moving piston to another space which was previously evacuated; the moving piston was, in consequence, suddenly sucked down against a rubber stop. Mr. Shimizu found, however, that sudden expansion was not necessary, and he, therefore, arranged a reciprocating piston by means of which he obtains cloud tracks of the rays at each expansion which may be timed to occur at rates of from about 50 to 200 per minute. The instrument thus designed is extremely simple, but there are several important points to which attention must be given for successful operation.

In fig. 1 A is the crank which is driven either by a hand-wheel or by means of a small motor. This crank drives the upright connecting rod C which, in turn, drives the horizontal connecting rod D; the far end of D slides in a sleeve E and is free to rock in F, which can be adjusted in a horizontal direction by means of the screw G. The piston rod H is connected near the middle of this latter connecting rod, and it will be seen, therefore, that as the crank A is a constant length, the horizontal adjustment of F alters the length of the stroke given to the piston rod H. By this means the expansion ratio at each stroke in the working chamber K can be adjusted while the instrument is in operation.

Now, in order to obtain a good picture of the rays which become visible at each expansion by the formation of linear clouds on the ionised particles in the ray tracks, it is necessary that the clouds be dissipated during the compression stroke. This is done by forming a vertical electrostatic field in the expansion chamber. The upper glass plate of the expansion chamber through which the tracks are observed or photographed is covered on the inside with a gelatine film which is made conducting, and this film is charged negatively with reference to the metal piston, but by means of the commutator L (see fig. 2) which rotates with the crank A, the plate is discharged just before the occurrence of the cloud formation. In the same way as the expansion ratio can be adjusted while the instrument is running, so the length of the period during which the electric field is cut off can also be adjusted while the instrument is functioning by means of the screw P, which traverses the contact brush Q along the commutator L, which is shaped (as will clearly be seen in fig. 2) in the manner required to give this adjustment. Also rotating with the crank A are two adjustable lead segments M and N, which can be used as shutters for admitting X-rays to the expansion chamber at the proper intervals. It is on the back of the disk carrying these segments that the above-described commutator L is fitted. The expansion chamber is provided with a small tube O by means of which radioactive matter can be introduced into the chamber for the production of α or β rays. The present chamber is made 55 mm. in diameter, which is, of course, less than the length of the tracks of some of the α rays in air, but the velocity of the α rays can be reduced by passing them through a mica screen. A small screen can also be placed on the piston to cut off the α rays, except at the moment of greatest expansion.

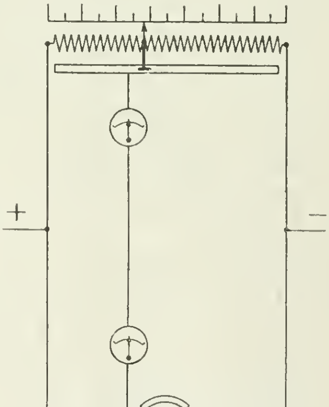


Fig. 3.—Diagram showing Principle of Pulsator Speed Telegraph.

The expansion chamber must be perfectly air-tight, as the minutest leak produces eddy currents which at once destroy the tracks.

The instrument is very quickly set up and easily operated, as a few expansions serve to filter out any dust originally in the air. The piston forming the floor of the expansion chamber is covered with a comparatively thick layer of gelatine containing about 10 per cent. of Indian ink. This gives a good black background against which the tracks show up brilliantly. For demonstration purposes a Pointolite lamp gives excellent results, but for photography a rather more brilliant lamp is desirable. Looking at fig. 1 the apparatus is seen as illuminated by means of a parallel beam of light coming from the left-hand side. The screen R cuts off all light except a small rectangular pencil passing through the middle of the expansion chamber.

Mr. Shimizu has taken many stereoscopic pictures on kinematograph films with his original apparatus, and by means of these stereoscopic pictures the exact paths of the particles in space can be calculated. The Cambridge & Paul Instrument Co., Ltd., hopes shortly to bring out a suitable stereoscopic camera as an accessory.

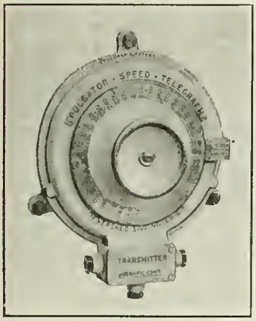


Fig. 4.—Transmitter or Speed Meter.

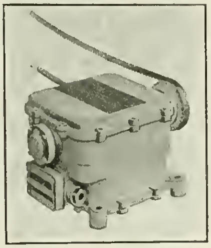


Fig. 5.—Chain-driven Pulsator.

Needham's pulsator system of speed measurement and control was shown in operation by Messrs. Evershed & Vignoles, Ltd. It provides a sensitive electrical means of measuring speed, and may be employed as a speed telegraph of novel and extremely trustworthy character. In addition to signalling from one or a number of control positions, measurements may be effected simultaneously and independently at a number of positions, so that the system is one of great flexibility; it also indicates the direction of rotation of the machinery, and provides an absolutely automatic relay by which it may be ascertained if an order to the engine room has been obeyed. The system is extremely suitable for use on ships, in power houses, and other places where a measurement or an indication of speed is desired at a distance from the moving machinery.

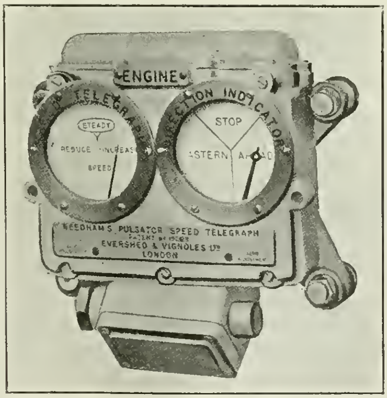


Fig. 6.—Combined Balance and Direction Indicator.

The system depends for the constancy of its indications on the capacity of an electrical condenser and on the value of an ordinary non-inductive resistance. The method of working is analogous in electrical principle to the operation of balancing a Wheatstone bridge and it, therefore, gives great accuracy and has a very large range. The diagram, fig. 3, shows the principle on which the device operates.

The action of the system is quite independent of voltage variation in the d.c. supply from which it is operated, and the apparatus may consequently be run from a ship's electric lighting circuit or any other convenient source of supply. The current taken is less than a quarter of an ampere for each transmitting or measuring position on a 220-volt circuit, while at 100 volts the current is halved.

The reply which the device provides when employed as a speed telegraph is automatic, and when the apparatus is in operation it is absolutely impossible to indicate that an order has been obeyed unless the apparatus under control is actually running at the speed which has been signalled to it.

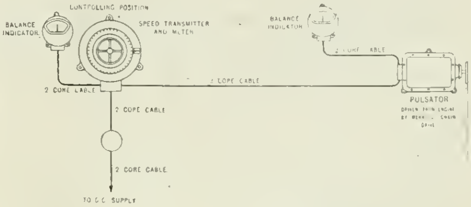


Fig. 7.—Lay-out Diagram.

The essential instruments of the system comprise a rheostat, fig. 4, serving either as a speed transmitter or speed meter, or both; a "Pulsator," fig. 5, driven by the engine or other apparatus, the speed of which is to be controlled or measured; and balance indicators which show when the pulsator is revolving at a speed corresponding to the position of a contactor in the rheostat. The speed transmitter and meter is mounted at the position from which control is to be effected which, in the case of a ship, would be generally on the bridge. One of the balance indicators is mounted in the engine room in a convenient position; the other, fig. 6, is mounted close to the transmitter or meter. The whole system is connected together by means of suitable cables, and is supplied from any available d.c. supply.

The diagram, fig. 7, shows the lay-out in the case of a simple installation capable of measuring and for controlling at one position the speed of an engine or other apparatus at a distance, but the arrangement shown does not indicate in any way the limit of the possibilities of the system. Arrangements can be made to suit cases in which a large number of alternative control or measuring positions is required, and the system can also be arranged to indicate or signal the direction of rotation of the engine or other apparatus.

The method of using the apparatus is as follows:—For controlling, the transmitter is set to the desired speed when, if the engine is not running at this speed, the pointers of the balance indicators will deflect to either "reduce" or to "increase" speed, depending on the nature of the order. The engineer must alter the speed of the engine accordingly until the pointer of his indicator shows balance, when the indicator at the control station will also show balance, and the operator will know that the order is obeyed. To measure speed, the dial of the meter is moved until the indicator is balanced. The speed can then be read off the dial of the meter against the fixed fiducial mark or pointer.

(*To be concluded.*)

OBSCURE DEFECTS IN HOUSE FITTINGS AND SOME UNUSUAL REMEDIES.

By "VOLTMAN."

The electrical troubles of the ordinary householder with regard to his lighting fittings generally prove on investigation to be what might be termed "obscure but minor faults." They are the little things that one would least suspect, and if one could go straight to them, one would save time, worry, and expense. When one gets a reputation amongst one's acquaintances as a dabbler in the electric arts one is liable to get all sorts of queer commissions to investigate faults which have nonplussed the local self-styled "electrician," who, one imagines, is really more in his element amongst gramophones and cycle accessories than in scenting out an elusive bad contact or using a galvanometer or test set.

One rather interesting case of the kind the writer investigated some little time ago. The centre light over a friend's billiard table was definitely "out," and holding up play. The local man had been called in, and as might be expected promptly diagnosed the trouble as a burnt-out lamp, but as a new lamp failed to function, the matter was held over to examine the fittings, and if need be re-wire them. The fuse on the three lights had meanwhile been found to be intact. Actually the fault proved to be a ludicrously simple one. At the suggestion of the writer it was decided to unscrew the cover of the ceiling rose. The cable ends, where they came through the terminals to which the flexible was connected, were found to be very much "alive." The terminal screws were tight up, and apparently firmly gripping the wires, but that was precisely the trouble; they were not long enough to grip, and both cable ends were, in fact, quite loose in the terminals. Luckily a small bit of the wire had been brought through the terminals and bent back. These ends were pushed into the terminals with the point of a penknife blade, and sufficient metal obtained to enable the screws to get a firm grip, and contact was restored. Thus the local man with his bag of tools and coil of cable was done out of a job.

Another house lighting problem which had proved a mystery to the household concerned was the case of a hall lamp which frequently switched itself on. How much current had been wasted was never known, but it is certain that the lamp used to be alight in the daytime continuously for hours. Again the solution of the mystery proved ridiculously simple. Inquiry indicated that when the light had been found "on" the switch seemed to be but partly "on," and only required a mere touch to put it "off." A glance inside the switch showed at once what was wrong. The throw-off spring had broken, and the contact arm was quite loose and had no positive off action. The application of Sherlock Holmes's methods of deduction infallibly showed that anyone putting on an overcoat or even brushing past would probably lightly and unconsciously touch the switch knob and close the circuit. An efficient substitute for a new spring was soon found by cutting a bit of rubber from an old motor tire tube. This was packed under the contact arm and provided ample tension. The "repair" has stood for three years, and may last indefinitely.

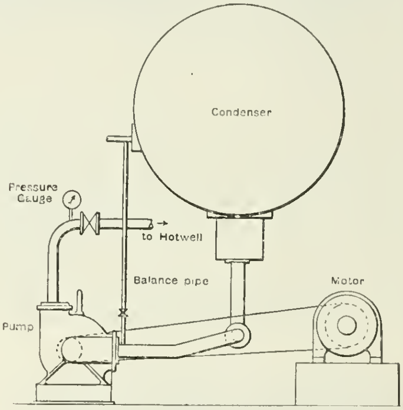
Obscure faults in lampholders are another source of worry to the non-technical householder. Here, again, it is nearly always a bad contact that causes trouble. The writer has "faked" two or three cases where lamps would aggravatingly light sometimes and not at other times, due to one or both of the spring plungers in the holder sticking. Arcing takes place and, of course, good contact soon disappears. A quite practical dodge of the writer's in such cases is to put a touch of solder on the lamp contacts so that firmer pressure is obtained against the plungers, which generally have a little "spring" left, but not much.

New lamps, owing, it would seem, to incorrect fitting of the cap, not infrequently fail to make contact even when the holder is in perfectly good order. The touch of solder treatment on the contact plates will quickly put this defect right and enable the lamp to be used.

AN EMERGENCY EXTRACTION PUMP FOR A CONDENSER.

By W. N. Y. KING, A.C.G.I., A.M.I.E.E.

The reliability of the steam turbine has been so proved that a supply of power can be depended on continuously for commercial purposes from two or three generating sets. Sometimes one set only is considered sufficient equipment to rely on for a private plant. In view of the fact that several such plants are in operation, many engineers are keenly interested in reducing any chance of failure to a minimum. The auxiliary plant is an important factor in this connection, principally as regards the condenser. While a steam turbine can operate successfully exhausting to atmosphere when the condenser fails, the boiler plant may, and very probably will, not have sufficient capacity to meet the extra demand for steam; especially with the class of fuel which has been and is likely to be obtainable for some time now. It may happen, then, that the full load cannot be maintained for long, and in addition the cost of the extra steam required will be about 50 per cent. more. Therefore, in case of a failure involving the closing down of a condenser, any temporary means of avoiding these consequences will prove a valuable asset. One example of this occurred in the case of a 1,500-kW turbine on the failure of a condensate extraction pump of the centrifugal type, running at 1,420 r.p.m. The pump cover was fractured and the vacuum gradually failed during a period of about 15 minutes, allowing time for another machine to be run up on load before turning on to atmosphere. There being no spare extraction pump, a temporary arrangement was made to enable the condenser to work by coupling a centrifugal water pump of the ordinary type to the condenser outlet, and driving it by means of a 20-h.p. motor and belt. The actual power required would have been met by a smaller motor, but the most readily available machine was made use of. The arrangement, illustrated in the accompanying sketch, proved thoroughly satisfactory, the whole condensate being dealt with, and full vacuum maintained, 28 in. to 29 in., in spite of the fact that the pump was of a different type to that designed for the purpose. Repairs to the fractured pump were then carried out at convenience.



Emergency Pumping Plant.

JOINT ELECTRICITY AUTHORITIES.

(*Concluded from page 634.*)

London Electricity Joint Committee 1920 (Ltd.).

The London Electricity Joint Committee 1920, (Ltd.), in submitting a scheme for the constitution of a Joint Electricity Authority, does so under the following reservations:—

The Joint Committee is not satisfied that the district, as provisionally determined by the Electricity Commissioners, is the best and most economical that could be devised for the supply of the London area. This being the case, in adopting the technical scheme prepared by the Engineering Committee appointed by the London County Council, the local authorities and the Joint Committee,[*] it adopts it as the best scheme for the district so provisionally determined as a whole, and not necessarily the best scheme for an altered London area. In certain circumstances it might be necessary to modify the district provisionally delimited by the Commissioners, but any modificaton would depend upon the extent to which the local authority and company undertakers within the district were prepared to join in a scheme for the establishment of a Joint Electricity Authority and the extent of the area covered by the undertakings which might so join.

The chairman and vice-chairman shall be appointed by the authority, and may, but need not, be appointed members. The members of the authority shall be appointed by the: (*a*) London County Council, five; (*b*) City Corporation, one; authorised undertakers in the district, being local authorities, (*c*) whether they have entered into an agreement with the authority or not (one for every 100 million units sold by the whole of such authorised undertakers within the district during the year ending March 31st next preceding the appointment); (*d*) who have entered into an agreement as aforesaid (one for every 50 million units sold by the whole of such authorised undertakers within the district during the year ending March 31st next preceding the appointment); authorised undertakers in the district (not being local authorities), (*e*) whether they have entered into an agreement or not (one for every 100 million units sold by the whole of such authorised undertakers within the district during the year ending March 31st next preceding the appointment); (*f*) who have entered into an agreement as aforesaid (one for every 50 million units sold by the whole of such authorised undertakers within the district during the year ending March 31st next preceding the appointment); (*g*) local authorities of areas in the district outside the County of London, from whom any right to purchase any or part of an undertaking is transferred to the authority by this scheme, two; (*h*) railway companies and large consumers (*i.e.*, consuming not less than 250,000 units per annum), three.

Notwithstanding anything in the Act or in this scheme, the authority shall not afford any supply of electrical energy to any railway company during the continuance of any agreement in force on the appointed day for the supply of electrical energy to such railway company by any authorised undertaker without the consent of such authorised undertaker. Agreements to transfer to the Authority generating stations and main transmission lines of authorised undertakers within the district shall not apply to any part of the undertaking of the Metropolitan Electric Supply Co., Ltd., which is outside the County of London, and is not subject to any right of purchase by a local authority.

It shall not be obligatory on the Authority to supply electricity to any authorised undertakers who have not agreed to transfer to the Authority their generating stations and main transmission lines within the district.

With regard to the financial proposals, as the law now stands the Authority could presumably borrow money for the purposes of carrying out the scheme on the security of its undertaking, but further capital powers seem open to doubt.

The remaining two schemes, submitted by the London County Council and the Conference of Local Authorities Owning Electricity Undertakings in Greater London respectively, have already been outlined in our pages (see Elec. Rev., Dec. 10th, 1920, p. 744; Mar. 18th, 1921, p. 363; and Feb. 11th, 1921, p. 169).

The Kent Electricity Area.

At a meeting at Gwydyr House (London headquarters of the Electricity Commission) in July, 1920, a committee consisting of the following gentlemen: Messrs. E. O. Forster Brown, E. E. Hoadley (Maidstone Corporation), H. B. Harvey (Kent Electric Power Co., Chatham), J. A. Forde (Isle of Thanet Electric Tramways & Lighting Co., Ltd., Broadstairs), A. Raworth, and Thomas Hesketh, acting secretary (Folkestone Electricity Supply Co., Ltd.), was appointed to survey the present position and potential requirements of electricity supply in the County of Kent (exclusive of the London area), and to recommend a general policy of development. The committee's report, which is dated November, 1920, has just been submitted to the Electricity Commissioners, and what follows is an abstract of it.

Present Position.—The bulk of the existing demand for and supply of electricity in the district under consideration (see fig. 1; the diameters of the circles are proportional to the electricity demands) are broadly for manufacturing purposes in the western area and for lighting and colliery purposes in the eastern area; while in the central area, which is mainly confined to agriculture, electrical developments are practically non-existent. The western manufacturing area may be defined as that lying approximately to the north-west of a line drawn through Tunbridge Wells, Maidstone, Sittingbourne and the coast. The eastern area lies approximately east of a line drawn a little west of Whitstable, Canterbury, and Folkestone. The only generating plant of which the committee is aware in the central and agricultural area is one of 500 kW at Ashford, belonging to the South-Eastern & Chatham Railway, and one of 250 kW at Faversham.

The demand for electricity for manufacturing purposes in the western area is a very rapidly increasing one, whereas in the eastern area the lighting demand is increasing at a more normal rate. It should be emphasised that in neither area has the development of electricity supply attained proportions in any way comparable with the more highly industrialised districts of Great Britain. The existing position of affairs in the eastern area, however, is likely to be entirely altered as the existing colliery undertakings in the south-east Kent coalfield become fully developed, and when new collieries are sunk in the undeveloped portion of the coalfield. The development of this field, and the effect is will have in creating conditions for the generation of electricity on a large scale at a relatively low cost, will eventually therefore convert an essentially lighting area into an intensified industrial one.

Another important factor which may in the future influence the scope and direction of electrical development is the electrification of the South-Eastern & Chatham Railway. The materialisation of this project might influence general electrical development not only in the western and eastern areas, but also in the intervening agricultural area; altogether apart from the possible construction, at some future date, of the Channel Tunnel.

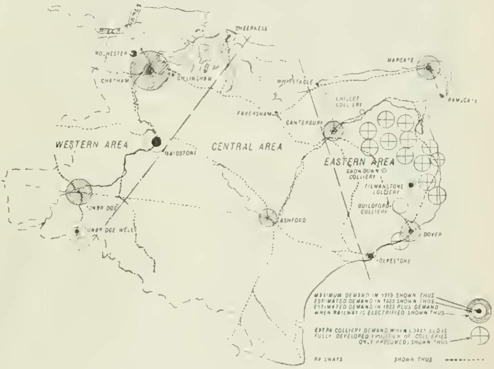


Fig. 1.—County of Kent Electricity Supply District.

The existing arrangements are not adequate to deal with the future requirements of the district, which should be controlled by one Joint Electricity Authority, although in the first instance there will probably be two independent areas of supply, situate in east and west Kent respectively. As development matures, however, it may become desirable to link up these two areas and form one entity.

Western Area.—Up to the end of 1919, the actual demand on the stations of this area has been in the neighbourhood of 6,458 kW, whereas the demand for 1923 may approximate to 15,120 kW; when the S.E. & C. Railway has been electrified, however, the demand may reach 27,420 kW. The total generating plant in the area approximates to 15,725 kW, and the amount of 3-phase 50-cycle plant included in this figure totals approximately 12,220 kW, of which a considerable proportion is of modern efficiency.

Ignoring for the moment the financial side of the matter, it would appear desirable to consider whether as a preliminary step the Maidstone and Chatham generating stations should be linked up to form the nucleus of an interlinking system for the western area, which might gradually be developed from this basis.

Eastern Area.—The major portion of the electricity in this area will probably in the future be consumed at the collieries and generated by means of coal produced from them. Even at the present incipient stage of development of the coalfield, the generating plant installed or provided for at the various collieries furnishes an important percentage of the total generating plant in the district.

Apart from financial considerations, a preliminary survey indicates that considerable benefits might accrue if the four existing collieries were linked up, and also connected with some of the more important towns in their vicinity, such as Dover, Canterbury, and Folkestone. The effect of this linking up, with the benefits of improved load factor and increased stand-by plant to which it would give rise, would probably go a long way towards meeting any increased demand, not only from the existing collieries, but also from the towns interlinked with them, for some time to come.

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[*] Electrical Review, Mar. 18th, 1921, p. 363; Dec. 10th, 1920, p. 744.

The conditions of electricity supply in the final stage of the development of the coalfield would be entirely different. During this stage it is anticipated that a considerable proportion of the output of the coalfield would be made into coke and employed in conjunction with iron and steel works on the spot. This development would give rise to various secondary products of coal such as waste heat, waste gas, coke breeze, and washery sludge, produced in large quantities in the neighbourhood of tidal waters which could be utilised for condensing purposes. By these means electricity could be produced on a large scale at a relatively low cost. The ultimate peak load of all the collieries may then amount to 50,000 kW; and in addition the accessory works, towns, and factories connected with the system would have to be provided for.

Electrification of S.E. & C. Railway.—The S.E. & C. Railway has a scheme prepared for the electrification of the lines to Chatham and Tonbridge, and the committee believes that, in the not far future, electrical operation of the main and Kent coast lines will be considered. The load factor of the railway demand will be excellent, and there is no doubt that if it is found practicable to supply both the railway and other demands from the same source, the advantages to the community will be considerable.

There are, however, certain difficulties in the way of attainment of this admittedly desirable arrangement which have been pointed out by Mr. Raworth, namely, that "the whole of the modern three-phase plant at present existing within the district is designed for the generation of energy at 50 cycles. If rotary converters are used, owing to the impossibility of obtaining a 50-cycle machine to produce d.c. at 1,500 volts, it will be necessary to employ 750-volt machines arranged in pairs and connected in series, an obviously costly and complicated arrangement. In this connection evidence is available which appears to justify the following conclusions: (1) That the cost of d.c. at 1,500 volts, if obtained through 50-cycle motor generators, would be some 15 per cent. higher than if obtained through 25-cycle rotary converters. (2) That 50-cycle rotary converters are not sufficiently reliable for railway operating purposes."

Finance.—The Committee emphasises the fact that finance is the dominating factor. Before any scheme is entered upon it will be necessary to know where the money is coming from, and upon that information it will be provided, and in the absence of that information the committee did not feel justified in attempting to do more than indicate the general lines upon which development might proceed.

Conclusions.—Summarised, the conclusions arrived at are as follows: (1) The district under review is at present inadequately supplied with electricity, and insufficiently organised in view of modern developments. That there is an urgent call for some form of control to be set up to supervise and mould the individual undertakings into a well organised whole, in order that full advantage may be taken of future developments. (2) To enable this to be done a Joint Electricity Authority should be set up forthwith for the district. (3) To commence with, the district should be divided into two main supply areas, viz., the western area and the eastern area, with the ultimate aim in view of their becoming interlinked and forming one complete whole as far as transmission is concerned. (4) The most promising line of development at the present moment would take the form of interlinking the best of the three-phase stations. (5) If any organisation is to be set up to deal with the matter, it is important it should be formed at an early date, and (6) it should be left to the Joint Electricity Authority to decide upon what periodicity the district as a whole should ultimately be developed.

An appendix to the report contains, amongst others, the following figures:—

	Western area.	Eastern area.	Collieries.	Private plant.	Totals.
Maximum demand, 1919, kW ..	6,458	4,755	1,425	955	13,593
Estimated demand, 1923, kW ..	13,120	7,200	7,500	2,800	30,620
Existing plant, kW	15,725	9,178	5,000	2,620	32,523
Existing 3-phase 50-cycle plant, kW	12,220	2,600	5,000	—	19,820
3-phase plant on order, kW ..	—	3,250	5,000	?	8,250

The possible demand for the S.E. & C. Railway electrification may be in the western area 12,300 kW and in the eastern area 13,200 kW.

The Electricity Commissioners have not yet come to any decision on the contents of the report.

The Swedish Electric Works.—The report of the A. B. Elektraverken states that the general industrial depression affected the company's manufacturing branches in 1920. Moreover, German competition based upon exchange dumping hampered the company's activity. Restrictions in working had to be made on a large scale in the second half of the year, and the unfavourable results were also prejudiced by a lock-out and the introduction of the eight-hour day. The accounts show a loss of 311,000 kroner, as against net profits of 557,000 kroner in 1919, when no dividend was paid. After extinguishing the loss by the absorption of most of the balance of 318,000 kroner brought forward, the sum of 7,000 kroner was carried to the accounts for 1921.

MULTI-PART TARIFFS.

Memorandum for the Electricity Commission.

In November, 1920, the Electricity Commissioners received as a deputation the Joint Committee of the British Electrical Development Association (Inc.), which was appointed to deal with tariffs and methods of charging for electricity supply in relation to proposed legislation; they indicated their willingness to consider any further statement of the case presented by the Committee, and asked for examples showing the operation of tariffs of the class which the deputation had in mind.

As a result of further deliberations by the Committee the memorandum abstracted below was submitted to the Electricity Commissioners, together with examples of multi-part tariffs in practice, namely, that at Grimsby, the floor space system at Dundee, and the rateable value systems at Gloucester, Norwich and Ilford (London).

The main object of the deputation was to ask that it should be made lawful for the Commissioners to grant requests from electricity suppliers for powers to enforce, in any particular distribution area or part thereof and with regard to any class or classes of consumers, systems of charging for supply which should secure to the suppliers payments or subscriptions sufficient to recoup them for the expense of being "ready to supply" and, in addition to such subscriptions, to charge for the energy actually used by the consumers as metered or otherwise computed. In order to effect this object the following draft clause was submitted as suitable for insertion in the Electricity (Supply) (No. 2) Bill:—

"Notwithstanding anything contained in any Act or Order confirmed by or having the effect of an Act, *it shall be lawful* for any undertakers on the application of such undertakers for any private purposes and any public purposes other than the lighting of any street, to charge by any method approved by the Electricity Commissioners for any particular area or class of consumers and any such method may authorise a periodical charge in addition to or in lieu of a charge for the energy supplied to him."

The systems of charging contemplated are generally referred to as *two-part or multi-part tariffs*, and are already in fairly extensive use (by agreement with consumers) for power and also for business and domestic supplies.

The advantages of this method of charging are:—

(*a*) *To the Supplier.*—A guaranteed return from each consumer on account of the costs incurred in being ready to supply him, &c.; such return being secured irrespectively of the amount of electricity used and also if for any reason *no electricity is used*. The ability to offer to consumers electricity at an average rate per kWh which diminishes as the load factor increases and in diminishing may be made to follow closely the characteristic of the curve of the cost of supply in relation to load and other factors in any given undertaking; and a relief from the risk of energy being used from a lower rated circuit for purposes which are chargeable at a higher rate. In effect, a tariff with which, if suitable values are chosen for the fixed and running charges, encouragement is offered to the consumer to use appliances and methods which tend to increase the efficiency of generation and distribution (*i.e.*, to lower costs).

(*b*) *To the Consumer.*—A supply of energy for all purposes through one meter at a single rate per unit. The ability to use apparatus of any kind on any part or circuit of the installation, subject only to its capacity, and without regard to varying charges; simplification of wiring; and freedom to use standard and interchangeable plugs and sockets for all purposes, within limits of capacity. Reduced cost of accidental waste or occasional abnormal use. Some control over average rates payable, and ability to lower it by arranging the use of the supply so as to improve the conditions of the suppliers; and in the case of a small user, knowledge in advance of the principal item of the account for supply.

(*c*) *To the industry generally.*—Encouragement to extend the general use of electricity, increased demand for apparatus and installation work, and simplification of methods.

The consumer automatically secures the service on a falling curve of average price which, to a great extent, coincides with the falling curve of the cost of supply. Other public utilities charge for service on a similar basis, and as in the case of water supply and telephone service the most equitable arrangement lies in collecting annual amounts from the consumers in relation to the "rate of use" and, in addition, making some further charge based upon their actual use of the commodity or service in question. Charges can in this way be made equitable to all.

Minimum Charge.—Although large increases in the charge per kWh have been necessary in recent years, yet the small consumer has really secured an advantage, his expenditure upon "electricity service" being actually reduced in certain cases. Until recently the consumer was liable to pay a minimum charge, generally equivalent to 80 kWh per year at 8d. per kWh, or £2 13s. 4d. In connection with maximum-price revision this has been altered generally to 2 quarters × 15 kWh × maximum price; 2 quarters × 10 kWh × maximum price; or 50 kWh per year at, for example, 1s. per kWh—only £2 10s., so that a 50 per cent. increase on the rate per kWh results in the guaranteed minimum revenue from the consumer falling £2 10s./£2 13s. 4d. = about 6 per cent.

Presumably the object of reducing the minimum *number of kWh* to be used or paid for from 80 to 50 (37 per cent.) is to allow the consumer a concession in view of the increased efficiency of the modern lamp. The result is to benefit the small consumer who had become a source of loss (*i.e.*, expense to all the consumers as a body) before the change; it in no way helps the consumer whose use exceeds the minimum, and it renders the position of the supply undertaking more difficult.

In the multi-part tariffs under consideration, the annual fixed charge is in the nature of a minimum payment, but does not cover any supply of energy, and merely to increase the minimum charges at present in force would not meet the requirements so well, and would only accentuate the disadvantages always attaching to such minimum demands.

There is little doubt that unification schemes for large areas would lead the public to demand more uniformity of the charge than exists to-day, and to satisfy such a demand might conceivably lead to an increase in charges near the centres of generation for the benefit of the more remote parts of the districts. It is contended that, so far as concerns the domestic load at least, multi-part systems of charging would help to overcome this difficulty. Consumers could be made to understand that the rates of a fixed charge or annual subscription must vary considerably in relation to distance along the distributing lines, the density of local loading, &c., whilst the running rate per kWh could be made uniform or nearly so over the whole area.

The potential domestic demand in this country is very large indeed. Even at present, and with the main heating of the house carried out by means of raw fuel, the use of electricity for lighting, for cooking, for occasional heating, and for mechanical appliances in the house may well call for from ten to fifteen times as much electricity as the lighting only, say, 2,000 to 3,000 kWh per home per annum as a moderate estimate against 200 for lighting only.

"Cheap and abundant supplies of electricity" have been put forward as the working ideal for industry, and as one of the most essential features of future prosperity. Within limits the statement is correct; in the majority of businesses, however, the expenditure upon electricity for light, power, or even heat ranks amongst the smallest of their outgoings.

Many machines and labour-saving devices now in use could never have been invented but for the ability to employ electricity in operating them. For some purposes also the cost of the electrical energy employed is so small compared with the value of the article produced, or with the incidental savings secured, that any reduction in the charges for supply is of no particular moment.

So far as concerns the country as a whole, it would appear more urgent for the supplies of electricity to be "abundant," *i.e.*, obtainable everywhere, than to be "cheap," and they must become abundant (widely distributed) before they can become "cheap." The maintenance of the flat rate method of charging and the restriction of maximum prices is responsible for delay in extension and for the refusal of business in many districts. Complaints of inability to obtain electricity are at present more prevalent than complaints relating to the prices charged.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Wear of Rotary-Converter Slip Rings.

The machines to which I refer are of the following capacity: 500 kW, 240 volts, d.c., the a.c. supply being 6-phase, 40 cycles, and the speed 800 r.p.m.

On each slip ring there are three tapping points, and we have found that the parts of the rings near these points become apparently high, whilst the parts between become low. The brushes used are "Metite," and the metal of the ring is of a copper bronze colour. Lubrication is effected by an oil swab lightly touching each ring.

Is it possible that the metal of the ring is transferred to the brush and *vice versa*, depending on the direction of the current, which will clearly go through three complete cycles during each revolution?

We find that an average run of 2,000 hours is about the maximum that can be obtained before a regrinding of the rings becomes necessary. Perhaps some other reader can elucidate this matter.

Koocaf.

May 11th, 1921.

Variable-speed a.c. Motors.

We are very much interested in the lecture by Dr. S. P. Smith, reported in your issue of May 6th, and although it is possibly not quite fair to criticise Dr. Smith in the absence of an absolutely complete report of his remarks, it would seem from your abstract as if he cannot be entirely acquitted of paying more attention to work done on the Continent than to that done in this country.

It is true he refers to Mr. Creedy's method of varying the speed of the polyphase induction motor, but he makes no reference to the variable single-phase commutator motor, developed by him, which has been on sale by us in this country for the past six years. These have been fully described in the Press on numerous occasions, and notably an abstract from a paper read before the Association of Supervising Electricians on April 9th, 1918, appeared in your columns and in the remainder of the technical Press.

We must all admire the work of Mr. Ll. B. Atkinson, but it is far from true that his conceptions have been developed not in this country but in Germany.

A very large number of these motors are running, some of which have been in operation for many years.

Pooley & Austin.

London.
May 10th, 1921.

The Grading of Mains Engineers.

It seems strange that no one has followed up the pertinent remarks of your correspondent "N. B." in your issue of April 22nd, for he really voices one of the anomalies of station work. Why should a mains superintendent get more pay than a charge engineer? One can answer that it is customary. But these are days when ancient customs are going by the board one after the other, and this particular custom will not really stand close analysis. The minimum necessary technical knowledge and practical experience are very considerably less to make a *passable* mains superintendent than a *passable* charge engineer. Against this must be set the fact that a mains superintendent is head of a department, and should have a certain amount more managerial and business responsibility, though in municipal stations this is not really a lot. On the other hand, the charge engineer has to possess certain physical and mental qualities in a considerably higher degree than the mains superintendent, and these qualities are probably rarer than the modicum of business ability set off against them. In close on 20 years of station experience I have come across over a dozen cases of men having to give up charge engineers' jobs because of the physical, mental, and nervous strain; yet the same men were almost invariably able to stand other branches of station work, and I cannot recall a single case of men in other positions having to seek a change. I can count up also a very large number of men with far less responsible positions in charge of running plant, from switchboard attendants to stokers, who were unable to "stick it," and it is recorded of the late Andrew Carnegie that as a youth he had a nervous collapse and had to give up his job through being put in charge of a boiler for heating a building.

If we take a hypothetical test case, I maintain that an intelligent clerk or layman, given a year's diligent work at a technical school and six months' practical experience, would make a better show as a mains superintendent than a similar man with two years' technical training and a year's practical experience would as a charge engineer, having the unrelieved responsibility for eight hours on end of engines, boilers, generators, switchboard, steam, and water auxiliaries, flues, fans, steam and water mains, &c.

I don't wish to detract from a mains superintendent's responsibilities; I have experienced the delights of turning out in a blinding storm at midnight with six inches of snow on the ground to try to locate a fault. I have also experienced considerable displays of fireworks on various switchboards, and honestly rather enjoyed the excitement of them as a rule. But a case of water hammer in a steam main at 4 a.m., a series of terrific unaccountable bangs that fairly shook the building, left me in a cold sweat for a month, as did also a breakdown of a pump (while the only other one was under repair) at the peak of a heavy load, with a bank of boilers all steaming their hardest.

But supposing, in deference to ancient custom, we concede the mains superintendent one grade above the charge engineer. By what freak of the maddest reasoning can we place him in the same grade as the station superintendent, as the E.P.E.A. schedule does? The station superintendent, whose necessary technical qualifications leave the mains superintendent in the infants' class! The station superintendent, who is responsible more than any man except the chief, for "producing cheaply," whose business abilities must be of a very high order to trace out the elusive B.th.u.'s through their many ramifications, and account for all of them!

The station superintendent and the charge engineers are really the key men of the electricity supply industry; without them any station will eventually stop; with them it can run almost indefinitely. Why, therefore, are they both so slighted in the E.P.E.A. schedule?—the one lumped in with the mains superintendent, and the other placed at the bottom of the list (for those grades from 8a to 10b are mere camouflage, no one is officially graded in them that I have been able to find out yet) with every Tom, Dick, and Harry in or about the station ranking with or over him! The explanation I have heard (I am open to correction on it) is that the schedule sub-committee was composed of three chief assistants and one mains man. 'Tis an ancient axiom of our race that "God helps those who help themselves," and that lonely but highly efficient representative of the mains department certainly got his ample fist well into the mess of pottage while it was being handed round.

It is a striking comment on the chastening effects of much shift work on the human system that, with the lonely exception of "N. B.," the charge engineers have accepted with humble and contrite hearts what the mains department has been pleased to give them.

P. S.

May 10th, 1921.

The Speed of Electric Motors as a National Problem.

The electric motor should be the prime mover for all industries, having the advantages of simplicity, safety, silence, and absence of offensive exhaust, among many others.

Electricity supply will become available in every part of the country when transmission is permitted with high-pressure overhead lines, as in Canada.

A large number of electric motors will be needed to make the factories they are required for efficient, whether placed in rural areas or in great and, too often, slummy towns. The capital required for these electric motors is a serious matter, and it is a clear proposition that, given the same durability, efficiency, and workmanship, the lowest first cost is the correct one.

The electric motor as a non-reciprocating prime mover is capable of rotating at high speed with no mechanical or electrical drawbacks; *vide* the generators of turbo sets.

Petrol-driven prime movers, with many delicate reciprocating parts, run at as high speed as the average electric motor, and in many cases at twice the speed.

The advertising pages of a leading mechanical engineering journal give the following machines that require driving: Pumps, cranes, fans, grinders, blowers, rolling mills, centrifugals, conveyors, mixers, lathes and machine tools, woodworking machinery, presses, vacuum plant, drills, out of which only one or two demand a low-speed mover.

Why then has the idea of low speed got standardised in the purchasing side of the electrical industry, and why does the electrical engineer of to-day permit his customer to specify low-speed machines?

The explanation often given is that the motor is to drive a line shaft, and this must not run above 160 r.p.m. Possibly the electrical engineer comes too late on the field to see that the shaft runs at 400 to 500 r.p.m., with corresponding saving in cost, weight, and maintenance.

Take wood-working machinery, where high-speed tools can alone secure perfect results; there are many instances where motors of 600 or 800 r.p.m. are being used to drive machines running at from 3,000 to 5,000 r.p.m., with intermediate shafts and corresponding want of efficiency.

The spread of polyphase supplies has tended to accustom buyers to speeds of the order of 1,500 to 1,800 r.p.m., even in large-sized motors, and that is to the good.

The object of this letter is to push forward the practical point that too much money is being laid out on low-speed motors to the detriment of the general purchasing power of electric motors and consequent spread of the demand for electric power which inevitably means more cables, switches, fuses, starters, conduit, electricity, work, and many other advantages to the electrical industry.

Justus Eck.

Southall.
May 16th, 1921.

The Maintenance of Intercommunication Telephones.

We noted with interest the letter of Mr. G. Theobald, of the B.E. Co., in your last issue. We have, since our company's formation, carried out work of this description, and we have no hesitation in saying that we have always given our clients every satisfaction. Any telephone installation overhauls which we undertake we always guarantee, and we also specialise in any complicated electrical systems not within the scope of the average electrical contractor.

We beg to state that our staff of expert telephone engineers is always at the service of all contractors—and Mr. Theobald.

W. E. Weekes & Co.

London. Chas. H. Clark.
May 14th, 1921.

[To avoid confusion, we may mention that the initials "B.E. Co." here denote the Balding Electric Co.—Eds. Elec. Rev.]

The Wiring of Ferro-concrete Factories.

In my previous letter on this subject I said that as a result of considerable experience in wiring ferro-concrete factories, I had found the screwed steel conduit system to be the most suitable for this class of building. Opinions since aired on the subject seem to favour the C.T.S. cable system. In designing a ferro-concrete building I take it that everything that goes into its equipment should also be as nearly fireproof as the structure itself. In classifying wiring systems, I should certainly place only those having a non-combustible outer covering in the fireproof category.

In your current issue, Mr. A. C. Purday quotes me as saying that in Vancouver the only system recognised as coming up to the requirements of the modern fireproof building is the screwed steel conduit system. This is quite correct, and the City of Vancouver is exceptionally advanced electrically, and probably contains more buildings of this class than any city of a similar size in the British Empire.

Regarding ferro-concrete factories especially, the selection of the wiring installation depends largely upon whether the system is embedded in the concrete during building construction or run on the surface of the completed structure. Taking the former case as being more up to date, all the tedious cutting, chasing, and plugging of ceilings and walls, so common in English practice, is obviated.

I believe I am right in saying that there is no other concealed system of wiring that so lends itself to subsequent examination and repair as that of screwed steel conduit, it being possible to draw the wires out or in at any time without the slightest interference or damage to the finish of the building. Also with the additional protection of the concrete, it is as fireproof as it is possible to make electrical work, and will remain so as long as the building stands. In concluding, I may state that the Admiralty specifies screwed steel conduit wherever there is a particular danger from fire, and in addition uses it almost exclusively for the permanent general wiring throughout H.M. Dockyards.

P. Davis.

Portsmouth.
May 16th, 1921.

Cables for Hot Situations.

I should be very pleased to give "R. A. H." my idea of the ideal cable for use in situations where the temperature is normally 105 deg. F. and sometimes exceeds that value. I was recently wiring a rag-drying room, and not being aware of the amount of heat required for the drying process, in accordance with orders I carried out the job with V.I.R. cable in conduit.

Only 14 days elapsed before I was called in to replace fuses, which persisted in blowing; on making a strict inspection I discovered that the insulation was literally as dry as sticks, and in places had completely left the conductors. I was then confronted with the problem of finding a suitable class of cable which would withstand the heat. What was required was a cable the condition of the insulation of which could easily be ascertained, also which had a protective covering; the only cable which fulfils these conditions is C.T.S. Eventually I rewired the drying room with C.T.S., which I found stood up to the heat exceedingly well; one very good point about it is that, on examining the condition of the outer rubber sheathing, the condition of the inner insulation can easily be ascertained. I should be pleased to hear of any other cable which is suitable for high temperatures. Mechanically enclosed cables are, to my idea, retainers of heat.

Two Phase.

May 16th, 1921.

Conservative Methods.

Surely it is time that a strong protest was made against the perfectly idiotic method of packing accumulator plates adopted by certain well-known manufacturers. The plates are sent out immovably wedged into unbreakable crates by means of wooden distance pieces which nowhere project beyond the battery plates, and so are impossible to seize. Two strong battens are then jammed across the row of plates from side to side of the crate, to which they are fastened by huge nails driven through from the outside into their ends.

If these crates are as valuable as the makers would have us believe, why are they so packed that the average man concludes that nothing but force without stint will unpack them? If they are not really valuable, why is such a preposterous price put upon them? On my desk as I write is an account for over £50 for the cases of a small 50-volt battery.

Can anyone tell us of a maker who has heard of such mechanical aids as screws and bolts and nuts, and who uses them on his packing cases? I have orders waiting for that maker, but no more for the wild men of the nail age.

Twice Shy.

May 13th, 1921.

Electrical Dock Equipment.—A dry dock of the Tietjen and Lang Dry Docks Co., at Hoboken, New Jersey, which has been in operation since 1900, has been recently fitted with a complete system of electrically controlled pumps and motors. The dock consists of sections having a total overall length, including outriggers, of 468 ft. The new pumping equipment consists of ten 18-in. vertical-shaft single-bottom suction pumps. One of these pumps is placed in the centre compartment of each wing of each of the five sections; 12-in. cast-iron pipes are connected from the bottom of each pump and terminate at the two end compartments in the same section. Twelve-inch valves are installed in these lines, and the stems are extended to the decks of the wings. Eighteen-inch gate and check valves are placed in discharge lines. All suction lines are terminated by foot valves which bring the suctions to within 8 in. of the bottom of the dock. The electrical equipment consists of ten vertical squirrel-cage type 360 r.p.m. constant speed induction motors, designed for 75 h.p. capacity in 150-h.p. frames and for use on 2,400-volt, two-phase, 60 cycle alternating current circuits. The motors are coupled by means of flexible couplings to the shafts of the pumps.—*Journal of Commerce.*

THE TEMPERATURE LIMITS OF LARGE ALTERNATORS.

Discussion at Liverpool.

Members of the Liverpool Sub-Centre of the North-Western Centre of the Institution of Electrical Engineers, discussed Mr. G. A. Juhlin's paper on the above subject, which was abstracted in our issues of February 4th and 11th, on February 28th, when Mr. **Hollingsworth** remarked that in connection with electric generating plant, they should try and further any proposition leading towards reduced capital cost and increased efficiency, provided it was not at the sacrifice of reliability. That was the crux of the question; were they going to sacrifice anything in the direction of reliability by adopting the proposals put forward by the author? Experience with alternators had been generally satisfactory during recent years, and unless a very great advantage was to be obtained it was not advisable to make any great change in the design or construction of such plant. A machine the speaker had control of (one manufactured by Messrs. Dick Kerr, of Preston, and of which Mr. Juhlin was the designer) had been the cause of sleepless nights owing to a "hot spot" on the top of the yoke. It was not an easy matter to ascertain the correct temperature on such a surface, and the spot in question seemed to get hotter every time they felt it. Not to his knowledge had the machine in question given any trouble, and in all probability it was working at a higher temperature than that which Mr. Juhlin was now advocating such machines should be worked at. Engineers would not disagree with the author's plea for the adoption of temperature detectors, in fact manufacturers had been backward in that respect, for speaking as an operating engineer, he would have welcomed anything of the sort years ago. In the case of machines running at the same speed, "those with high temperature rating are cheaper," but would that mean any great decrease in capital cost? There would be a reduction in material, but the labour costs would not be reduced very much, and in any case would the reduced capital cost compensate for the reduced reliability? The speaker could not understand what Mr. Juhlin meant by "higher efficiencies are obtainable"; how did a decrease in copper mean increased efficiency? "Larger units can be built at higher speeds," but with their present knowledge of the steam turbine that was the limiting factor, and they could not deal with the alternators without taking the turbines into consideration. Mr. Juhlin was prepared to build alternators of considerably greater capacity than at present at a speed of 3,000 r.p.m., but the speaker said he would not like to install one of more than 8,000 kW at 3,000 r.p.m.; therefore, he did not see that any great claim could be made for higher alternator speeds until Mr. Juhlin could get some of his brother engineers to produce a reliable turbine.

Mr. F. J. **Teago** pointed out that the author proposed that the limit of the ultimate temperature, as measured on the conductors in the core, should be 160 deg. C. The existing rule was that, for mica, paper, and like materials, the limiting ultimate temperature should be 125 deg. C. The latter figure, then, would be measured on the end windings and not in the slots, since the insulation in the slots was practically pure mica. Now, in general, if the end windings were worked at a total temperature of 125 deg. C., the windings in the slots would be 160 deg. C. and perfectly safe, since micanite tubes would withstand temperatures far in excess of anything yet proposed. Since the end windings formed the weak spot, and since 125 deg. C. measured there would rate the machine as high as 160 deg. C. measured in the slots, why not use the end windings as the point of reference? The end windings also had the advantage of accessibility. In any case, Mr. Juhlin's proposals were in no way revolutionary, because existing plant was operating round about his figures.

Prof. E. W. **Marchant** asked Mr. Juhlin whether he had ever measured the temperature rise of windings by measuring their increase in resistance by superimposing a small d.c.? A scheme of that kind would be practicable. The speaker sketched a Wheatstone bridge circuit which would enable one to determine the increase in resistance of the windings when hot, with the alternator running, which would not be of very great value if thermo-couples were fitted, but if a machine was built without thermo-couples, and one wanted to find the average temperature rise of the windings it would be useful. With regard to thermal resistivity, experiments on some insulating materials used on buried cables showed that apparently, although the alteration was not very marked, there was a diminution in the resistivity with increase of temperature.

Mr. A. E. **Malpas** explained that the author's opening statement gave 40 deg. as the limiting temperature rise generally adopted in this country, but on the Continent the speaker had generally seen 45 deg. specified, and the difference of 5 deg., of course, gave the Continental makers an advantage in competition. To employ a liberal number of embedded temperature detectors would add to the cost of the machine, although the addition might not be very serious in the case of really large apparatus. With regard to the type of indicating device, some years ago he used a thermo-couple instrument by Le Chatelier to measure the temperature of hot gases, but found that the millivoltmeter used in conjunction therewith was so sensitive as to be seriously interfered with by stray fields. There was no d.c. anywhere near the instrument, but the conclusion come to was that atmospheric disturbances caused a great deal of interference. It happened to be very hot, dry, weather at the time, and it was conceivable that atmospheric influence could at times have the same effect in this country. For that reason, the resistance thermometer would appear to offer a great advantage, more especially as the null method of measurement was more accurate than any direct-reading method. In the case of large machines of new design, it was highly desirable to provide embedded temperature detectors, but whether the advantage to be gained by fitting those devices to every large machine turned out would justify their cost was open to some doubt. It must not be lost sight of that their use would involve some danger, since if the detectors did not happen to be placed at the spot of maximum temperature, their readings might induce the operator to overload his machine beyond the real danger point.

Mr. C. **Rettie**, referring to the electric propulsion of ships, the conditions in which were totally different from anything ashore, said that the sudden reversal of motors totalling 180,000 h.p. from full speed ahead to full speed astern, and also the possibility of the propellers rising out of the water and sudden turning movements, demanded a safe temperature limit for the machinery. In later ships, as well as in the *New Mexico*, a new instrument had been installed for measuring the field temperatures, which showed the temperature of the field conductor and depended for its operation on the change in resistance of a conductor with the change in its temperature.* It really indicated electrical resistance, but instead of a scale of resistance a scale graduated in degrees Fahrenheit was used. The instrument was employed on the alternator field only, no such instrument being necessary in the field of the synchronous motor. He felt they were being left behind in the development of the electric propulsion of ships. Other countries were building ships of all kinds which were being electrically driven, and were having every success.

LEGAL.

Dispute *re* Electrical Apprentices' Wages.

A wages dispute between Mr. E. E. Newbald, electrical engineer, Sutton, Surrey, and the Electrical Trades Union was amicably settled at the Sutton Police Court on May 12th.

Mr. Newbald's men and three apprentices, it was stated, came out on strike because he declined to pay the apprentices higher wages, and he applied to the Court for an order setting aside or rescinding the indentures in consequence of the action of the youths.

The parties, however, consulted in private, and Mr. C. Doughty, counsel for Mr. Newbald, informed the Court of the settlement. If the Court had made an order for the youths to return to work he feared they would not have done so, with the result that they would have been sent to prison. The settlement was this: The indentures of the three apprentics would be transferred to another employer, and Mr. Newbald had agreed to carry on their wages until that transfer took place, but not for longer than a month. The wages agreed upon were slightly more than the indenture wages, and the figure was fixed on pre-war wages with the addition of war increases which had been given under the various orders of the Industrial Courts. The last condition was that the men in Mr. Newbald's employ should return to work at once, and that the embargo placed on Mr. Newbald's activities should be immediately removed.

Mr. G. W. H. **Jones**, M.P., for the Union, said the Union was fighting for a principle which, he was glad to say, had been recognised, and in order to get rid of the differences the Union had agreed to concede half the amount.

Sir **Ralph Forster**, J.P.: What is the principle? These boys are serving by indenture; a rate of pay is fixed and the union comes along and says you must alter that rate. Is that so?

Mr. **Jones**: Not quite. We say certain awards have been made, and these boys are to benefit as a right to them.

Mr. **Doughty** observed that that principle, although not recognised by people not within trade unions, was established to some extent during the war, but there was nothing to-day to prevent employers paying any wages they thought fit, but if they did they would have to combat the hostility of the unions.

Hampton & Sons *v.* Monroe.

Mr. **Edward Pollock**, High Court Official Referee, on May 13th, continued the hearing of this action, which was commenced on April 18th and adjourned on the 23rd for the evidence of Mrs. Monroe, who was unable to attend owing to illness.

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* Electrical Review, April 15th, 1921, p. 496.

On the case being resumed, some further evidence chiefly of a formal character was called, Mr. Pollock having in the meantime taken the testimony of Mrs. Monroe at her residence at Chessington, she being still too unwell to attend the court.

Mr. Saville Percy Morrell, costs clerk employed by the plaintiff firm, gave evidence as to certain charges which had been made in excess of the contract prices. He said there was an amount of £105 charged, owing to increase of wages resulting from the advance in the scale upon which they had to pay, and the calculations upon which he had arrived at that figure were correct. That was upon two items only, £64 in respect of decorations and £41 in the sanitary and hot water trades. In every case he had taken the figures out of the actual wages sheets, and had rectified them in accordance with the new wages prevailing.

In cross-examination, the witness further explained the method by which he had made his calculations. He said he had the award and instructions from the head office, and on the basis of the award he worked out the increased cost by adding 12½ per cent.

Mr. Compston, K.C., for plaintiffs, said that the firm had lost on two of the estimates and slightly gained on the others, but on the whole it was less than it had expected.

In further cross-examination, witness said that where the name of Mrs. Monroe appeared it was a clerical error, as most of the orders were in the name of Mr. Monroe.

The Official Referee, in the result, found that the husband and wife were jointly liable, and gave judgment against both for the sum of £4,800 with costs. He also gave judgment for the plaintiffs on a counterclaim set up by the defendants with costs.

Unauthorised Supply.

Summoned for unlawfully connecting an electricity meter with an electric line through which energy was supplied by the Wallasey Corporation, without giving forty-eight hours' notice of his intention to do so, Francis Bisson, of Trafalgar Road, Egremont, appeared before the magistrates at the Wallasey Petty Sessions on May 11th. For the Corporation it was stated that as defendant did not pay for electricity which had been supplied, the supply was cut off. Defendant afterwards paid the bill and connected the wires himself. He pleaded that he acted in ignorance. He was going to pay the bill when the workman came to cut off the supply. He told the man that, and he said that another man would be there in the afternoon to put it on again. When the bill had been paid and the man did not come, he connected the wires himself, as he had done many times aboard ship. The chairman of the magistrates agreed that defendant had done what he had no right to do, and ordered him to pay the cost of the summons.

Sedition Charge.

At the South-Western Police Court on Tuesday, Frederick Newington, district secretary of the Wandsworth Branch of the Electrical Trades Union, was summoned under Regulation 19 of the Emergency Regulations for acting in a manner likely to cause disaffection among H.M. Forces. It appeared that F. R. A. Freeman, a member of the E.T.U., joined the Defence Force, and was expelled by the branch "for conduct contrary to the interests of the union," the resolution being communicated to him by Newington. In defence it was alleged that Freeman and another were expelled because a strike was called, and instead of standing by their comrades they joined the Defence Force. The case was adjourned till June 2nd to enable the union to consider the reinstatement of the men.

Butler *v.* Hamel.

At the Nottingham County Court last week, Clifford Butler, trading as Clifford Butler & Co., electrical engineers, Mansfield Road, sued E. Hamel, of Holly Dene, Mansfield Road, for £17 12s. 3d. for electrical work done. Defendant admitted the claim, but he also claimed £100 from plaintiff for damage done to a candelabrum by the latter's workmen. Conflicting evidence was given as to the value of the candelabrum. Judgment was given for Butler on the claim and for Hamel on the counterclaim for £75 and costs.

BUSINESS NOTES.

Bankruptcy Proceedings.—Francis Edward James Padmore Marlborough Road, Nuneaton, electrical contractor.—The debtor's statement of affairs, issued by the Official Receiver (Mr. C. J. Bond, Coventry), shows gross liabilities amounting to £211 the whole of which is expected to rank for dividend. The assets are returned as "nil," leaving a deficiency of £211. Debtor gives as the causes of failure "illness of self and family; bad trade; competition in trade." It appears that he commenced business with a cash capital of £5, in November, 1918, at his present address. The only books of account disclosed by the debtor are debtors' and creditors' ledgers. He became aware of his position 12 months ago. The household furniture is claimed by his wife.

Herbert Doyle, trading as the Accessories Supply Co., 56, Hardman Street Deansgate, Manchester. Factor in electrical accessories.—The first meeting of the creditors of the above was held on May 11th at the Official Receiver's Offices, Byrom Street, Manchester. According to the statement of affairs submitted, the ranking liabilities amounted to £624, while the assets were estimated to realise £423. Debtor attributed his position to lack of capital, depression in trade, and general decline of the business partly owing to inattention. It was stated that the business had gradually declined since May, 1920, with the result that the debtor had been obliged to borrow money mainly from his friends. The matter was left in the hands of the Official Receiver as trustee of the estate.

S. H. Dougherty (Mersey Electrical Co.), electrical engineer, late of 36, Renshaw Street, Liverpool. Receiving order made May 12th, on creditors' petition.

W. H. Pease, electrical engineer, late of Royal Hotel Shops, Scarborough, and Doncaster.—Last day for proofs for dividend, June 1st. Trustee, Mr. L. J. Clegg, Official Receiver's Office, 14, Figtree Lane, Sheffield.

Company Liquidations. — Morris, Valentine and Willis, Ltd., electrical and mechanical engineers, Highfield Avenue, Golders Green, London, N.W.—In pursuance of the provisions of the Companies (Consolidation) Act a meeting of the creditors of the above was held recently at the offices of Messrs. Bate & Co., 35 Bedford Row, London, W.C. The company, it was stated, had gone into voluntary liquidation, and had appointed Mr. A. C. Gearing, of 29, Highfield Avenue, Golders Green, London, N.W., to act as liquidator. The liquidator stated that the liabilities to the trade amounted to approximately £150, and only two firms were interested for more than £10 each. A sum of £170 was owing for rent, while Mr. Willis, one of the directors of the concern, was a creditor in respect of loans amounting to £800. Mr. Morris had also made advances to the company totalling £300. The assets of the company included stock of electrical goods, £43; mechanical stock, £23; motor stock, £599; and plant, drilling machines, &c., £200. It was pointed out that the company had not failed, but there had been some differences of opinion with regard to the management, and it had been decided in the interests of all concerned to go into liquidation, and pay the creditors in full. The two cash creditors who had been referred to would stand aside until the other creditors had been paid in full A resolution was passed unanimously confirming the appointment of Mr. Gearing as the liquidator.

Pinkney & Forster, Ltd, electrical engineers, Newcastle.—At Newcastle-on-Tyne Bankruptcy Court, on 12th inst., his Honour Judge Greenwell had before him the petition of J. R. Rutherford, contractor, of 199, Westgate Road, Newcastle (a creditor), for the compulsory winding up of this company. Mr. H. S. Mundahl appeared for the petitioner, and stated that the parties were trying to arrive at a settlement by way of a voluntary winding up. In those circumstances he applied for an adjournment. His Honour granted the application.

Bastian Electric Co., Ltd.—Following upon the recent hearing in the Winding-Up Courts, a meeting of creditors has been called for May 24th, at Carey Street, W.C. 2, for the purpose of ascertaining whether they desire the company to be wound up, and, if so, whether such winding-up shall be by the Court or voluntarily.

Trade Announcements. — Messrs. Leo Sunderland and Co. have removed their offices only to 119, Jermyn Street, S.W.1. 'Phone, Regent 3395. The workshops and stores still remain at 33, Strutton Ground, Victoria Street, S.W. 'Phone, Victoria 3068.

Messrs. Salterns, Ltd., of Salterns Works, Parkstone, Dorset, have taken over the water-turbine manufacturing business hitherto carried on by Mr. P. Pitman, of 25, Victoria Street, London. The company will manufacture and sell turbines and accessories and carry on hydraulic engineering work under Mr. Pitman's supervision.

The Born Electrical Engineering Co. has opened operations at 32, High West Street, Dorchester, and Mr. S. M. Osborn desires to receive manufacturers' catalogues.

The telephone number of Messrs. Goldfarb & Bottom, 8, Leadenhall Street, London, E.C. 3, is now "Avenue 8700"; telegraphic address, "Electengin, Stock, London."

The Credenda Conduits Co., Ltd., now has an office at 97, Waterloo Street, Glasgow.

Messrs. D. Selby, Bigge & Co., consulting engineers, have removed their Glasgow offices to 121, Douglas Street, as from May 21st, their present offices having been acquired by Messrs. Scottish Oils, Ltd.

Mr. Fred. Lake has removed from 132, Upper Thames Street, E.C. 4, to 44-47, Devonshire Street, Theobald's Road, London, W.C. 1. Telephone number, "Museum 4116"; telegraphic address, "Garnham, Westcent, London."

Dissolution of Partnership.—Grassendale Motor Co., automobile and electrical engineers and dealers, 25, Aigburth Road, Grassendale.—Mr. H. M. Watkinson and Mr. C. Sutherland have dissolved partnership. Mr. H. M. Watkinson will attend to debts.

Catalogues and Lists.—The Perfecta Seamless Steel Tube and Conduit Co., Ltd., Plume Street, Birmingham.—An illustrated list giving prices and dimensions of steel tubes of a wide range of sizes.

The Hewittic Electric Co., Ltd., 80, York Road, King's Cross, N. 1.—List No. 75, giving very full particulars of mercury vapour rectifiers of different types and for various purposes. The booklet is well illustrated by diagrams and photographic reproductions.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C. 2—List No. 313, illustrating and describing switch and fuseboards, switches, fuses, motor starters, motor control panels, charging boards, &c.; List No. 287, dealing with the "Xcel" electric iron; and List No. 324, advertising the "Lesco" electric lampholder. All three lists are full priced.

The General Electric Co., Ltd., Magnet House, Kingsway, W.C. 2.—Leaflet O.S. 2,490, dealing with low-voltage "Osram" lamps for electric signs, with bayonet or Edison screw caps. Priced. Also Folder No. OS 2,393, giving prices of "Osram" gasfilled lamps of various sizes and types; and Publication No. L 2,524, an illustrated description of train signalling or controlling by the vibratory sleeper contact.

Metropolitan-Vickers Electrical Co., Ltd., 20, Brazennose Street, Manchester.—Special Publication No. 7,875/2, describing loom motors for textile mills. A number of illustrations show these motors, accessories and applications, and the advantages of the electric drive for this purpose are fully set out.

Materiel Electrique Alex. Lefebvre, Export Department, 9, Rue Arsène Houssaye, Paris (VIIIe). List of plant for sale No. 49, giving full details and prices in francs of complete power plant and generating sets, electrical machinery, and prime movers.

Messrs. George Nobbs, Ltd., 89, Cleveland Street, Fitzroy Square, W. 1.—List No. 185, giving an illustration, prices, and description of "Genii" hot-water radiators fitted with electric immersion heaters; List No. 190, illustrating and describing "Genii" warming plates.

Messrs. G. W. Dowding & Co., 66, Victoria Street, S.W. 1.—List No. 64, giving an illustrated description of a grinding outfit for attaching to lathes. Priced.

Private Meeting.—William Morris, electrician, Bridgend, Glamorganshire.—A meeting of the creditors was held recently at Bridgend, when a statement of affairs was submitted, which showed liabilities amounting to £406. The bank were fully secured creditors for £310, and held securities valued at £500. Debtor had borrowed £98 from his brother, which was still owing. He had a debt of £15 due to him for work done, while the house furniture was estimated to be worth £200. No offer was forthcoming, and the creditors decided, in view of that fact, that the debtor should be asked to execute a deed of assignment. The principal creditors are:—

General Electric Co., Ltd. ..	£205	Simpson Baker & Co.	£53
Electric Lamp Co., Ltd... ..	68	Metallic Electric Engineering Co.	16
Boresdale & Co.	50		

The Electrical Wages Dispute.—One of our correspondents says that most of the Electrical Trades Union men affected at Leeds are in the employ of wiring contractors, and they ceased work last week. Up to the time of writing the dispute had not affected the men employed in kinema theatres, even those in the Union, though there was every possibility that, failing speedy settlement, they would come out also. A meeting of the West Yorkshire branch of the National Federated Electrical Association, on May 11th, at Leeds, decided to adhere to the wage reduction notices. It was reported at the Leeds meeting that only a small proportion of men in Yorkshire had yet come out on strike. About half the men affected in Bradford ceased work on May 10th, but others continued at work.

The E.T.U. has issued an instruction that in the event of any employer offering to reinstate his men at the wages prevailing before the dispute, the men may return to work. Reports from some centres indicate that many men have resumed work upon these terms.

We are informed by the Secretary of the N.F.E.A. that so far, no definite move towards settlement has been made, although it has been reported in the daily Press that the E.T.U. intends to bring the matter to the notice of the Minister of Labour for decision under the Industrial Courts Act.

So far as can be ascertained, between 8,000 and 9,000 men are idle as a result of the dispute; 2,000 of these are in the Liverpool district.

As we go to press we learn from a Blackpool correspondent that a special national delegate meeting of the Electrical Trades Union was held there on Tuesday. The Executive Council was instructed to open up negotiations at once with the employers' organisations with a view to arriving at a settlement.

Safeguarding Key Industries.—The discussion on this Bill was resumed in the House of Commons on May 12th. Various amendments were moved, but they were defeated by overwhelming majorities. They proposed the limitation of the 33⅓ per cent. duty to articles made in Germany, and to exempt optical glasses and scientific glassware.

Book Notices.—Souvenir Menu of the Twenty-First Anniversary Commemoration of the 1,000 Miles Trial of 1900. London: Iliffe & Sons, Ltd. This was presented by *The Autocar* at the banquet held on May 12th, in which only those who took part in the 1900 trial participated. The souvenir takes the form of an illustrated description of the affair, together with a list of prize-winners. The illustrations are particularly good as affording a means of comparing the cars of the far-off days of 1900 with modern automobiles.

"Useful Engineers' Constants for the Slide Rule, and How they are Obtained." By J. A. Burns, M.I.Mech.E. Third Edition. (78 pp.) London: Percival Marshall & Co. Price 2s. net.—A quantity of new material has been added to the third edition, enlarging the scope of the work, but not sufficiently to suggest an alteration of title. There is a lack of uniformity in published data concerning several of the subjects chosen but an effort has been made to select average safe figures. In some cases (especially in the "Weights and Measures" section), the quantities have been extended to more figures than can be read on an ordinary slide rule, the object being to make the book as useful as possible.

"The Metropolitan-Vickers Gazette." Vol VI. No. 97. April, 1921. (22 pp.) Price 1s., post free.—The April issue contains an interesting illustrated article on the M.V. patent overspeed device for electric winders, as well as a description of tests on a large alternator (illustrated) and a number of reprinted articles.

The *Journal* of the South African Institution of Engineers. Vol. XIX, No. 9, April, 1921.—This issue includes a paper on "Wire Ropes," by G. W. Westgarth, and some remarks upon the work of the Low Grade Mines Commission and its report.

"Elements of Direct Current Electrical Engineering." By H. F. Trewman and G. E. Condliffe. Pp. viii + 220, 146 figs. London: Sir I. Pitman & Sons. Price 7s. 6d. net.

"Engineering Electricity." By R. G. Hudson. Pp. viii + 190, 194 figs. London: Chapman & Hall. Ltd. Price 13s. 6d. net.

"*Journal* of the American Institute of Electrical Engineers." Vol. XL. May, 1921. No. 5. New York: The Institute. Price $1.

New Swiss Company.—A new company has been formed in Geneva, with the title La Société des Ateliers de Charmille to continue the construction of hydraulic turbines formerly manufactured by Piccard, Pictet & Co.

Holland's Electrical Imports.—According to a report recently drawn up by H.M. Commercial Secretary at the Hague, Germany supplied 60 per cent. of the insulated cables and wires imported last year into Holland; the British share was only 30 per cent., the remainder coming from "other countries." As regards electric motors and transformers, Germany supplied 50 per cent. of the requirements, and Switzerland 17½ per cent. In the case of electrical instruments, 70 per cent. of the imports were of German manufacture.

Wages in Bradford.—The Advisory and Co-ordination Sub-Committee of the Bradford Corporation Finance Committee (a Sub-Committee created especially with a view to curtailing expenditure) recently received deputations from four Trade Unions, including the United Tramway and Vehicle Workers' Union, the Electrical Trades Union, and the Society of Engineers, who asked that no reductions should be made at present in the wages of Corporation employés, as had been recommended by the Committee. The Committee eventually decided to recommend to the Corporation that, as from May 18th, employés affected by national awards, &c., then or thereafter in operation should be paid strictly in accordance with the minimum rates therein, provided that where this would involve a reduction of more than 2d. per hour, the 2d. reduction should be made from the 18th inst., with a subsequent reduction of 2d., or such sum as may be necessary, at the end of each four weeks, until full effect be given to the resolution. A Sub-Committee was appointed to deal with any matters of doubt or uncertainty arising out of the operation of this resolution, or in cases of special circumstances.

Rules of Golf.—We have received from the Royal Insurance Company, Ltd. (24 to 28, Lombard Street, E.C. 3) a new edition of their booklet, "Rules of Golf," as approved by the Royal and Ancient Golf Club of St. Andrews, September 28th, 1920. The Official Rules operate as from May 1st, and the booklet contains an inset showing the differences between the old rules and the new. Copies will be sent to any reader on application until the stock is exhausted.

Testing German Electrical Apparatus.—The *Technical Review*, quoting from *Elektrotechnische Zeitschrift*, says that the Association of German Electrical Engineers has drawn up new regulations concerning the organisation that it is setting up to carry out tests on electrical apparatus. It is hoped that all manufacturers in Germany will send their products for official testing by the Association, and point out in their catalogues which of their appliances have been thus officially tested. To goods that are in accordance with the regulations of the Association, a mark will be affixed, consisting of the letters VDE enclosed in a triangle with rounded corners. The tests will be carried out either at the laboratory of the Association in Berlin or at one of the accredited laboratories in the country.

For Sale.—By direction of the Disposal Board, Messrs. King & King will sell by auction on June 1st and 2nd, at Eastleigh Aerodrome, plant and machinery, including electric motors, electric winches, portable telephone exchange, semi-Diesel oil engines, &c. For particulars see our advertisement pages to-day.

Electricity Supply in South Africa.—An Electricity Supply Bill is being introduced in the Union Parliament this session, containing novel and extended provisions. According to the *S.A. Mining and Engineering Journal*, it has been drawn up by a Commission, and provides for the establishment of an Electricity Board "in which the control of all electricity supply is vested, and which will decide all questions relating thereto." It also provides for the appointment of local advisory committees, consisting of suppliers and consumers, which will have no executive powers but will be charged with the duty of advising the Board. The establishment of Government generating stations is contemplated, the first of which will probably be those required for the electrification of the railways.

It is stated that the powers to be conferred on the Board are very far-reaching, and will have a great effect on municipalities which supply electricity. For instance, in the interests of economy, the Board may require the amalgamation of two or more undertakings, whether municipal or private, or may order that where an available bulk supply is cheaper than that generated by a corporation, the bulk supply shall be purchased. This would enable the Board to order the Johannesburg Town Council to obtain a supply from the Victoria Falls Power Co., which, the Commission states, is cheaper than that of the Council. Other provisions will enable consumers to obtain permission to get a supply of power from any other source than the municipal power station, and will empower private suppliers to break up streets and lay cables in a town.

Naturally the municipalities are offering strong opposition to a number of the clauses.

The Coal Dispute.—One of the most important developments of the strike has been the installation of oil-fuel burners in power stations all over the country. Leeds was one of the first authorities to realise the importance of this measure, and, as a result, it has been found possible to augment the depleted tramcar services and to maintain better supplies of power for industrial purposes. One of the largest stations in the country—Lots Road, which supplies the underground railways—is now running almost entirely on oil fuel. Other stations to which oil has been introduced include those at Hull, Sunderland, Swansea, Barrow, Blackburn, Blackpool, and Newcastle. With regard to the last undertaking it is freely stated that no attempt will be made to revert to coal, and no doubt this will prove to be the case in many instances; Swansea was contemplating the change before the mines closed down.

In spite of threats of drastic action by the transport workers, large quantities of foreign coal have been brought into the country and distributed, principally among undertakings sustaining public services. The only undertaking that has been seriously affected by the workers' objection to handling foreign coal is the L.C.C. station at Greenwich. The employés struck work on May 14th, but naval men and others have been keeping the plant running with but one or two temporary stoppages, which the *Daily Herald* describes as an "amusing result . . . owing to the blacklegs requiring a rest." The same organ states that conductors and drivers are to ballot on the question of ceasing work. The unions participating in the Greenwich strike are the E.T.U., the Dockers' Union, the A.E.U., and the Enginemen's and Firemen's Union; about 300 men are affected.

The daily loss to the State occasioned by the coal stoppage is estimated at £3,250,000, including defence measures, unemployment allowances, loss in taxes, &c.

Transformer Tenders for Wallasey.—The Wallasey Council last week discussed a situation which had arisen following its acceptance of a tender for a transformer required by the Electricity Committee. At a previous meeting the Council considered whether it should accept the quotation of a British firm at a higher cost or that of a Swedish firm at a lower, and eventually the tender of the Swedish concern was accepted. On Thursday last week, however, the deputy chairman of the Electricity Committee reported that the firm now said it had made a mistake in its offer, and wished to amend it. The tender as amended was still lower. Members of the Council expressed dissatisfaction at the course events had taken, and it was stated that there had been an irregularity in the method of receiving the tenders. It was decided to start all over again and invite new tenders.

E.T.U. Observations on the Situation.—Viewing the electrical trades through the spectacles of the Electrical Trades Union, as focused in their monthly *Journal*, employment would seem to be going from bad to worse, and the past month has seen a very large increase in the number of branches applying for funds from the General Office. "We had a somewhat optimistic feeling a little while ago," states Mr. J. Rowan, "and thought we could discern signs of a revival of trade. There is no shadow of a doubt that there are many firms declining to open out work in anticipation of a fall in wages. We cannot see that there is any justification for expecting a material decline in wages while the cost of living remains so high. The engineering employers are much more exacting in their demands than the shipbuilders, and are insisting on a reduction of 6s. and, in addition, the 12½ per cent. bonus as well. The unions have conferred on this, and while they have not yet indicated the exact steps they propose to take, they have indicated to the employers that the reduction will be resisted. The attitude of the engineering employers is all the more unreasonable when we remember that the prospects of a revival in trade are distinctly more rosy than in the case of shipbuilding. We are among those who believe that trade is already on the turn, and that before the end of the year there will be a distinct revival something approaching a boom."

The E.T.U. *Journal* reports that a Central Strike Committee has been formed for Scotland, and this has resulted in a greater co-ordination between the districts. It is also stated that the E.P.E.A. has appealed to the E.T.U. for support at Aberdeen, where it anticipates having to withdraw its members to force the Corporation to pay the agreed rates to its members. The E.T.U. has promised support.

In the organisers' reports, it is recorded that the Scottish members accepted the challenge of the Scottish Electrical Contractors' Association to fight against a reduction of 3d. per hour. The Glasgow Strike Committee had been successful in getting 40 employers to guarantee they would pay the district rate of 2s. 3d. per hour to all men in their employment.

Blackburn branch of the Electrical Trades Union reports that trade is very moderate in the district, mainly owing to the lack of supply, which it is hoped will be augmented in September, when the new power station is erected.

A new branch of the E.T.U. has been opened in Bristol.

Trade in Cardiff and the surrounding district is said to be very slack. The Gorton secretary says they are faced with the worst spell of unemployment he has yet experienced. The branch members at Govan "are not in the least pessimistic on account of the lack of work on the Clyde through depression in trade, strikes, &c."

The Mersey District Committee says it is heartbreaking to meet its members who are looking for a job. It is thought the shipping section will remain in its present bad state until the joiners' strike is settled. There are about 120 ships lying up.

A committee of kinema and station engineers' branches has been established at Liverpool, and the question of non-unionist operators has been gone into. The non-unionist question at the Liverpool Corporation is said to be well in hand. The report continues:—"The local N.F.E.A. have replied that the result of our joint meeting *re* regrading from Grade B to Grade A is that they cannot see their way clear to support the application in any way. I think the time has arrived for the E.T.U. to consider the question of withdrawing from the Whitley Council," states the committee's scribe.

A District Industrial Council's Report.—The first annual report of the No. 5 (West Midlands Area) District Industrial Council for the Electricity Supply Industry shows that, apart from the settlement of wages questions, the Council has in mind the other objects for which it was formed. These, while generally considered of secondary importance, will do quite as much to make for harmonious and easy running. This Council has nine representatives of municipal undertakings and three company representatives on the employers' side, while on the other side eight different trade unions are represented by twelve members. The questions to be considered include: The feasibility of preparing a scheme for indentured apprentices, and the desirability of setting up a contributory scheme for payment of sick benefits and superannuation allowances to men no longer capable of performing their duties efficiently. The accounts of the Council show a small balance on the right side.

London's Electricity Supply.—We have received from Mr. Leslie Gordon, hon. secretary of the Conference of Local Authorities owning Electricity Undertakings in Greater London, a copy of a memorandum which he submitted to the Executive Committee of the Conference on May 10th. Its purpose is to review the principal provisions of the Electricity (Supply) Bill which is now before the House of Commons, and to combat the suggestions which have been made regarding the alleged tendency of the Bill towards the nationalisation of the industry. With this object Mr. Gordon summarises the history of the subject as dealt with in the reports of the Reconstruction Committee, the Board of Trade Committee on Electric Power Supply, and the Ministry of Transport Committee of Chairmen on Electric Power Supply, showing how the recommendations of these Committees have been embodied in the Act of 1919 and the present Bill. Mr. Gordon points out that none of the schemes for the formation of a Joint Electricity Authority for the London area, whether emanating from municipal sources or from the London companies, can be carried into effect without the necessary financial powers contained in the Bill. These schemes are based upon co-operation and unity of control, with the view of stopping the waste due to excessive capital expenditure on existing but unsuitable generating stations, and effecting a great saving in working costs. He further states that the risk of any charge falling upon the rates in any part of the area is a very remote contingency.

Mr. Hoover Resigns Engineering Presidency.—Stating that he cannot remain president of a society which seeks to influence legislation, even though he be in favour of such action, owing to his appointment to an official Government position, Mr. Hoover has resigned the post of President of the Federated American Engineering Societies.

Trade Mark Applications.—Appended is a summary of the recent applications for British trade-marks in respect of goods and productions connected with the electrical trades and industries :—

Vincent (lettering and design). No. 410,072. Class 13. Electric switches, switch fuses and electrical fuses.—F. W. Abbott, trading as the Vincent Switchgear Manufacturing Co., 61, Vincent Parade, Balsall Heath, Birmingham. November 25th, 1920.

Thermica. No. 412,710. Class 50. Electric insulating materials made from mica.—Bertie G. Levis, trading as B. G. Levis, 1, Leadenhall Street, London, E.C. February 2nd, 1921.

Isolac. No. 412,869. Class 50. Electric insulating preparations and materials.—Pinchin, Johnson & Co., Ltd., General Buildings, Aldwych, London, W.C. February 26th, 1921.

Bellerite. No. 402,319. Class 40. An ebonite compound for heat-insulating purposes.—Barrett & Elers, Ltd., 127-9, Wallis Road, Hackney Wick,,London, E. February 9th, 1921.

A Chave (lettering with key design). No. 411,733. Class 8. Rubber-insulated electric cables.—Callender's Cable and Construction Co., Ltd., Hamilton House, Victoria Embankment, London, E.C. January 20th, 1921.

Celec. No. 412,717. Class 8. Resistances, charging boards, switchboards, &c.—Frederick C. Curtis, trading as the Curtis Manufacturing Co., Conduit Place, Paddington, London, W. February 21st, 1921.

Maxiphone. No. 413,430. Class 8. Electrical instruments for magnifying sounds.—Herbert Powell Rees, 8, Grange Park, Ealing, W. March 15th, 1921.

Austin Motor Co.—With reference to the affairs of this company (Elec. Rev., March 13th, p. 622) the financial Press states, on the authority of Sir Herbert Austin, that all the additional finance required to put the company on a sound financial basis has been definitely settled, subject to the approval of the creditors of the company. There will not be any public issue.

The petition for the compulsory winding-up of the company has been adjourned.

The Proposed Inquiry into Industrial Unrest.—With reference to this proposal, which we discussed in a leading article in our issue of April 29th, the *Times* quotes the following terms of a reply by the Premier to a question put in Parliament by Lord Robert Cecil :—

"The Government are considering whether some form of systematic inquiry into industrial unrest is desirable, but at the moment I cannot say more. It will be appreciated that the matter is not free from difficulty; we must, for instance, remember that at the present time, by means of conciliation boards, industrial councils, and other joint bodies, negotiations are going on between employers and employed in a large number of trades, and I am glad to say that in many instances recently these negotiations have resulted in mutual agreement.

"Two years ago the Government urged upon employers' associations and trade unions the need for mutual discussion, without external interference, and I am glad to say that the views we then expressed have been accepted, as the joint negotiations now in progress show. I am sure my noble friend will agree that, in these circumstances, in coming to a decision on the matter he has raised we must consider carefully whether a general inquiry might not retard rather than accelerate the progress of these negotiations."

Electrical Trade in Italy. — The *Rivista Tecnica d'Elettricita* gives the following details of the gradual expansion in the varied uses of electricity in Italy in 1920. It is based on the Customs reports of the Ministerio delle Finanze, which compares the imports of 1920 with those of 1913. Dynamos weighing over a ton weight were imported in 1920 to a little over 10,300 tons, against 20,000 in 1913; the principal suppliers being the United States with 5,000 tons and England with 3,600 tons. Lighter dynamos were imported to 10,500 cwt. against 15,000 in 1913, the United States being again the chief suppliers with 4,500 cwt. Of transformers there were imports of a little above 1,000 cwt., contrasted with 13,000 in 1913. Taken altogether, reduction was more marked in generator and network plant and less in accessory material, the aggregate imports being 27,500 cwt. in 1920 against 73,300 cwt. in 1913—a fall of two-thirds. "Does this contraction," asks the writer, "answer to a reduction in consumption or to a growth in national output? Before the war we imported yearly about 40,000 cwt. of dynamo and transformer sheet iron—to be exact we imported 38,000 cwt. in 1913. Since then, in the six years 1914-19, the imports varied between the minimum of 33,000 cwt. (1915) and the maximum of 55,200 (1916), or an average of 45,000 cwt., and certainly by 1919 the stocks accumulated in the war period were exhausted. But in 1920 imports sprang up to 59,000 cwt., or nearly half as much again as before the war. Hence it must be concluded that the output of electric machines in Italy in 1920 approximated to 225,000 cwt., equal to the full requirements of 1913. The home consumption did not increase to the extent which these data would lead one to suppose; but, as a fact, Italy in 1920 exported over 15,000 cwt. of electric machines, a not inappreciable set-off for the 27,000 cwt. imports for the same period. These exports consisted primarily of the lighter dynamos and transformers. Hence no appreciable increase of home consumption happened between 1913 and 1920, but our output sufficed to cover our requirements and, in some lines, to strengthen our efforts abroad.

"Passing to the examination of other lines, we find that the 12,200 cwt. of apparatus, heavy and light, imported in 1913 had sunk in 1920 to 3,000 cwt.; the difference must undoubtedly have been covered by the national industry, since the consumption could not have varied greatly from that of 1913. We may recall the case of arc lamps, whose fatal decline had already begun in 1913; the 500 cwt. of that year having shrunk to 37 cwt. in 1920. On the other hand, glow lamp imports markedly bettered before-the-war figures, being 12,300,000 against 9,670,000 in 1913. In this field we have no privileged suppliers, the most important being Holland, Switzerland and Austria. Our own exports were insignificant. Electric furnace electrodes record a noteworthy advance, the 8,000 of 1913 having sprung to 50,000 in 1920, but it is to be observed that in 1919 they had risen to 150,000. Carbons for arc lamps and other small uses fell from 10,000 cwt. to 1,300 cwt. Copper wire of over ½ mm. thickness, which in 1919 rose from about 8,700 cwt. to nearly 50,000 cwt., fell to about 6,000; while insulated wire dwindled from 3,600 cwt. to 550, and cable from 8,350 to 68. Our exports of bare wire are practically nil, but those of insulated wire advanced from 10,000 to 21,600 cwt.; electric cable from 13,000 to 23,000 cwt., and all the countries of the world strove to become our customers. In subsidiary products, imports of rubber and gutta-percha advanced from 34,000 cwt. to nearly 70,000, which figure, although the rubber industry shows undeniable progress, is a fall from the 1919 total (120,000 cwt.). Exports of rubber goods, which recorded 30,000 cwt. in 1913, rose to 69,000 cwt. in 1920."

Engineering Wages.—According to the *Daily Chronicle*, a long conference took place at York on 12th inst. between the Engineering and National Employers' Federation and representatives of the Amalgamated Engineering Union, the Engineering and Shipbuilding Federation, the National Union of General Workers, the Electrical Trades Union, and other organisations on the proposed reduction of wages in the engineering industry.

The proposals have already been stated in the Electrical Review. Our contemporary reports that the men's representatives declined to consider the employers' proposals, on the ground that they were too drastic. They also asked that the matter should be submitted to arbitration under the Industrial Courts Act. This the employers refused, and after five hours' discussion the conference broke up.

"It is understood that the men will bring the matter to the notice of the Ministry of Labour, with a request that the Government put into operation the powers of the Industrial Courts Act."

Manchester Chair of Commerce.—A new chair in the Faculty of Commerce, to be known as "Commerce and Administration," has been instituted at the Manchester University, and Mr. G. W. Daniels has been appointed first professor.—*Daily Dispatch.*

St. Dunstan's.—A copy of the sixth annual report of the St. Dunstan's Blinded Soldiers' and Sailors' Hostel has been received from Sir Arthur Pearson, the chairman of the Blinded Soldiers' and Sailors' Care Committee. It tells a wonderful story, and contains a number of photographic views of the workshops where those who were blinded, in what we trust we shall never forget was the cause of righteousness, are engaged. There are now 1,772 names on the books of St. Dunstan's; 106 new-comers were admitted during 1920, and in the course of the year 305 blinded soldiers completed their training and were set up in occupations that they had mastered. As the report shows, therefore, more than 1,200 men are already established at work.

Inquiry.—The makers of Parry (or Perry) electric punkahs are asked for.

Fire.—Fire broke out, last week, at the premises of Messrs. F. W. Birkett & Sons, Ltd., electrical engineers, Cleckheaton. The damage is estimated at £5,000.

Sports.—The Sterling Club (Sterling Telephone and Electric Co., Ltd.) wound up a very successful season on Whit Monday by defeating Great Eastern Railway (holders), who had four Essex County players in their team, by 5 goals to 2, in the final of the Ilford Hospital Senior Charity Competition. Last season as a junior team, "Stecco" won the above competition's Junior Cup. It is the first team to win both competitions in successive seasons.

A New Motor Fuel.—An experimental consignment of the new patent alcohol fuel "Natalite" will arrive at the Port of London next week, from South Africa. Natalite has been manufactured, and has been in general use, in South Africa for four years, and is now also being produced in East Africa, India and Australia, but this is the first consignment to reach this country, and is being imported under special permit given by the Excise and Customs authorities. The whole of it will be used exclusively for demonstration and experimental purposes. Tests are reported to have shown that Natalite will give as good mileage as petrol, and in many other respects is superior as a fuel for internal-combustion engines.

LIGHTING AND POWER NOTES.

Algeria.—Power at Mine.—Considerable extensions are taking place in connection with the electrical equipment of the iron ore mines of the Société des Mines de Fer de Rouina, in Algeria. A hydro-electric power station is being established about 6½ miles away to utilise the water power of the river Cheliff. The plant will have a capacity of 1,200 h.p., and the power will be transmitted to the mines at a high voltage. The plant at the existing steam-operated generating station is being increased by the addition of a 350-h.p. engine and dynamo, bringing the capacity of this plant up to 630 h.p. The company's railway which carries the ore between the mines and the railway station at Rouina is also being electrified, while a number of electrically-operated exhaust pumps are also being installed. At the Breira Mines of the same company a generating plant of 200 h.p. capacity is being installed.

Australia.—Victoria.—Some criticism has been offered on the 25,000-kW proposal, in which two sets would be in commission, with a third set as a standby. It is said that it is "putting too many eggs in one basket." This criticism would have more weight if the Morwell scheme were entirely self-contained and independent. It will, however, be closely linked up with Newport, and so, if there were a failure at Morwell, Newport could always come to the rescue. It should be remembered, too, that if 25,000-kW sets are decided upon, this will be only the initial installation; the complete scheme provides for an output of 100,000 kW, provided either by four large sets and a standby, or by eight small sets and a standby. The small sets, with their auxiliaries, would cost more, and with them there would be a slight loss in economy. They would also be more liable to breakdown, for they would be speeded up to 3,000 r.p.m., whereas the large sets would be run only at half that speed. But whether large or small sets are decided upon will depend a good deal upon the tenders. The probability is, however, that the Electricity Commissioners would prefer large sets, other things being equal. Then the Commissioners have made arrangements for putting down an experimental briquetting plant, which will briquette 70 tons a day. The cost of this will be about £30,000.—*Reuter's Trade Service* (Melbourne).

Aylesbury.—Loan.—The Town Council has applied for a loan of £27,632 for additional plant at the electricity works.

Ballycastle (Co. Antrim).—Lighting Agreement.—The Urban Council has given instructions for the completion of the agreement with a Belfast electricity supply company for the lighting of the town.

Bristol.—Extensions.—At a meeting of the Town Council held on May 10th, a report was submitted by the Electricity Committee. This stated that it was necessary to erect a number of new sub-stations, and to alter some of the existing ones. Apart from this it was stated that large additions to the power station plant were required. The total estimated cost of these works is £200,062, and application is to be made to the Electricity Commissioners for powers to borrow this amount.

Carmarthen.—Farm Power Plant.—The Carmarthen Committee appointed to inquire into the best means of obtaining electricity for the Pibwrlwyd demonstration farm, has decided that the installation of a small oil engine and generator, at a cost of £500, will be more satisfactory than a supply from the town. It was thought that the students should have some knowledge of the working of small farm plants, and that the suggested procedure would provide additional education.

Cheadle and Gatley.—The Urban District Council has applied to the Electricity Commissioners for authority to purchase in bulk, generate and distribute electrical energy for public and private purposes in the urban district of Cheadle and Gatley.

Continental.—France.—Application has been made by a syndicate for a State subvention in aid of an electrical distribution network to be set up in the Département de l'Ain, in an agricultural district comprising 19 communes in the Cantons of Collonges, Ferney-Voltaire, and Gex. The cost of the work is estimated at 2,500,000 fr. Two networks are contemplated—high and low pressure—the former being three-phase, 15,000 volts, and the latter three-phase 200/115 volts. The length of the first network will be 57 km., and of the second 50 km. Four other syndicates, representing 30 communes, are also interested in similar schemes in the same *département*, and they are expected to eventually combine and join forces.

La Compagnie des Forges et Acieries Electriques Paul Girod, of Ugine, has applied for a concession to utilise the water power of the Doron de Beaufort Falls, near Chambery Savoy, for the generation of electrical energy. Part of the power is required for the works of the company, which has, however, undertaken to supply the electricity necessary to meet the public requirements of the Department.

Belgium.—The Société Intercommunale Belge d'Electricité is steadily extending its programme. During the past year it took over the working of the generating stations at Roux, Paturages, and Malines, while it also repurchased the plant at Sweveghem. In order to meet the increasing demand for electricity, particularly for power purposes, not only is the plant at these stations being enlarged, but new generating stations are being established at Alost and Monceau-sur-Sabre. New interconnection lines are also being established between the Monceau power plant and those at Roux and Paturages.

Italy.—A big scheme for the supply of Trieste with electrical energy and drinking water has been drawn up by the Unione Esercizi Elettrici, of Milan. The scheme proposes to extract water from the Upper Reka, and a 43,000,000 cb. m. storage reservoir fed by the Padez and Suhorka Falls. The water will be taken *via* a tunnel and cast-iron pipes to a station of a capacity of 1,700 e.h.p., equal to 10,000,000 kWh yearly; 50,000 cb. m. of the water taken from the Padez Fall daily will be filtered and sterilised. The cost of this part of the scheme is set at 50,000,000 lire. The cost of the electrical portion of the scheme is reckoned at 88,000,000 lire.

Spain.—A recent company formation in Barcelona illustrates a growing tendency in Spain to the formation of co-operative electricity supply undertakings. The Sociedad Anonima Co-operativa La Fluido Electrico has been formed by the Asociacion de Consumidores de Fuerza Motriz de Cataluna, with a capital of 25,300,000 pesetas, the whole of which has been subscribed by its founders, who themselves will be the chief consumers of the energy produced. This is estimated at 25,000 h.p. at the least, but will probably be raised to 75,000 h.p. by the absorption of the Sociedad Hidroelectrico del Cadi, a company formed a year ago with a capital of 7,500,000 pesetas, whose assets include seven waterfalls on the slopes of the Sierra del Cadi (Province of Lerida), and the rivers La Vausa, Cardoner, and Segre, whose aggregate output is estimated at about 140,000 h.p. The Co-operativa also owns falls on the River Esera, and has taken over the shares of the Sociedad Espanola de Construcciones Electricas (formed in 1912 with a capital of 12,500,000 pesetas), with its works and trained staff.

Derby.—Fire at Power Station.—A fire in the basement of the power station, on May 13th, did considerable damage, and also seriously interfered with the whole supply of power, the tramcars being stopped for several hours. The fire started, it is believed, through the fusing of a cable, and the Derby Fire Brigade was promptly summoned. With water from two standpipes they confined the fire to the basement, and soon extinguished the flames. James Morell (59), a cleaner, was badly burned about the hands, arms, and face, and had to be taken to the infirmary.

Glasgow.—Inspection of Housing Scheme.—The Corporation electrical engineer has called the attention of the Corporation Housing Committee to the working-class garden village at Billingham, near Stockton-on-Tees, where, apart from the domestic hot water supply, which is afforded by a boiler behind the coal fire in the living room, all heating, cooking, and lighting are done by electricity, and the Committee has agreed to send a deputation to inspect them.

Grange.—Council's Protest.—The Urban District Council has informed Messrs. T. Wilkinson (Arnside), Ltd., who supply electricity to the town, that unless a circular issued with regard to the minimum charge for energy is withdrawn, the Council will give notice to terminate the agreement with the firm.

Harrogate.—Loan Sanctioned.—It was reported at a Town Council meeting, on May 9th, that the Electricity Commissioners had sanctioned the borrowing of £46,000 for electricity purposes.

Hull.—Area of Supply.—The Corporation is applying to the Electricity Commissioners for powers to extend the area of supply of electricity in the Western area of the rural district of Sculcoates, and to alter the maximum price and the method of charging.

India.—Gersoppa Electricity Scheme.—The chief engineer of the Government of Mysore has submitted his report on the scheme for harnessing Gersoppa Falls with the object of producing electric power. The total cost of the scheme is estimated at about Rs. 4½ crores.—*Reuter's Trade Service* (Bombay).

Calcutta.—A Special Committee of the Municipal Council states that it is unanimously of opinion that if any concession is to be granted to the Calcutta Electric Supply Corporation, Ltd., it should only be on the basis of a corresponding concession to consumers in the matter of rates. It suggests, therefore, that in the matter of the extension of the period of option for the purchase of the undertaking, in the manner suggested by the company, the question of reduction of rates (whenever practicable) in the interests of the public, should be safeguarded by the Government.

Jedburgh.—Price Increase.—An order has been issued authorising the Electric Supply Corporation to increase the charges for electricity from 10d. to 1s. per unit as from January 1st last, and to impose minimum charges of 15s. up to 15 units for each winter quarter, and 10s. up to 10 units for each summer quarter. The company had asked for power to charge up to 1s. 2d. per unit.

Lyme Regis.—Purchase of Undertaking.—The Town Council has decided to seal the contract for the purchase of the undertaking of the E.L. & P. Co., Ltd., October 1st being the date for the completion of the purchase.

Lynn.—New Plant.—At a recent meeting of the Town Council, the electrical engineer reported that the new turbo-generator set and rotary converter had been completed. The Electricity Committee arranged a visit of inspection.

Matlock. — Proposed Hydro-Electric Scheme.—Another small scheme for the utilisation of water power for generating electricity has been put before the Urban District Council by a Mr. Pearson. He suggests the construction of works on the Derwent, near the new Suspension Bridge.

Mexico.—Power Company's Extensions.—A cable from a special correspondent of the *Agence Economique* states that the Mexican Light and Power Co. is going to install a turbine of 6,000 h.p. and a new power set of 20,000 h.p. The company has just secured the funds necessary for the utilisation of a 60,000-h.p. waterfall. The work will occupy two years. The company suffers much from the drought, and is now obliged to make use of petrol engines.—*Financial Times.*

Nuneaton.—Street Lighting.—On May 6th, Major Stewart, O.B.E., R.E., of the Ministry of Transport, held an inquiry into the circumstances attending the Borough Council's application for sanction to borrow £1,050 for the purpose of street lighting. The electrical engineer, in reply to the Inspector, said that this requirement was not foreseen when the previous amount for the same purpose was applied for. They had spent nearly £2,500 already this year out of revenue, and it was impossible to meet any more charges in that way.

Redditch.—Financial Position of Undertaking.—At a recent meeting of the Urban Council, it was reported that the electricity undertaking had incurred a heavy loss, the liabilities totalling £17,651. The only remedies were said to be increased charges or the levying of a general district rate of 2s. 6d. in the £. The latter course is being adopted subject to the approval of the Finance Committee.

Scunthorpe and Frodingham.— Bulk Supply.— The Urban District Council is applying to the Electricity Commissioners for authority to purchase electricity in bulk from Messrs. John Lysaght, Ltd., or any other company, and to supply the same for public and private purposes within the urban district of Scunthorpe and Frodingham.

Stafford.—Year's Working.— The accounts of the electricity department for the year ended March 31st last, show an income of £20,817 (an increase of £4,007), and expenditure of £15,984 (an increase of £3,992) leaving a trading balance of £4,833—an increase of £15. Deducting loan charges, income-tax, and a deficit brought forward, there was a surplus of £501. The Mayor (chairman of the Electricity Committee) said they had made a profit of £500, but this had been done by taking money from the depreciation account to wipe out some of the deficits. Alderman Bostock said there had been a serious falling-off in the sales, and this seemed likely to continue unless trade took an unexpected turn. They were at a critical point with regard to the undertaking, and it was of the first importance to secure an increased number of consumers. To do this there would have to be a considerable outlay on new mains, which would not be immediately remunerative.

Sunderland.—Price Increase.—The Town Council has adopted a revised tariff for supplies from the low-pressure network, to take effect from the June meter readings. The general effect of the new tariff is to raise prices by about 10 per cent. It was argued that the small consumers were being penalised by this increase in order that the large users could continue to receive supplies of power at a low cost, but the chairman of the Electricity Committee replied that the new charges were justified, and were the lowest they could impose to ensure the prosperity of the undertaking.

Surbiton.—Report Upon Meters.—Complaints having been received from consumers that the amount of power registered by their meters seemed to be excessive, Mr. A. H. Preece, of Messrs. Preece, Cardew, & Rider, was asked to report on the matter. He considers the meters, all of which are of reliable make, are accurate, but that any tendency towards incorrectness is in favour of the consumer. The methods adopted by the supply company for testing the meters are stated to be excellent. The report was considered satisfactory, and was adopted.

Taunton.—Public Lighting.—The borough electrical engineer informs us that the whole of the public lighting standards in the main streets have been fitted with 200-W gasfilled lamps in Holophane "Refractor" fittings. The illumination is quite equal to the old seven-ampere open type d.c. arc lamps.

Liquid Fuel.—The boilers are being fitted to burn liquid fuel in place of coal. It is expected to effect a saving in the fuel bill as well as to make the undertaking independent of coal supplies.

Extension.—The Council is applying for an order authorising a supply to certain farms and residences in the Norton Fitzwarren and Bishops Lydeard districts through 2,200-V single-phase overhead mains.

Tregaron (Cardiganshire).—Proposed Water-Power Scheme.—A committee has been formed with the object of establishing electricity works in the town. It is proposed to utilise water as the motive power.

Worthing.—New Plant.—The Electricity Committee reports that it will be necessary to install a 350-kW generating set to meet the probable requirements of the undertaking by the winter of 1922, and the electrical engineer has been instructed to prepare specifications and plans with a view to tenders being invited in the early autumn.

TRAMWAY AND RAILWAY NOTES.

Australia.—Electrification of Melbourne Railways.—The latest railway figures published show that the partial electrification of the Melbourne suburban railways has proved a great financial success, the saving effected thereby amounting already to £191,000 per annum.—*Reuter's Trade Service* (Melbourne).

Bootle. — Track Renewals.— A resolution of the Electric Power and Lighting Committee deciding that the work of relaying the troughing for tramway purposes throughout Strand Road should be proceeded with at an estimated cost of £1,040, and that the expenditure be defrayed out of the electricity reserve fund account, has been approved by the Town Council.

Continental. — Spain. — The Railway Bill, recently brought before the Legislative Chamber by the Minister of Public Works, seeks to nationalise the railways when this is considered expedient. In the meantime a close arrangement is to be made between the railway companies and the Government. If necessary, rates are to be brought down to below working costs and the deficit will be made up by the State. Sanction is sought to construct new lines, and for the subsequent electrification of the railways.

Exeter.—Offer of Purchase.—At a meeting of the City Council on May 10th, it was reported that the National Electric Construction Co. recently had inquired whether the Council was disposed to sell or lease the tramway undertaking, and the Tramways Committee recommended a reply in the negative.

A £4,000 loss on the tramways had been included in the estimates, and at previous meetings the question of sale had been mooted. There was a disposition to criticise the committee for not putting fuller particulars of the offer before the Council. Mr. M. J. McGahey thought the majority of the Council might be against selling or leasing, but some were in favour of it. Mr. Towill, chairman of the committee, said the committee was unanimous in its recommendation. It was decided to report further at the next meeting.

Electric Vehicles.—Reference was made in the accounts to £500 expenditure in connection with electric vehicles. Mr. J. S. Steele-Perkins thought there should be a fuller report. The Council had been promised a large reduction in men and horses through the introduction of the vehicles. He supposed the committee concerned had spent between £7,000 and £8,000 in connection with these vehicles. The surveyor said he had promised a report after the vehicles had been in use for three months.

Stockton-on-Tees.—Loan Sanctioned.—The town clerk reported at a recent meeting of the Town Council that the borrowing of £155,201, repayable in 30 years, in respect of the purchase of the tramways had been sanctioned.

South Africa. — Railway Electrification. — In the Union Senate, on April 6th, Mr. Ehrlich asked the Minister of Railways and Harbours :—(*a*) Is the Minister aware that the High Commissioner's office in London, on behalf of the Railway Department, has called for tenders for various supplies required for the electrification of the line from Cape Town to Simon's Town and from Durban to Maritzburg, and the time for tendering expires on May 2nd next? ; (*b*) does the Minister, at this inopportune time, intend to accept a tender, or will he agree to suspend these works and divert the money required, and estimated at nearly five millions sterling, to the building of new lines instead, and thus provide nearly 1,000 miles of additional new railway lines for the opening up of the country not yet served by railways, and provide work for many unemployed?

The reply was :—(*a*) Yes ; (*b*) the estimated cost of the electrification scheme as sanctioned is £4,385,400. Electric traction is being introduced in South Africa for the same reason that it is being introduced in other parts of the world—namely, to effect economy in working, and help to counteract the large and universal increase in operating costs. Traffic has fallen off somewhat on certain lines, and the outlook at the moment is not so reassuring as when the electrification scheme was sanctioned, but, while reasonable prudence must be observed in capital expenditure, it would be unwise to provide for the future on the basis of present-day trade and traffic conditions or the present-day outlook, which are abnormal and transitory. The desirability of constructing additional developing railways for the opening up of the country districts is appreciated, and is likely to be hastened, rather than retarded, by the introduction of modern and economical methods of working. To build a large mileage of branch lines at the expense of modern methods would only mean increasing the loss on working without introducing any counterbalancing economies in the operation of existing lines.—*South Africa.*

While the Government is proceeding with the electrification of the Natal line, owing to the financial position it is postponing temporarily the electrification of the Capetown-Simonstown line.—*Reuter's Trade Service* (Capetown).

Southend.—Railless Cars.—A deputation appointed by the Southend Corporation to inspect the railless system at Rotherham, Bradford, and York recommends the adoption of the system in Southend, stating that the cost of power for driving a railless trolley car is 1 1·7d. per mile, as compared with 5d. per mile for a petrol 'bus. In its report to the Corporation the deputation says that the systems in Rotherham and Bradford were amongst the first to be operated in this country. The York system was started last December. Rotherham and Bradford having old systems and rolling stock of the earliest type, with complicated propelling machinery, the cost of upkeep is heavy, and in both these towns it is proposed to scrap the existing rolling stock, and to build entirely new and up-to-date vehicles. Last year there were losses of £1,650 at Rotherham and £10,000 at Bradford, but the engineers there are of opinion that when modern cars are secured the undertakings will be able to operate at a profit. At Bradford the deputation saw the experimental double-deck vehicle, which seats 57, and reports that it ran smoothly and satisfactorily. Districts served in Rotherham and Bradford would not have justified the heavy expense of ordinary tramways. In York the railless service is through narrow streets, which forbade the installation of tramways.—*Electric Railway and Tramway Journal.*

TELEGRAPH AND TELEPHONE NOTES.

A Magnetic Storm.—The electrical storm which had been growing since May 13th became so violent on the 15th inst. that it caused widespread interruption of telegraphic communication. One of the first warnings of the magnetic disturbance came last week when wireless telegraph operators on the "airways" between London and the Continent reported frequent interruptions in the continuity of their messages. Another symptom was seen on the night of the 13th, when Auroræ Boreales were observed about 11 p.m, from the aerodrome at Croydon, Surrey, in the form of a band of light across the sky, which appeared to alternately contract and expand. The severity of the storm put out of order for a time the telegraph and telephone services in Sweden, and it was impossible to communicate between Stockholm and Gothenburg from 10 p.m. on the 13th until 8.30 a.m. on the 14th. A fire was started at the Karlstad (Sweden) telephone exchange, which was destroyed, and electrical flashes were observed at other telegraph and telephone offices. "A very nice sunspot has appeared," Sir Frank Dyson. the Astronomer Royal, reported on the 15th, "and although I do not know that sunspots cause magnetic storms, they often come together. The sunspot will go round with the sun in 25 days, but the magnetic storm will not last as long as that." A New York message says that Aurora Borealis, on the 14th, caused one of the most severe electrical disturbances there for 30 years. Nearly every telegraph wire in the United States outside New York was out of order. The Naval Observatory at Washington considers the phenomenon due to a sunspot, which was estimated to be 94,000 miles long and 21,000 miles wide, and which was observed and photographed on the 10th and 11th.

The *Daily Chronicle* states :—"A group of sunspots, of quite exceptional size, is at present visible on the sun, one of the individual spots being large enough to be seen with the naked eye. The group stretches from near the centre of the sun almost halfway to the western limb, and extends for at least 150,000 miles in length. The total area occupied by the group is probably not less than 2,000 million sq. miles, and the largest spot which is nearest the sun's limb. exceeds 700,000,000 sq. miles in area."

On Sunday last the storm abated, but there was a fresh increase in intensity about 3 a.m. on Monday morning, and by noon the disturbance was believed to be over. Meanwhile, although British postal authorities suffered but little from the disturbance, which happened during a quiet period of telegraphic and telephonic transmission, cable companies and wireless operators found repeated breaks in messages both from America and Canada, and from practically every part of the world. At the offices of the Western Union Co. the effect of the storm was very pronounced.

An Aurora Australis was distinctly seen in Australia and New Zealand on Sunday night. Telegraph circuits throughout Australasia were affected.

Mr. Carlton, President of the Western Union Telegraph Co., announces that the damage done by the storm on Saturday evening may necessitate the lifting of some of the trans-Atlantic cables for repairs. He says the oceanic currents accompanying the phenomenon found out the weak spots in the insulation and aggravated them, thus interrupting the service.—*Reuter's Trade Service* (New York).

Peru.—Concession to Marconi Co.—The Peruvian concession to Marconi's Wireless Telegraph Co., of London, to operate the Peruvian wireless postal and telegraphic services for a period of 25 years, has been made the subject of representations by the United States Government. The communication to the Peruvian Government has not been published, and officials of the State Department decline to discuss it, but it is learned that it is not in the form of a protest.—*Reuter's Trade Service* (Washington).

River Plate.—Cable Renewals.—The directors of the "Compania Telegráfico-Telefonica del Plata," in their report for the year ended December 31st, 1920, state that their lines continue to receive preference for communications between Buenos Aires and Monte Video. Working results amounted to $504.715.49 m/n. as against $379.114.69 m/n. in the previous year, but expenses of administration rose from $266.447.61 m/n. to $332.452.46 m/n. Some extraordinary expenditure was incurred on repairs, primarily for mending cables which had been cut in several places, due to the resumption of sailings by large trans-Atlantic liners. It was also found that the old cables were in such a bad state, owing to their lengthy use, that they might easily have endangered the security of service, and the Board arranged immediately to replace them. Two new single-conductor cables arrived at the end of the year, the laying of which was expected to be completed during March. The cost of these cables and of laying them amounted to $160.000 m/n., and as the company had only recently terminated the construction of the two new conductors mentioned in the preceding report, it was necessarily obliged to have recourse to credit. The Board was unable to recommend the distribution of a dividend, and placed towards the amortisation of the cables the surplus of $126.436.70 m/n.—*Review of the River Plate.*

South America.—Improved Cable Facilities.—Mr Carlton, president of the Western Union Cable Co., stated before the Commerce Committee of the House of Representatives that his company expects to double its cable facilities to the South American east coast, and also to lay a cable on the west coast of that continent.—*Reuter's Trade Service* (Washington).

The Telephone Service.—The Postmaster-General in reply to a question in the House of Commons, said that the number of subscribers who had given up the telephone owing to the increased charges was rather less than 3 per cent. of the number of those who had so far signed the new agreement, and if that proportion was maintained throughout, the gain from the revised tariff would not be seriously affected.

U.S A.—Wireless Phenomena.—A co-operative study is being carried on by the American Radio Relay League and the Bureau of Standards, tests having been conducted during June and October, 1920, and January, 1921. A further series of tests was to be carried out in April, in which from five to ten stations were to transmit signals in succession, these signals being received simultaneously at about 100 receiving stations, whose operators were provided with forms for recording the variation in the intensity of the signals as received. A paper presented before the Philosophical Society at Washington on January 29th described the results of the tests so far conducted and proposed an explanation of the phenomena which associates the long-distance transmission accomplished at night with the boundary of the highly conducting outer portion of the atmosphere, which is also the origin of auroral disturbances. Fluctuations in intensity are probably caused by irregular absorption of the waves by masses of slightly ionised air through which the waves travel in their course. The fading phenomena are closely associated with the strays or atmospheric disturbances which affect all radio communication.—*T. & T. Age.*

Wireless Telephony.—On May 11th two representatives of *The Times*, one at Zandvoort, in Holland, and the other at Southwold, on the East Coast between Lowestoft and Harwich, held a conversation lasting 50 minutes without an interruption by wireless telephone across 125 miles of the North Sea. The experiment, which was completely successful, was arranged by the Marconi Co., which has been granted a licence by the British and Dutch Governments to test its newest apparatus. The station in Holland is only a temporary one, but that at the English end is fully equipped; the familiar telephone receiver and transmitter were used in conjunction with valve amplifiers, and it is stated that a new screening device was employed which warded off alien disturbances of natural origin, and (at least, to a greater extent than has hitherto been achieved) even those caused by other wireless waves. Hitherto, when speaking with the aid of wireless, it has been necessary for the first speaker to finish what he had to say, and then switch over from the transmitting to the receiving circuit before being able to listen to incoming speech. This process, however, has not only been done away with, but apparatus is practically perfected, so that instead of there being the necessity of keeping a watch on the instrument for calls, it will be possible to ring up a wireless telephone station in just the same way as one rings up on the ordinary line instrument.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia. — Melbourne. — June 15th. Victorian Government Railways. 50 oil-immersed single-phase track and signal transformers for power signalling (Contract No. 33,901).*

June 22nd. One electric lifting magnet (capacity ½ ton), one 440-V motor generator.*

June 29th. Supply of 1-ton platform type industrial storage battery trucks, also battery-charging equipment.*

August 10th. 250 core-type impedance bonds for power signalling, with a capacity of 1,000 amperes per rail; also 50 miles of solid insulated copper wire, No. 14 Brown & Sharpe gauge, and 50 miles of solid insulated copper wire, 16 standard gauge.

August 17th. 3,000 sets of renewals for caustic soda primary cells.

August 30th. Board of Works. Four electrical centrifugal pumps, each with a capacity of twelve million gallons daily.

Aldershot.—May 24th. Urban District Council Electricity Department. Three miles of 6,000-volt, 3-phase cable. (May 13th.)

Belgium.—Antwerp. May 27th. Municipal authorities. Paper-insulated telegraph cables required in connection with the fire brigade service. Particulars, 1 franc, from the Service Electrique, Hotel de Ville, Antwerp.*

June 7th. Municipal authorities. Construction of a transformer post at the canal dock. Particulars for one franc from the Service Electrique, Hotel de Ville, Antwerp.

June 30th. Municipal authorities of Lokeren. For an underground system of electricity supply mains. Particulars (15 francs) from the Directeur des Services du Gaz et de l'Electricité de la Ville de Lokeren. Tenders to the College des Bourgmestres et Echevins, Hotel de Ville, Lokeren, by registered post.

Brighton.—June 7th. Electricity Department. Oil fuel plant. (See this issue.)

Canada. — Edmonton. — Provincial Government of Alberta. Construction of 2,000 miles of pole lines for telephones and stringing 4,000 miles copper wire.—*Reuter's Trade Service.*

Doncaster.—May 23rd. Tramways Department. Doubling of Balby route, from Cleveland Street to Balby Bridge. Mr. F. O. Kirby, borough engineer, 2, Priory Place, Doncaster.

Dundee.—Corporation. Electric lighting fittings for new City Hall and for the supply of a kinematograph and appliances. Mr. Jas. Thompson, city architect.

June 6th. Electricity Department. One coupled motor-generator, consisting of two interpole machines; motor, 400 V, d.c.; generator, 75 V, 130 amp.; also regulator, 60 to 70 V. (See this issue.)

Fiji.—Suva.—June 30th. Municipal Council. One 200-kW, 480/520-V, 3-wire, d.c. generator, directly coupled to a 300-h.p. vertical Diesel oil engine, with accessories and generator panel. Specifications (21s.) from the Town Clerk, Suva, Fiji, c/o Box 2,557, G.P.O., Sydney.

France.—French Post and Telegraph authorities, Paris. A 60-element battery of accumulators of 1,500 amp.-hour capacity for the wireless telegraph station at Ouessant (Finisterre).

Glasgow.—May 31st. Electricity Department. Cables (including small i.r. cables and flexibles) and meters for twelve months. (May 13th.)

Gravesend. — May 24th. Town Council. Electrical wiring of houses, King's Farm Estate. Borough Engineer.

Huddersfield.—May 28th. Electric light installation in United Methodist Church and School, Outlane. Mr. F. Roberts, Maplin Lea, Lindley Moor, Outlane.

London.—Shoreditch.—June 7th. Electricity Department. Constructional steel and ironwork building, 20-ton weighbridge, h.p. steam pipes, valves, &c., for Whiston Street generating station. (May 13th.)

Mexborough. — May 21st. Urban District Council. Electricity Department. One 750-kW rotary converter with transformer. (May 6th.)

New Zealand.—June 28th. Public Works Department. Ten s.p. oil-filled transformers for the conversion of three-phase current at 50 cycles, the voltage ratio being 50,000/11,000, for Waikato power scheme.*

June 28th. Supply and delivery at Lyttelton of two 50-kVA, two 100-kVA and two 200-kVA condensers in connection with the Lake Coleridge electric power supply (Section 116).*

Wellington.—June 14th. Post and Telegraph Department. 7,460 lamps, various voltages.*

August 9th. Public Works Department. Suspension-type porcelain insulators for the Waikato power scheme.*

Oldham. — Electric lighting of 50 houses at Hollin's housing site. Particulars from Borough Surveyor's Office.

South Africa.—July 5th. Electrification of Capetown-Simonstown and Durban-Maritzburg lines.

Wimbledon.—May 25th. Electricity Committee. H.p. sub-station switchgear. (May 13th.)

[*] A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—A Reuter dispatch from Melbourne states that the Victorian Electricity Commission has accepted a single American tender of £379,000 for switchgear and transformers. It is stated that this figure represents a saving of £200,000 on a combination of sectional tenders by various British firms, and that no British firm put in a tender for the material in one lot.

Barnsley.—Town Council:—

H. and l.p. cables, £6,821.—Western Electric Co.

Erith.—Urban District Council:—

Cables, &c., for the bulk supply from Woolwich.—Callender's, Ltd.

France.—La Société des Constructions Electriques de France, of Paris, has secured the contract for the electric locomotives and the equipment of the hydro-electric power generating stations required in connection with the electrification of the steam railways of the Compagnie des Chemins de Fer du Midi.

Glasgow.—Corporation. Electricity Department. Accepted:—

Cast-iron boxes, section pillars, &c.—J. Allan, Sen., & Sons; James Carmichael & Co., Ltd.; Carron Co.; Falkirk Iron Co., Ltd.; Lion Foundry Co.; McDowall, Steven & Co.

Malleable iron tube and fittings.—Scottish Tube Co., Ltd.

London.—St. Marylebone. — Electric Supply Committee:—

Constructional work in connection with the new boiler-house and pump-room extension, £23,495.—A. E. Symes (recommended).

Worksop (Notts.).—The Urban Council has accepted the following tenders in connection with the supply of electricity from the Manton Colliery:—

Cables, £13,042.—W. T. Glover & Co., Ltd.

Switchgear, £3,764; transformers, £2,328; and rotary converter, £4,831.—Metropolitan-Vickers Electrical Co., Ltd.

The total cost of the scheme will be £23,166.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, May 20th. At Caxton Hall, Westminster, S.W. At 8 p.m. Lecturette on "Liquid Fuels," by Mr. A. Arnold.

Friday, May 27th. At Caxton Hall, Westminster, S.W. At 8 p.m. "Notes on Electrical Transformer Breakdowns," by Mr. S. A. Stigant.

Royal Photographic Society (Scientific and Technical Group).—Tuesday, May 24th. At 35, Russell Square, W.C.1. At 7 p.m. Discussion, opened by Mr. J. C. Elvy, A.M.I.E.E., on "Illumination Problems in Kinematography."

Institution of Electrical Engineers.—Thursday, May 26th. At the Institution, Savoy Place, Victoria Embankment. At 6 p.m. Lecture on "A Physical Phenomenon and its Application to Telegraphy, Telephony, &c.," by Messrs. A. Johnsen and K. Rasbek.

Wireless Section Meeting.—Wednesday, May 25th. At the Institution of Mechanical Engineers, Storey's Gate, S.W. At 5.30 p.m. Discussion on "Long-distance Wireless Transmission." To be opened by Mr. C. F. Elwell.

Institution of Mechanical Engineers.—Friday, May 27th. At the Institution, Storey's Gate, Westminster, S.W. At 6 p.m. Special meeting.

Physical Society of London.—Friday, May 27th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary meeting.

NOTES.

Eight-Hour Day Bill Passed in Belgium.—The Senate, on May 13th, passed the Bill providing for the establishment of an eight-hour day and a 48-hour week. An amendment was made in the Bill as originally presented whereby the King was empowered to suspend the application of the limitations provided in the Bill in the event of war, or of any other emergency constituting a danger to national security, and when advised by the Supreme Councils of Labour and of Industry and Commerce that such a suspension was required as a matter of national necessity, in order to ensure by the development of the export trade the means of exchange indispensable for the importation of foodstuffs.—*Reuter's Trade Service* (Brussels).

Reproduction of Speech by Galena and Undamped Waves.—As far back as 1913 Brazier and Dongier showed that the passage of a sufficiently strong alternating current across the surface of contact of a metal point with a crystal of galena caused a sonorous effect. Mr. P. Collet (*Comptes Rendus*, June 7th, 1920), in continuing these experiments used a primary circuit in which undamped waves were set up, and a secondary circuit, entirely separate from the primary, and tuned to it by means of a variable condenser. From the terminals of this run off two line wires several metres long, at the end of one of which is a crystal of sensitive galena, while a platinum point is at the extremity of the other touching the galena, thus forming a circuit shunting the condenser. The point is fixed to the centre of a phonograph disk mounted on the horn of the instrument, and if the secondary circuit be turned to the primary, and the latter be periodically interrupted by a tuning fork, then the phonograph will emit a note of the same pitch as the fork. When a carbon microphone was joined in the secondary circuit, the sounds of a voice speaking in front of it were reproduced in an adjacent room with great intensity and with remarkable fidelity in quality; the singing voice was likewise admirably rendered in all detail. There is no advantage gained by using loud voices or intense currents. The phenomenon is attributed to thermal effects, being kindred to the Trevelyan rocker made well known in America by Prof. Tyndall half a century ago.—*Journal* of the Franklin Institute.

Electrical Adhesion.—The following is a synopsis of the lecture by Messrs. Alfred Johnsen and Knud Rahbek, which will be delivered before the Institution of Electrical Engineers on May 26th (see "Institution Notes").

The lecturers discovered in 1917 that strong adhesive forces were developed in some cases where an electric potential difference was applied to a solid body consisting of certain badly conducting materials, *i.e.*, various minerals, and a conducting body, such as a metal disk, resting on the former body. This adhesion was found to be proportional to the true area of contact between the bodies, so that ground and polished surfaces fitting accurately together afforded the best results.

It was found that the adhesion was due to an extraordinarily strong electrostatic attraction between the two surfaces in contact. The solid materials in question conduct electrolytically, and show a very high contact-resistance with regard to an adjacent conductor, if no conducting liquid, cement, &c., be interposed between the two surfaces. The contact resistance can greatly exceed the interior resistance in the material used. If a potential difference be applied to the metal disk and a metal electrode cemented to the semi-conductor (as the material may be called), a weak current will flow through this semi-conductor and across the contact surface to the metal disk. This causes a finite potential difference between the surfaces in contact, due to the very high contact resistance. The result is an unusually strong static attraction, which may easily be understood if it is borne in mind that the attraction between the plates of an "air condenser" for a given potential difference between the plates is proportional to the inverse square of the distance between the plates. The distance between the attracting surfaces being, theoretically, in this case zero, an infinitely large attraction should be expected. In practice, a limited attraction is manifested, the limitation being probably due both to electrolytic phenomena and to ionisation; nevertheless, an exceedingly strong attraction can be obtained at moderate potentials. It has been found that an electrostatic attraction of several pounds can be obtained between a thick lithographic stone, fitted with an electrode at the back, and a metal disk, two inches in diameter, resting thereon, when a potential of 440 volts is applied. The current is of the value of a few micro-amperes. The disk will lift the stone in an exactly similar manner to that in which an electromagnet can be lifted with its armature, and the stone will drop if the current be interrupted. Similar qualities are exhibited by flint, agate, some species of slate, and many other minerals and salts, as well as many organic substances, for instance, animal membranes, skin, gelatine, bone, &c. On the other hand, the experiment cannot be carried out with true insulators, such as glass, mica, ebonite, &c., as the necessary current cannot flow.

The attraction naturally causes a considerable friction between the two surfaces. This is utilised for technical purposes by using the semi-conductor in the form of a cylinder, maintained in rotation, and on which a metal band slides. As soon as a suitable potential is applied to the apparatus the band will adhere firmly to the cylinder, and can be made to operate various devices, the whole forming an effective electrostatic relay. In connection with telegraph apparatus, it is essentially useful as a radio recorder, the current from ordinary small valves being sufficient for its operation at a speed up to several hundred words per minute, if a sufficiently high potential (100 to 200 volts) be used for the valves. If the metal band be connected to a diaphragm or similar sound-reproducer, and telephone currents be applied, a very loud-speaking telephone is obtained. This and other applications, among which is a low-pressure pocket electroscope, will be demonstrated at the lecture.

It is obvious that the phenomenon forms a wide basis for scientific investigation, and that it will probably in the future be used for the construction of electrical apparatus for various purposes, especially in cases where a small current consumption is essential.

Australian Wiring Rules. — The Fire Underwriters' Association of Victoria announce several alterations and additions to the general wiring rules previously issued.

According to the *Australian Mining Standard*, in the rule specifying minimum size of conductor, an alteration is made in the wording to conform with the new method of defining size of conductors. Under the heading "Cased Wiring," a clause is added to the effect that metal conduit of class "B" must be used when protecting conductors any one of which conveys 50 amps., or more, while wood casing must not now be laid under floors, in hollow walls or where liable to be damaged by rodents. Insulated conductors, protected by an outer reinforcing cover of tough rubber compound, &c., may now be used when in view or not exposed to mechanical injury or damage by rodents, subject to the conditions obtaining in the rules as previously set out. Unarmoured conductors having a lead sheathing, &c., must be protected when laid between walls, &c., where liable to damage by rodents. Flexibles may be used for connections to lifts, subject to their being supported by porcelain insulators, and of such length that they will not come into contact with the bottom of the lift well when the lift is at the lowest point of its run. Unless permission be obained from the inspector, no flexible extension shall be taken across a ceiling to a drop-light or other fitting. Switch and distribution boards must be so arranged that a fire therein cannot spread, whether occurring at the front or back, and when placed on or within 6 in. of a wooden wall or 18 in. of a wooden ceiling, a thickness of hard insulating fire-resisting material is to be placed between switch or distribution boards and the wall or ceiling, and must extend at least 6 in. beyond the board all round. Wire, &c., passing through this material must fit the holes through which it passes as tightly as possible. Switch and distribution boards must be fixed on incombustible supports. The space at the back of the boards shall in no case be less than 4 in. between any live metal and the wall, supports, or tubing, except that where the potential above earth does not exceed 250 volts, the provisions of 87 (c) shall apply, and the distance between charged metal parts of fuses connected to opposite poles or phases shall be 4 in.

Educational.—In its report for 1919-20, the University Grants Committee comments on the large increase in the number of students which has occurred since the close of the war. Excluding Universities which are not in receipt of annual grant aid, and those institutions receiving a grant for the first time in 1919-20, the figures compare as follows for full-time students in the United Kingdom :—1913-14, 22,234 ; 1919-20, 36 424. The increase is mainly due to the presence of ex-Service students. In the 1919-20 session there were nearly 17,000 ex-Service students in attendance at university institutions in the United Kingdom Of these, rather more than 11,500 were attending institutions covered by the table.—*Daily Telegraph.*

Lecture on Electricity.—An interesting discussion took place at the Rotary Club luncheon at the Grand Hotel, Sheffield, on May 9th, following an instructive paper by Mr. A. E. Jepson, on "The Domestic Uses of Electricity." The speaker laid stress on the importance of the development of electricity for domestic purposes, especially in view of the difficulties which frequently arise with regard to coal supplies. He referred particularly to electric radiators, washers, irons, vacuum sweepers, and toasters, and said that his own experience showed that the cost was less than that of coal and gas, the house was kept cleaner with less effort, and washday became a pleasure. He had even used electricity for heating his fowlhouse, and found that under its influence hens laid earlier and more regularly than was the case ordinarily.—*Yorkshire Telegraph and Star.*

Economy!—As a measure of economy no officials or chairmen of committees of Leigh, Lancashire, are to be sent to any of the annual conferences.—*The Times.*

Electric Battleship Trials.—In a trial test with all four propellers working, the electrically-driven battleship *Tennessee* achieved an average speed of 21 knots. Her engines developed 30,909 h.p. The Trial Board announces that the engines, turbines, and generators worked excellently. The vessel carries 12 14-in. guns mounted in triple turrets.—*Reuter* (Rockland, Me.).

Appointments Vacant.—Assistant officers in charge (£300 +), for the Government wireless stations at Leafield (Oxon.), and Abu Zabal, near Cairo ; cable jointer (94s. 1d.), for the Eccles Corporation Electricity Works ; charge engineer, for the Bedford Corporation Electricity Department ; assistant charge engineer (£309), for the Islington Borough Council Electricity Department ; engineer-in-charge (£438), for the Hammersmith Borough Council Electricity Department. For particulars, see our advertisement pages to-day.

Electric Furnaces in America.—The net increase in the number of electric furnaces in the United States last year was 33, as against 36 in 1919, 54 in 1918, 97 in 1917, and 63 in 1916. The total is now 356, as against 323 on January 1st, 1920. The expansion of the industry will be appreciated when it is recalled that there were only 19 furnaces of all types in the United States on July 1st, 1913. In Canada the industry is virtually at a standstill. As heretofore, the Héroult furnace maintains its leadership in installations and output. Most conspicuous in the progress of the American steel industry last year were the Green and Greaves-Etchells types. Expansion in the installation of other types has either been small or absent. A new furnace of small size, but of decided interest and practical use is the Von Schlegel repelling arc furnace sold by the Industrial Electric Furnace Co., Chicago. Only one of them is operating in the steel industry, but about six are in use in the non-ferrous industry. The Volta furnace, sold by the Volta Manufacturing Co., Welland Ontario, is an outgrowth of the war, and two are being installed near Pittsburg. The world's steel industry, as a whole, is credited with 961 furnaces, of which the United States and Canada are credited with 399, or over 40 per cent. The numbers of furnaces in the other leading countries are as follows :—England, 150 ; Germany, 100 ; France, 69 ; Italy, 50 ; Sweden, 50 ; and Norway, 20.—*Scientific American Monthly.*

Synthetic Resins and Varnishes. — The Electrical Research Association is actively interested in furthering the manufacture and use of electrical insulating materials made from synthetic resins and varnishes, and having the well-known heat-resisting characteristics associated with some of these materials. Leading manufacturers and users of the raw materials and finished products are already co-operating, and it is hoped that persons not already in touch with the work will take an early opportunity of communicating with Mr E. B. Wedmore, Director and Secretary of the British Electrical and Allied Industries Research Association, 19, Tothill Street, Westminster, S.W. 1.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Return to I.E.E. Building.—The removal of the Institution offices to its own building began on Tuesday, May 17th, and all communications to the Institution should now be sent to Savoy Place, Victoria Embankment, London, W.C. 2. The telephone number will continue to be "Gerrard 764," and the telegraphic address, "Voltampere, Phone, London."

Special Lecture.—On May 26th, at 6 p.m., at the I.E.E. building, Messrs. A. Johnsen and K. Rahbek, two Danish engineers, will lecture on "A Physical Phenomenon and its Application to Telegraphy, Telephony, &c.," and will repeat the demonstrations of their inventions, which, it will be remembered, took place at the Polytechnic Academy at Copenhagen, recently, on the occasion of the centenary of Hans Christian Oersted. The lecturers claim that by sending an electric current through certain substances—such, for instance, as lithographic stone (slaty limestone) - an adherent force, in some respects resembling, but entirely different from, electromagnetism, is produced. The discovery will, it is thought, inspire a series of inventions, both within and outside the field of wireless telegraphy, such as, for instance, greater speed in wireless reception. The lecturers will also give a demonstration of a violin being used as a loud-speaking telephone. A synopsis of the lecture appears on p. 656.

Benevolent Fund.—In order to secure the 19 donations of £250 required to comply with Mr. E. M. Hughman's offer of £250, it has been suggested that some members might be willing to invest that sum in the name of the Fund, subject to their receiving the income during their lifetime; or they might take out fully-paid-up policies on their lives and assign them to the trustees of the Fund.

Annual General Meeting.—On May 31st, at 5 p.m., at the I.E.E. building, the annual general meeting of the Institution will be held to receive and consider the accounts for the year ended December 31st, 1920, and the annual report of the Council, and to elect auditors.

The Charter.—At 5.45 p.m. on the same evening and at the same place a special general meeting will be held for the purpose of considering and, if thought fit, of passing the following resolution, namely :—

"That the Council of the Institution of Electrical Engineers be requested to apply to the Privy Council for a Royal Charter of Incorporation, and that the draft petition and draft charter therefor, which have been initialled for purposes of identification by the chairman of this meeting, be approved, subject to such alterations as the Council of the Institution may deem it necessary or expedient to make therein prior to the application to the Privy Council, and to such alterations as may be made therein by the Privy Council and approved by the Council of the Institution."

Copies of the draft petition and charter have been circulated to members.

Lecture.—At 6.30 p.m. on the same evening and at the same place Dr. F. B. Jewett will lecture on "Research Work in the United States."

Wireless Section.—On May 25th, at 6 p.m., at the Institution of Mechanical Engineers, Mr. C. F. Elwell will open a discussion on "Long-distance Wireless Transmission," and on June 8th, at 6 p.m., in the I.E.E. building, Prof. J. S. Townsend, F.R.S., will read a paper on "Electric Oscillations along Straight Wires and Solenoids."

North-Eastern Centre.—The annual meeting of this Centre was held on May 9th, at Newcastle-on-Tyne, Mr. J. R. Beard presiding. The report of the Committee stated that the membership of the Centre again showed an increase, from 396 to 434.

At the beginning of last session the Committee decided to award annually a local premium valued at £2 5s. for the best paper read by a Student before the Students' Section which is not awarded one of the Institution's Student premiums. Last session the premium was awarded to Mr. L. Champney, for a paper entitled "Wave form of an Alternator." The premium for the closing session has been provisionally awarded to Mr. H. M. Rochester for his paper entitled "Electricity in Mines"; but the award cannot be confirmed until the Council's awards are known. The Committee also decided at the commencement of the session that a further local premium, valued at £2 2s., should be awarded to the Student who made the best contribution to the discussions at the Students' meetings, and this premium has been awarded to Mr. E T. Jones. The officers and members of Committee for the ensuing year, are :—

Chairman.—Prof. W. M. Thornton, D.Sc.

Vice-Chairmen.—Messrs. E. Fawssett and T. Carter.

Past Chairmen.—Messrs. J. R. Beard, M.Sc., and W. Cross.

Committee.—Power Supply Undertakings.—Messrs. W. F. T. Pinkney, C. Vernier, and A. A. Hughes.

Manufacturers and Contractors.—Messrs. P. F. Allan, A. P. Pyne, H. W. Clothier, N. W. Prangnell, and J. Rosen.

Universities and Technical Colleges.—Mr. W. T. MacCall.

Municipal Engineers.—Mr. E. Moxon.

Consulting Engineers.—Mr. C. H. Davidson.

Civil Service and Railways.—Messrs. F. G. C. Baldwin, G. L. Drury, and H. Kitchen.

Miscellaneous Sections.—Mr. A. C. Michie.

Hon. Secretary.—Mr. H. B. Poynder.

Auditors.—Messrs. C. Turnbull and J. M. Heslop.

Institution of Civil Engineers.—At the annual general meeting, on April 26th, the result of the ballot for the election of officers for the year 1921-22 was declared. The President-Elect is Mr. W. B. Worthington. Amongst the members of Council are Colonel R. E. Crompton, C.B., R.E. (T.); Sir Robert A. Hadfield, F.R.S.; Captain H. Riall Sankey, C.B., R.E. (retired); and Sir John F. C. Snell. The new Council will take office on the first Tuesday in November, 1921.

Royal Photographic Society.—On Tuesday next, at a meeting of the Scientific and Technical Group, by request of the Society, Mr. J. C. Elvy will open a discussion on "Illumination Problems in Kinematography." It is expected that Messrs. Walsh and Buckley, of the N.P.L., and Mr. Priest, of the U.S. Bureau of Standards, will take part.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

At a Mexboro' (Yorks.) Urban Council meeting an animated discussion took place on the question of the salary of the electrical engineer (Mr. J. B. Feltham). In 1919 his salary of £300 per annum was referred to arbitration, the Council and the engineer agreeing to abide by the award. A year later a salary of £660 was awarded. The Council, however, decided that it could not afford to pay such a salary, and it rescinded the agreement to accept the decision of the arbitrators, and offered a salary of £500, which Mr. Feltham accepted without prejudice. The question that now faces the Council is that of the payment to the engineer of £480, representing the difference between £300 and £660 over a period of 16 months, during which time the question of salary was in abeyance. The Council has rejected the Finance Committee's recommendation that the amount be paid, and has also rejected amendments that a smaller sum of £266 be paid, and that the matter be further considered.

Aylesbury Town Council has granted £370 to the electrical engineer (Mr. W. A. Turnbull), as remuneration for work in connection with the installation of additional plant.

Mr. F. Flynn has been appointed acting borough electrical engineer by the Limerick Corporation, with Mr. Grund as acting assistant engineer.

A recommendation by the West Hartlepool Electricity Committee to increase the salary of the engineer to £900 has been rejected.

Mr. George Sutton, who was already an elected member of the Council of the Bribery and Secret Commissions Prevention League, Inc., has been nominated as representative of the Cable-Makers' Association on the Council.

Mr. David T. Wilson, director of William McGeoch & Co., Ltd., announces his retirement, for reasons of health, as from June 30th, 1921. Mr. Wilson has been associated with the firm for close on 40 years as assistant manager, and latterly as director, and is well known in the electrical trade.

Obituary.—Mr. A. G. Newington, M.I.E.E.—We regret to record the death, which occurred on April 30th at Dunfermline, at the age of 49 years, of Mr. A. G. Newington, M.I.E.E., who was on the electrical engineering staff of H.M. Dockyard, Rosyth. The deceased gentleman was a brother of Mr. F. A. Newington, M.I.E.E., city electrical engineer of Edinburgh.

Mr. C. L. Oechsner.—We deeply regret to record that Mr. C. L. Oechsner, publicity manager to the British Thomson-Houston Co., Ltd., at Rugby, passed away on Sunday last at Bournemouth. He had been in failing health for some time. The funeral was to take place yesterday, Thursday.

NEW COMPANIES REGISTERED.

Electric Traction Developments, Ltd. (174,459).—Private company. Registered May 4th. Capital, £4,000 in £1 shares. To acquire and turn to account any patents, licences and concessions relating to (1) railways, tramways and other methods of traction, and (2) and (3) the production, treatment, storage, distribution, application and use of electricity, motive power and lighting and apparatus therefor. The first directors are: T. H. Minshall, 34, Victoria Street, S.W.1, engineer; P. Horsfall, Queen's House, Kingsway, W.C., secretary. Remuneration as fixed by the company. Solicitor: L. H. Booth, Milburn House, Newcastle-on-Tyne. Registered office: 34, Victoria Street, Westminster, S.W.

Scottish Industrial Exhibition, Ltd. (11,712).—Private company. Registered in Edinburgh May 4th. Capital, £500 in £1 shares. To promote and carry on in any part of the U.K. exhibitions of the manufactures, products, industries and material resources of Scotland and of all articles illustrative of science and art, &c. The first directors are: J. Cousin Stevens, 57, Queen Street, Edinburgh, S.S.C.; R. Morrison Ireland, 57, Queen Street, Edinburgh, W.S. Secretaries: Kitchen and Stevens, 57, Queen Street, Edinburgh.

Combination Metallic Packing Co. (1921), Ltd. (174,649).—Private company. Registered May 11th. Capital, £5,000 in £1 shares. To take over the business and certain of the assets of the Combination Metallic Packing Co., Ltd. (incorporated in 1900, and now in voluntary liquidation), and to carry on the business of packing manufacturers, dealers in metallic and other packing, engineers, brass and aluminium founders, forge masters, electric welders, shipping agents, ship repairers and owners, &c. The first directors are: W. M. Brown, 46, Bede Burn Road, Jarrow; G. H. Mackrow, 5, Gordon Terrace, Whitley Bay; W. Matheson, The Clach, Hebburn-on-Tyne. Secretary: G. H. Mackrow. Registered office: Hillgate, Gateshead.

Aylesbury Motor Co., Ltd. (174,646).—Private company. Registered May 11th. Capital, £6,000 in £1 shares. To take over the business of a motor, electrical and general engineer carried on by W. H. Perry at 48 and 50, Kingsbury Square, Aylesbury, Bucks. The first permanent directors are: W. H. Perry, 1, Woodside Avenue, Highgate, N.6; Ellen F. C. Perry, 1, Woodside Avenue, Highgate, N.6; R. R. Gordon Barrett, 48, Kingsbury Square, Aylesbury, Bucks. W. H. Perry may retain office as governing director while holding 1,000 shares, with £250 per annum as remuneration. Registered office: 48-50, Kingsbury Square, Aylesbury, Bucks.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Strand Electric and Engineering Co., Ltd.—Particulars of £2,000 debentures authorised March 11th, 1921, present issue £1,200, charged on company's property, present and future, including uncalled capital.

Woking Electric Supply Co., Ltd.—Issue on various dates from August 7th, 1919, to April 26th, 1921, of £8,070 debentures, parts of a series already registered.

Marston Billington, Ltd.—Debenture dated May 3rd, 1921, to secure £1,000 charged on the company's undertaking and property, present and future, including uncalled capital. Holder: F. G. W. Pearson, Highlands, Farnham Common, Bucks.

Comac Manufacturing Co., Ltd.—Particulars of £2,000 debentures authorised April 20th, 1921, present issue £700, charged on company's property, present and future, including uncalled capital.

J. E. Lester & Folwell, Ltd.—Satisfaction in full on April 28th, 1921 (*a*) of mortgage dated August 17th, 1920, securing £1,500, and (*b*) of equitable charge dated December 13th, 1920, securing all moneys then due or to become due notified. Transfer of mortgage and further charge on 60, London Road, Leicester, dated April 29th, 1921, to secure £8,000, including £3,500 transferred. Holder: Mrs. G. A. Hill, Cedar House, Aylestone Road, Leicester.

CITY NOTES.

Potteries Electric Traction Co., Ltd. The report shows that the capital expended during 1920 was £22,081, chiefly for additional motor omnibuses. The revenue was £299,929. Traffic and parcel receipts £280,632, or £28,194 in excess of 1919. Expenses increased by £44,261, due principally to increases in wages and to the higher cost of fuel. After deducting all expenses chargeable to revenue, including £11,025 for debenture interest and a provision of £15,000 for renewals, there remains £28,500 (against £44,141 in 1919), plus £12,082 brought forward. There is put to reserve £10,000; 5 per cent. preference dividend, £12,250; dividend of 5 per cent. on the ordinary shares, £12,250; carried forward, £6,082. The reserve will now stand at £110,687, and the renewals fund at £71,319. The increases in wages granted during the year were heavier than during any previous year, and as it was not possible to increase the revenue to the same extent, the balance available for distribution is consequently less. The traffic receipts for the current year were satisfactory until the mines closed down. Considerable competition with the regular services of the company is being experienced at present from motor vehicles, and steps are being taken to meet it. Additional omnibus services have been opened and are providing travelling facilities in districts formerly without adequate means of communication.

Calcutta Electric Supply Corporation, Ltd. At the annual meeting, held on May 12th, Lord Meston, K.C.S.I., explained how the company's business had developed in spite of the check which Calcutta experienced in its general prosperity during 1920. The demand rose steadily, and 39 millions of units had been sold, as against 32 millions in 1919. Every class of consumer contributed to the increase; the demand for power for industrial purposes rose by nearly 20 per cent., and for private lighting and fans by nearly 25 per cent. In addition to the regular supply the company's staff came to the assistance of Calcutta in October, when the gas strike plunged the city in darkness; for this they received the thanks of the municipality. The expenditure had gone up considerably, due largely to the increased output, but also to a serious increase in the cost of coal, the bill for which rose by over 42 per cent. Wages and salaries had also been increased in view of the high cost of living. The effect of the depreciation of the rupee was not so marked in 1920 as it would be in 1921. But to meet all these adverse circumstances the scale of charges had to be revised and a surcharge of 15 per cent. was added to all consumers other than those with special contracts—to take effect from January 1st. Even with the additions the rates were not only below the legal maximum, but below those charged before the war. Owing to the cheapening of the supply in March, 1920, on a flat rate of 3 annas per unit for domestic purposes other than cooking, the rise in revenue had not been proportionate to the increase in demand. The new increase in rates was but a temporary measure to be abolished as soon as possible. The policy of reducing rates had been fully justified in the past, and in their business the maxim of a large turnover and small profits would probably command their approval, as well as that of the customers. The extensions foreshadowed a year ago had been prepared for, but in view of existing conditions the directors had postponed all capital expenditure which could possibly be allowed to stand over. However, £500,000 of the first mortgage debentures were floated last July, the proceeds enabling the directors to push on with the provision of one 15,000-kW set and one 6,000-kW set with boilers, auxiliaries, and transmission mains. These were still much short of the plant originally contemplated. The directors had written off the whole cost of the recent debenture issue, £24,793, out of the profits, and reserved £83,000 for E.P.D. and other taxation in England. £43,760 had been carried to the depreciation fund, and the reserve and other funds strengthened to the extent of £10,000. The directors proposed a final dividend on the ordinary shares of 6 per cent., with an additional bonus of 1 per cent., making 11 per cent. in all for the year. This is subject to English income tax at the rate of only 3s. 6½d., allowance being made on account of the tax already paid by the company on its profits in India. A bonus of 2 per cent. on the net rupee profits of the company was proposed for the staff in India, who had worked loyally and well in the middle of a local epidemic of strikes and labour unrest. Figures were quoted to show the remarkable progress of the company. Twenty years ago, only 407 houses in Calcutta were supplied with current; the present number was 11,500. The cable mileage rose in the same period from 26 to 525 miles, and the sales of electrical energy from under half a million to nearly 39 million units. And yet the business was capable of almost infinite development in a city like Calcutta, with its steady increase of industrial enterprise and a dense population now breaking through their innate conservatism. The company's position was very sound; there was no need for uneasiness about good Indian investments. The wave of unrest was passing, and the risks attending well employed capital in India were not greater, but probably on the whole less, than under present industrial conditions in England.

The resolution was seconded by Mr. P. V. Luke.

Col. Westrop asked what was the average rate of exchange at which the net profits had been brought home from India, and was informed that it was rather over 2 shillings.

Mr. Lamert commented on the iniquity of the excess profits duty and other taxation. Altogether taxation accounted for about £120,000 out of a revenue of £270,000.

In reply, the chairman agreed that the disappearance of the E.P.D. would benefit the company; but on the other hand, it would mean a higher range of income tax, while there was always the possibility of an extension of the corporation profits tax. Though next year a considerable reduction in taxation might be expected, it was prudent to keep a fair margin for the future. The chairman also raised the point of having a shareholders' register in Calcutta. It was urged that it would be good for the company if Indians and Anglo-Indians were personally interested. The board had considered the matter for some time, and for various reasons had gone slow in that connection, but had now practically decided to open a register in Calcutta.

The resolution was unanimously approved.

At a subsequent special meeting the directors were given additional borrowing powers up to £100,000; and it was agreed to sub-divide the existing £5 preference and ordinary shares into five shares of £1 each.

German Companies. The accounts of the *Welter Elektrizitats und Hebezeugwerk A.G.*, of Cologne-Zollstock, whose manufactures include lifting appliances, show net profits of 252,000 marks for 1920, as contrasted with 135,000 marks in 1919, and the dividend is at the rate of 15 per cent. and 10 per cent. in the two years respectively.

The accounts of the *Ver. Isolatoren Werke A.G.*, of Berlin, show net profits of 363,000 marks for 1920, as compared with 166,000 marks in the previous year, and the dividend is at the rate of 12 per cent., as in 1919. The report states that the great activity in the first half was followed by a decrease in the demand for insulators and falling prices in the second half of the year.

The directors of the *Accumulatoren Fabrik A.G.*, of Berlin and Hagen, whose share capital was increased from 12,000,000 marks to 20,000,000 marks last year, report net profits of 5,056,000 marks, as against 2,525,000 marks in 1919, and that the dividend rises from 17 per cent. in the latter year to 20 per cent. for 1920 on the larger amount of share capital. The report expresses the hope of a revival in manufacturing, and states that the maintenance of accumulators was being continued in return for additional payments on the part of customers.

The report of the *Sachsenwerk, Licht und Kraft A.G.*, of Dresden, states that the production in 1920 was considerably greater both in value and quantity than in the pre-war year of 1913. It was possible for the Radeberg works, which was acquired from the State, to employ a larger number of men than the 800 originally provided for; the transformer factory at Niedersedlitz was considerably enlarged and the construction of apparatus was extended, while 100,000-volt transmission lines for Saxony and the Reich were being made. The net profits in 1920 were 17,100,000 marks, as compared with 2,160,000 marks, and the dividend is 16 per cent., as against 20 per cent. on less capital in 1919.

Italian Companies. The report of the *Società Generale Italiana Edison di Elettricità* shows a steady increase in the cost of working, resulting more particularly from the wages increase authorised by the Labriola award, which is, however, counterbalanced in part by the higher tariff granted by Decree No. 2,264. The accounts show a balance of 10,315,584 lire, which allows of a dividend of 36 lire on each of the 240,000 fully paid shares of December 31st, 1919, and of 13.3 lire to 80,000 shares partly paid up. To carry out the installation of new plant, the shareholders have sanctioned the increase of the company's capital from 96,000,000 to 108,000,000 lire, and eventually to 180,000,000 lire by the further issue of 240,000 300-lire new shares.

The report of the *Società Anonima per Imprese Elettriche Conti* refers to the unfavourable conditions created by the Labriola wages award as well as to the increasing dearness of raw materials, which had seriously affected the working of the company. Besides carrying out the works under way at Valdo, plans were being prepared for the installation at Crevoladossola. The accounts disclosed a net balance of 4,905,000 lire, from which a dividend of 22.50 lire to each of the 184,000 old shares and 2.25 to each of the 96,000 new shares would be distributed.

Steady progress marked last year's working of the *Società Elettrica et Elettrochimica del Caffaro*, the accounts closing with a net balance of 909,000 lire, allowing of a distribution of 25 lire to each of the 32,000 250-lire shares. Power was given the directors to increase the capital from 8,000,000 to 12,000,000 lire by the issue of 16,000 new shares. The company has recently secured a concession to develop the Upper Caffaro river, for which the new capital was demanded.

Società Lombarda per Distribuzione di Energia Elettrica.—The report, closing with December 31st last, showed a considerable increase both in the receipts and in the disbursements. The net balance was 3,810,282 lire, which allowed of the distribution of a dividend of 52 lire to each of the 65,000 fully paid up shares.

Società Adriatica di Elettricità (Venice).—The sanctioned increase of the capital to 100,000,000 lire had been carried out, and the augmented demand for energy during the past year had necessitated the resort to the reserve thermic plant. The works for the utilisation of the water power of the Veneto had been carried on uninterruptedly, while those for the more thorough utilisation of the waters of the river Adige by the Milan company were almost completed. The company's operations during 1920 were concerned with the repairs of the lines and plant damaged during the war. The Labriola wages award had imposed heavy sacrifices, having raised the cost of hand labour eight times above that ruling before the war. The accounts showed a net balance of 6,019.224 lire, out of which a distribution of 9 lire per share was declared.

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Siemens Bros. & Co., Ltd.—The report for 1920 shows a profit of £253,254, plus £315,776 brought in. The directors recommend a final dividend of 1s. per share, free of tax, making 10 per cent., free of tax, for the year, placing to a special surplus fund £30,000, and carrying forward, subject to excess profits duty for 1918, 1919 and 1920, and to corporation tax, £435,218. It is proposed to increase the share capital from £1,500,000 to £2,500,000 by the creation of ten per cent. cumulative preference shares, to be issued when required, and to capitalise £300,000 surplus assets, to be distributed in the proportion of one ten per cent. cumulative preference shares for every five shares paid.—*Financial Times.*

Mackay Companies.—Receipts of the Mackay Companies for the year to February 1st, 1921, from investments in other companies totalled $4,868,988. Dividends paid absorbed $4,230,330. Operating expenses, including Federal income tax, transfer agents', registrars', auditors' and trustees' compensation, office rent, salaries, stationery, engraving of certificates, &c., totalled $535,400, leaving to be carried forward $103,251. A contract has been signed with Swan Hunter and Wigham Richardson, of Newcastle, for the construction of a new cable repairing steamer to replace present cable ship *Mackay-Bennett*. The new steamer will be completed early in 1922.—*Financial Times.*

Chesham Electric Light & Power Co., Ltd.—The profit for 1920 on electricity supply, after deducting all costs of generation and distribution, and on contracting and other work, was £5,642. Deducting general expenses, rent, rates, &c., leaves £4,332, plus £4,577 brought forward. Debenture and loan interest absorb £1,796, depreciation on property £1,000, balance of cost of debenture issue £302; dividend, £900; balance, £4,910.

Oldham, Ashton & Hyde Electric Tramway, Ltd.—The report for 1920 shows a net profit of £11,500, plus £5,987 brought forward. There is put to reserve £6,000. The dividend on the ordinary shares is 6 per cent. for the year, and £5,987 is to be carried forward. As a result of the arbitration proceedings and subsequent negotiations, the directors have received a definite offer from the local authorities of £125,000 for the system (in addition to the price of stores) and to settle all matters outstanding. The directors advise the shareholders to accept the offer. The amount that will ultimately be available for distribution cannot at present be definitely stated, but there will be a surplus for both classes of shareholders after repayment of the capital.

Constantinople Telephone Co.—After providing for interest on obligations and debt certificates and debiting 5 per cent. interest on share capital, full amount of amortisation, together with reserves for renewals, &c., accounts for year ending December 31st show a loss of £T18,431, which makes a total deficiency of £T74,025.

Craigpark Electric Cable Co., Ltd.—The annual meeting was held in Glasgow on May 12th, Dr. Magnus Maclean in the chair.

New York Telephone Co.—Net earnings for 1920, $12,164,575; deduct interest, $6,094,502; balance, $6,070,073; add surplus at January 1st, 1920, $38,814,111; total, $44,884,184; dividends (8 per cent.), $12,000,000; miscellaneous items, $381,022; surplus, December 31st, 1920, $32,503,162.—*Financial News.*

Anglo-American Telegraph Co., Ltd.—The report is issued for the year ended March, 1921. It states that the four dividend payments announced already absorbed altogether £262,500, being the rent paid by the Western Union Telegraph Co. for the year, equal to 3¾ per cent. on the ordinary stock, 6 per cent. on the preferred, and 1½ per cent. on the deferred. The balance at credit of revenue account, £72,158, includes £6,533 interest received, and the balance (£65,625) is available for the payment of dividends for the quarter to March, 1921.

STOCKS AND SHARES.

TUESDAY EVENING.

WITH the labour crisis fluctuating daily (if not hourly), the Stock Exchange markets are at some loss to know in which direction the immediate indications point. There was a certain amount of accumulated business to be dealt with after the Whitsun holiday, but as soon as this was cleared off, markets settled down to await developments in the coal trade. Publication of the Railways Bill had an effect surprisingly little upon quotations of stocks and shares in the railway markets. Indeed it may almost be said that the result was practically nil, and the reason may be partially ascribed to the difficulty which the ordinary mind experiences in grappling with the intricacies of the Bill's provisions.

So far as the electric railways are concerned, we have already pointed out that the Bill is not likely to influence their financial position seriously one way or the other. Gorgeous weather at Whitsun caused motor-'bus traffic, in and out of London, to break all records, and this lent fresh courage to those who have been maintaining for some time past that the tube companies are getting into a strong position. As soon as the companies are able to take full advantage of their profit-earning capacities, the shareholders are likely to reap the reward of a long-exercised patience. Because of this, the prices of the various stocks are well maintained on the whole. Though steam stocks may droop, the Undergrounds, with occasional ups-and-downs, manage to hold rises on balance. The enthusiasts are talking about the possibility of a dividend being declared on Districts about the end of next year, though this did not prevent the stock losing 10s. at 16½. Underground Incomes have risen to 74½.

The way in which the prices of new issues continue to advance is remarkable. Central Electric Notes have risen 1½ to 5½ premium. The new City of London Electric second preferences left, it may be recalled, in the hands of underwriters to the tune of about 60 per cent., are now up to 1s. 3d. premium, instead of being 1s. discount, at which the price opened when dealings started. Auckland 6 per cents. have improved to 5 premium. British Oxygen 8 per cent. debentures, which came out at 96, are 4½ premium. Melbourne Electric 8 per cent. preference, now £3 paid, and offered to the shareholders at 4¼ for the £5 shares, stand at 3 1/16, while the ordinary shares 5s. paid are 6d. premium. It is expected that when the proposals for the issue of Siemens new 10 per cent. preference shares are passed, and a market opens in the shares, there will also be a premium on these. The meeting to sanction the increase of capital is being held this week, and the ordinary shares, which drooped to 23s. 9d., have recovered to 25s.

Babcock & Wilcox are firm at 2 7/16 on the issue of a report which shows the gross profit of £770,800 to have risen nearly £104,000, and the net profit of £497,468 is £42,500 up on the year. The dividend, which remained at 15 per cent. for five consecutive years, is raised to 16 per cent., the same rate as was paid for the year before the war. It has to be remembered, too, that new capital ranks for dividends this time, and the report speaks of there being a considerable increase in the amount of work in hand, though this is qualified by the statement that new orders are now difficult to obtain, while the coal dispute has caused a cessation in some departments. In these latter considerations, shareholders will find food for reflection that is not altogether palatable, but it must be admitted that the company has had wonderfully good luck and good management in the past decade.

The only change in the home electricity supply market is a rise of ⅛ in County of London ordinary, which puts up the price to 7¾. Calcutta Electric Supply shares are better at 5¼, and Melbourne preference at 5 are ¼ higher. In the list of manufacturing companies, Edison Swans have given way to 11s. 3d. Electric Constructions at 16s. 3d. are also 9d. down. On the other hand, Metropolitan-Vickers preference at 1 13/16 are ⅛ higher, and the market generally is steady.

Montreal Light, Heat and Power shares have improved to 92½. Shawinigan shares at 120 and the 5 per cent. bonds at 113 are both lower. British Columbia Electric preferred at 53¾ is down a point, and the Anglo-Argentine Tramways list is steady at the previous quotations. Mexicans are better as a whole, but the only change in the Utility issues is a dollar rise in the 5 per cent. first mortgage bonds of the Mexican Light and Power Co. Stock Exchange gossip hints at a scheme to be promulgated at an early date under which the arrears of interest on the bonds of the Mexican Utility Companies may be dealt with. Part of the overdue money, according to this report, will be paid in cash and part in Funding scrip. Some such arrangement has been long expected, and the revival of the talk may serve to cheer the fainting spirits of bondholders who have received no interest on their investments for nearly seven years. We give the rumour for what it may be worth; some day, of course, it is sure to materialise. Pharaoh's dream came true of seven fat years being succeeded by an equal period of lean. What happened in the third seven years must present itself as an interesting speculation to holders of bonds in Mexican Utility companies.

Great Northern Telegraphs, with a rise of 25s., and Indo-Europeans, with a rise of 40s., are outstanding features of strength in the market for cable stocks. Eastern ordinary has hardened to 163½. Westerns are 5s. better at 16¾. Oriental Telephones have picked up to 2 3/16. Marconi's continue steady at 2⅝, but speculation has given place to renewed quietude in the market.

Passing of their dividends by rubber-producing companies is so common nowadays as to arouse no comment. Prices naturally sag. The armament group attracts but mild attention. Prospects of early settlement in the coal trade are canvassed, and, if these fructify, a fall to 6 per cent. in the Bank Rate is held to be inevitable. It is this latter consideration which serves to maintain investment securities at good prices.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1919.	Dividend 1920.	Price May 17, 1921.	Rise or fall.	Yield. p.c.
Brompton Ordinary..	12	12	6	—	£10 0 0
Charing Cross Ordinary . ..	7	8	8⅞	—	10 6 6
do. do. do. 4½ Pref...	4½	4½	8		7 10 6
Chelsea..	4	6	8¼		9 4 8
City of London	18	14	1³⁄₁₆	—	11 16 0
do. do. 6 per cent. Pref...	6	6	17/-	—	7 1 2
County of London	8	8	7¾	+ ⅛	10 6 6
do. do. 6 per cent. Pref...	6	6	8	—	7 10 0
Kensington Ordinary	7	9	4⅛	—	10 18 2
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref. ..	6	6	2¾	—	10 18 2
Metropolitan	6	7	8¾	—	10 7 4
do. 4½ per cent. Pref. ..	4½	4½	8¹⁄₁₆	—	7 7 0
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	6	7	2½	—	9 2 10
South Metropolitan Pref... ..	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	5⅛	—	9 15 2
Telegraphs and Telephones.	**1918**	**1919**			
Anglo-Am. Tel. Pref.	6	6	78½	—	7 12 10
do. Def...	83/6	1½	16	—	9 7 6
Chile Telephone	8	6	5¼	—	6 6 8
Cuba Sub. Ord.	7	7	7¼	—	9 6 8
Eastern Extension	10	10	16⅜	—	6 2 2
Eastern Tel. Ord.	8	10	163½	+1	6 2 4
Globe Tel. and T. Ord.	8	10	16⅜	—	6 2 2
do. do. Pref.	6	6	9	—	6 13 4
Great Northern Tel.	22	22	24	+1½	9 3 4
Indo-European	18	10	82	+ 2	7 16 4
Marconi	25	25	2⅝	—	—
Oriental Telephone Ord.	10	12	2³⁄₁₆	+ ¹⁄₁₆	*5 13 0
United R. Plate Tel.	8	8	6⅛	—	6 10 8
West India and Panama	1/3	Nil	⁹⁄₁₆	—	Nil.
Western Telegraph..	8	10	16¾	—	*5 19 5
Home Rails.	**1919**	**1920**			
Central London Ord. Assented ..	4	4	45½	—	8 15 10
Metropolitan	1½	1½	25½	— ½	5 17 8
do. District	Nil	Nil	16¾	— ⅜	Nil
Underground Electric Ordinary ..	Nil	Nil	2⅜	—	Nil
do. do. "A" ..	Nil	Nil	7/-	—	Nil
do. do. Income ..	4	2	74½	+1½	2 13 5
Foreign Trams, &c.	**1918**	**1919**			
Anglo-Arg. Trams, First Pref. ..	Nil	6½	2⅝	—	10 9
do. do. 2nd Pref. ..	Nil	Nil	8	—	Nil
do. do. 5 % Deb. ..	5	5	61½	—	8 2 8
Brazil Tractions	Nil	Nil	81	—	Nil
British Columbia Elec. Rly. Pfce.	5	5	55	—	9 1 10
do. do. Preferred	2½	5	58½	—1	*3 15 0
do. do. Deferred	Nil	8	61¼	—	*11 17 6
do. do. Deb. ..	4½	4½	58½	—	7 5 4
Mexico Trams 5 per cent. Bonds..	Nil	Nil	42	—	Nil
do. 6 per cent. Bonds..	Nil	Nil	23½	—	Nil
Mexican Light Common	Nil	Nil	11½	—	Nil
do. Pref.	Nil	Nil	18	—	Nil
do. 1st Bonds	Nil	Nil	69½	+1	Nil
Manufacturing Companies.					
Babcock & Wilcox	15	15	2⁷⁄₁₆	—	6 11 2
British Aluminium Ord.	10	10	16/3	—	12 6 2
British Insulated Ord.	12½	15	1³⁄₁₆	—	9 12 0
Callenders	25	15	1½	—	10 0 0
" 6½ Pref.	6½	6½	17/6	—	7 8 7
Crompton Ord.	10	10	16/3	—	12 6 2
Edison-Swan	10	10	11/3	+9d.	—
do. do. 6 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	16/3	—9d.	12 6 2
English Electric	—	8	13/-	—	12 6 2
Do. Pref.	—	6	11/6	—	8 5 6
Gen. Elec. Pref.	6½	6½	19/-	—	6 11 10
do. Ord.	10	10	23/9	—	*8 8 0
Henley	25	15	1⁷⁄₁₆	—	10 8 8
do. 4½ Pref.	4½	4½	8¼	—	6 13 6
India-Rubber	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	1¹⁄₁₆	+ ⅛	8 15 10
Siemens Ord.	10	10	1¼	—	*8 0
Telegraph Con.	20	20	20½	—	*5 18

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, May 17th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Oxalic	per lb.	10d.	..
a	Ammoniac Sal	per ton	£75	..
a	Ammonia, Muriate (large crystal)	"	£65	..
a	Bisulphide of Carbon	"	..	..
a	Borax	"	£34	..
a	Copper Sulphate	"	£33	..
a	Potash, Chlorate	per lb.	6d.	..
a	" Perchlorate	"	8d.	2d. dec.
a	Shellac	per cwt.	£19 10s.	£3 inc.
a	Sulphate of Magnesia	per ton	£16	..
a	Sulphur, Sublimed Flowers	"	£19	..
a	" Lump	"	£18	..
a	Soda, Chlorate	per lb.	5d.	..
a	" Crystals	per ton	£7	..
a	Sodium Bichromate, casks ..	per lb.	8d.	..
	METALS, &c.			
p	Babbitt's Metal Ingots	per ton	£95 to £300	..
c	Brass (rolled metal 2" to 12" basis)	per lb.	11½d.	..
c	" Tubes (solid drawn) ..	"	1/1¾ to 1/2	..
c	" Wire, basis	"	11⅝d.	.
c	Copper Tubes (solid drawn) ..	"	1/8¾	..
c	" Bars (best selected) ..	per ton	£114	£2 dec.
c	" Sheet	"	£114	£2 dec.
c	" Rod	"	£114	£2 dec.
d	" (Electrolytic) Bars ..	"	£73	..
d	" " Sheets ..	"	£145	..
d	" " Wire Rods..	"	£89	..
d	" " H.C. Wire..	per lb.	11³⁄₁₆	..
f	Ebonite Rod	"	3/6	..
f	" Sheet..	"	3/-	..
n	German Silver Wire	"	2/9	..
h	Gutta-percha, fine	"	14/- to 16/-	..
h	India-rubber, Para fine ..	"	10½d.	..
l	Iron Pig (Cleveland Warrants) ..	per ton	Nom.	..
l	" Wire, galv. No. 8, P.O. qual.	"	£40	..
g	Lead, English Pig	"	£25	£1 10s. inc.
g	Mercury	per bot.	£11 5 to £11 10	..
e	Mica (in original cases) small ..	per lb.	4d. to 4/-	..
e	" " " medium ..	"	5/- to 10/-	..
e	" " " large ..	"	12/6 to 25/- & up	..
p	Phosphor Bronze, plain castings .	"	1/4 to 1/9	..
p	" " rolled bars and rods	"	2/1 to 2/6	..
p	" " rolled strip & sheet	"	2/2 to 2/7	..
d	Silicium Bronze Wire	per lb.	1/2¾	..
r	Steel, Magnet, in bars	"	1/8	..
n	Tin, Block (English)	per ton	£178	£11 to £12 inc.
n	" Wire, Nos. 1 to 16	per lb.	4/-	..
p	White Anti-friction Metals ..	per ton	£78 to £300	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
p ————
r W. F. Dennis & Co.

British Engineering Standards Association.—A conference, unofficial in character, of the secretaries of the various standardising organisations at present in existence, has recently been held in London. The conference was opened by the chairman of the Association, Sir Archibald Denny, Bart.

The following secretaries were present:—Dr. P. G. Agnew (U.S.A.), Mr. J. R. Durley (Canada), Mr. A. Eriksen (Norway), M. G. Gerard (Belgium), Mr. E. Hijmans (Holland), M. Zollinger (Switzerland), and Mr. C. le Maistre, C.B.E. (Great Britain).

Each secretary gave a brief report of the general organisation of the work in his own country, the methods adopted in arriving at the standards, as well as the principles followed to ensure their adoption when issued. It is interesting to note that in most countries it is becoming more and more recognised that industrial standardisation, whether of quality or dimensions, to be really useful must be arrived at through a process of unifying the needs of industry rather than by attempting to set up an ideal. It also appears that whereas engineers are everywhere giving freely of their time and experience to this important work, its value to commerce generally is far too little appreciated, and it is, therefore, not being supported financially to the extent it should be.

The conference preferred to see international standardisation develop along national lines, and sectionally, similar to those adopted for instance by the electrical industry in the case of the now well-established International Electrotechnical Commission. Each secretary will, in due course, submit to his respective organisation the suggestions of the conference on the various points discussed.

The secretaries were entertained by the British Engineering Standards Association during their four days' conference.

Assistant Examiners in the Patent Office.—The open competitive examination will begin on Tuesday, July 26th, instead of on Tuesday, July 12th (as stated in the printed regulations) and will last until Saturday, July 30th. Any candidate who has attained the age of 20 on July 26th, 1921, and has not attained the age of 25 on July 12th, 1921, will be regarded as eligible in respect of age to compete on this occasion.

SUBMARINE CABLE TELEGRAPHY.

Oscillatory Circuit Signal Conditions: Some Graphs, Tables, and Scales.

By EDWARD RAYMOND-BARKER.

(Concluded from page 630.)

52. Expressions 42 and 45 may be used for the plotting of corresponding curves, for calibration of scales, or—as has been seen—for compilation of tables. The various curves in the following series (considerably reduced from originals) happened to be called for in connection with trials over laid cables, and for laboratory purposes. Judging from reports received, these curves have proved their value. They are reproduced here, on a necessarily much reduced scale, as examples of a few out of very many ways in which these matters may be treated graphically.

53. A pair of compasses, or a paper straight-edge and pencil marks, may conveniently be used in deriving data from these curves.

54. Fig. 8 shows K, in microfarads, suitable severally for L of 2, 3, 5, and 10 henries, at various speeds in *l.p.m.*

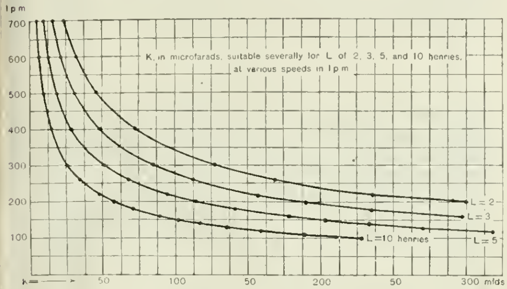

Fig. 8.

Example.—At a signalling speed of 300 *l.p.m.*, and with an inductance shunt of 10 henries, a receiving condenser of 25 mfd. ought to be used. Checking by actual figures (see 45),

$$K = \frac{1}{10}\left(\frac{4{,}774{\cdot}7}{300}\right)^2 = 25{\cdot}3 \text{ mfd.}$$

55. Fig. 9, electrically, is the same as fig. 8, but is on a smaller scale in order to show more extensively, over a given space, the general trend of the curves.

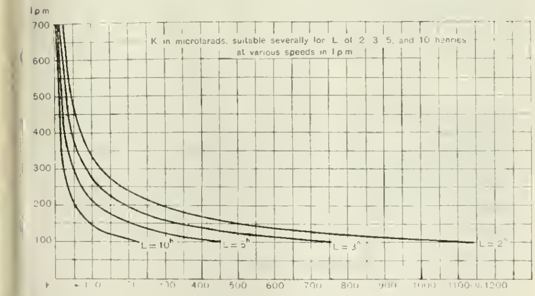

Fig. 9.

56. Fig. 10 shows L in henries suitable severally for K of 5, 10, 15, and 20 mfd. at various speeds in *l.p.m.*

Example.—At a signalling speed of 180 *l.p.m.*, and with a receiving condenser of 20 mfd., an inductance shunt of just over 35 henries ought to be used. (The curve shows this at a glance). Checking by actual figures (see 42)

$$L = \frac{1}{20}\left(\frac{4{,}774{\cdot}7}{180}\right)^2 = 35{\cdot}2 \text{ henries.}$$

57. Fig. 11, electrically, is the same as fig. 10, but is on a smaller and more extended scale, showing the general trend of the curves.

58. Figs. 12, 13 and 14 constitute valuable graph-records of K and L relativity severally for signalling speeds of (fig. 12) 150, 175 and 200 : (fig. 13) 300, 400 and 500 : (fig. 14) 600, 700 and 800 *l.p.m.*

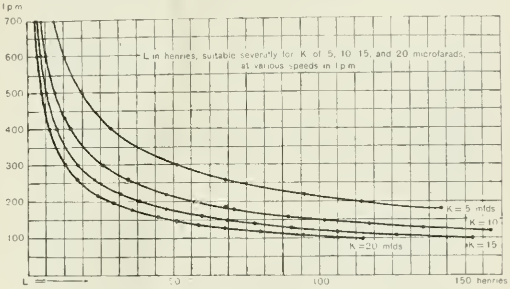

Fig. 10.

59. Table V affords an example of one out of innumerable ways in which the foregoing curves may be used for calibrating speed scales for any required purpose.

The three calibrated (K) scales shown in Table V were taken from the three curves in fig. 12. These scales, of course, might have been calibrated directly by calculation, and not by means of preliminary curves.

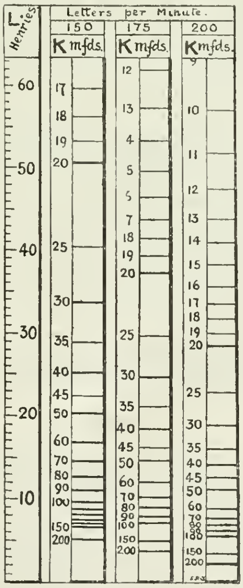

Table V.

60. A straight-edge extended horizontally from any given reading (on L scale) in henries, will indicate on the three K scales the microfarads necessary for these three signalling speeds. The number of scales thus built up, and included in an extended series, may be continued at pleasure.

61. Before concluding, let us revert, for a moment, to the oscillatory circuits of reception respectively in simplex working and in duplex as shown in figs. 5 and 6. Inspection of these two diagrams discloses the fact that

there is nothing novel in these connections and general electrical arrangement as portrayed in the two diagrams in question. Electrically—similar diagrams are to be found in Patent Specifications of more than 20 years ago, *e.g.*, the British Specification 12,731 of the year 1898, due to the late Dr. Alexander Muirhead, F.R.S. Invaluable matter of cognate nature, also, is to be found in the British Patent 1,434, of 1899, emanating from Mr. S. G. Brown, F.R.S. Cable telegraphy owes much to these two distinguished investigators.

62. However, notwithstanding this apparent sameness, the fact is that only in recent years has the actual nature of the problem of high-speed cable transmission and reception been perceived, and the necessity realised as to bringing about correlative conditions with regard to transmitting frequency, and reception *natural* frequency as referred to in 7.

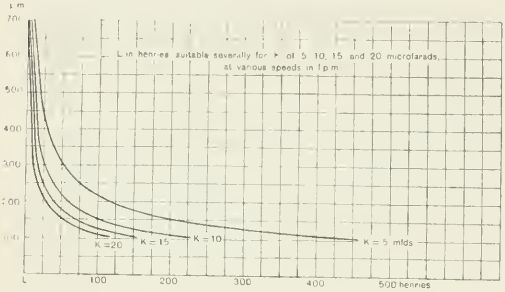

FIG. 11.

63. In the first afore-mentioned Specification (Muirhead's) the student is shown how the inductance coil L can be varied readily in relation to the capacity K of the receiving condenser employed; and how, when the receiving instrument and condenser are shunted by an inductance L, more sudden changes are attained in the circuit of the receiver which, by the way, at the present day, is invariably an amplifier. Thus, all initial impulses of received current flow through, and affect, the receiving instrument, while subsequent steady current is shunted off to earth through the self-inductance L.

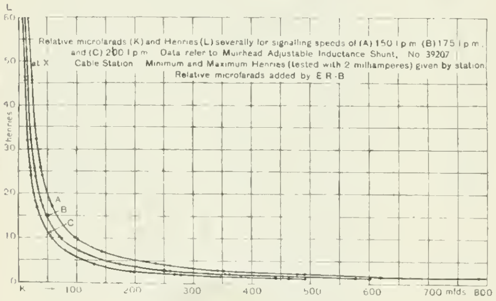

FIG. 12.

64. In connection with the second specification before referred to (Brown's), one is shown how the resistance of the magnetic shunt (or heavy inductance) L is much less than that of the receiving instrument. For instance, the resistance of the former may be, say, 30 ohms, and that of the latter, say, 500. The result, according to the inventor, is that all slow impulses flow through L, leaving the receiving instrument unaffected, while all sudden impulses, such as the line signalling currents, are resisted by the choking action of the iron-cored inductance L, and, therefore, are free to affect the receiving instrument. Also any varying zero, such as is due to slow irregular currents, is thus prevented, maximum signal-definition is attained, signal efficiency is thereby enhanced, and speed increased.

65. In spite of all this excellent work done more than 20 years ago, it was much later on that the close relationship, or rather, relativity which, in a truly coherent signalling system, must exist between transmitted-signal frequency, and the *natural* oscillation frequency of the receiving apparatus (as already expressed in 7) was at length recognised and taken into account. The present writer is unable to state from actual knowledge, to whom,[*] personally, this advance in applied electro-physics has principally been due, but the fact is clear that much light has been thrown on these matters by Dr. H. W. Malcolm in his book already referred to. Also, invaluable investigation work, under the enlightened *régime* of progressive electricians-in-chief, has been carried on for years past by the Eastern Telegraph Co.'s Experimental Department successively by such well-known specialists as Mr. J. Elton Young, and by his present successor, Mr. Benjamin Davies.

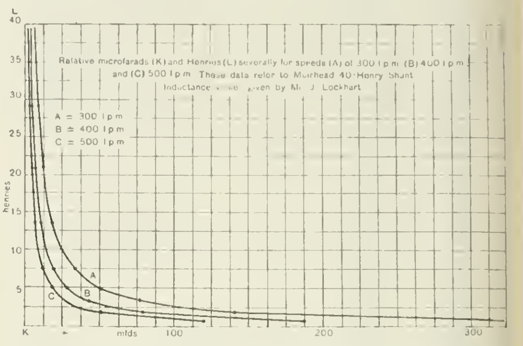

FIG. 13.

66. In conclusion, the writer lays no claim to have done more here than to touch the fringe of one particular section of technics relating to the working of long submarine telegraph cables under modern conditions. All he has tried to do has been to deduce, from already-known methods, an easily workable system of tables, graphs, and scales as best suited to time-saving requirements of telegraph-cable men.

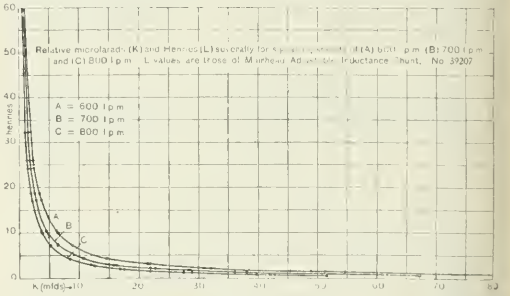

FIG. 14.

[We understand that Mr. Raymond-Barker has received additional information of great interest, which will be embodied in a supplementary article.—EDS. ELEC. REV.]

British Traders in Australia: A Protest.—According to the *Daily Mail*, British traders are raising a protest against an Act passed by the Australian Government known as the "Who Are You?" Act. Agents for British goods in the Commonwealth now have to furnish details of the total capital of the firms they represent, a list of directors, and a profit and loss account, and answer a long list of questions which have no bearing on the goods they sell. The Colonial Office is to be approached to see if British firms can be excluded from the provisions of the Act.

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[*] In all probability Kay Oscar Arthur Gulstad, of the Great Northern Telegraph Co., of Copenhagen, was the first to devise, and produce over a submarine cable circuit, instrumental oscillatory synchronism between current-impulse transmission and reception. See description of the Gulstad Vibrating Cable Relay in the ELECTRICAL REVIEW, June 3rd and June 10th, 1898, also August, 1902, and, lastly, Mr. Walter Judd's concise little monograph on the same subject in the ELECTRICAL REVIEW of March 27th, 1914.—E.R.-B.

THE PRESENT ECONOMIC POSITION OF THE ENGINEERING AND ALLIED INDUSTRIES.

(*Continued from page* 610.)

The Influence of Taxation.

When introducing his Budget in April, 1920, the Chancellor of the Exchequer evidently failed to realise that the causes which had stimulated the boom in trade were beginning to fail. Counting unjustifiably on a continuance of the boom, he naturally sought the opportunity to obtain as great a revenue as possible, for the purpose mainly of reducing our debt abroad and that form of debt at home known as the "Floating Debt."

Economically these added to our burden and aggravated the financial stringency, and therefore contributed to the present situation.

In the case of the Excess Profits Duty (a tax imposed for the very proper purpose of preventing, so far as might be possible, the accumulation of huge profits out of the nation's necessity) the trouble was that account was not taken of the changed value of money, and profits were described as excessive, which in purchasing value were frequently below the pre-war level, and in consequence the supply of new capital for the maintenance and development of industry was diverted to other purposes, and the financial stringency reached such a pitch that, in combination with the other causes already described, a slump became inevitable.

The Particular Case of the Engineering and Allied Industries.

As between a period of good trade and bad trade, the business of a baker may only fluctuate by as little as 10 per cent., whereas to-day there are engineering firms which are obtaining no orders at all, and in some cases whole branches of the industry are only receiving orders equal to one quarter (or less) of their productive capacity.

During the present crisis cancellation and suspension of orders have taken place and are still taking place to a very serious extent, and in consequence the slump in employment has been more rapid and more serious than on any previous occasion.

How the Burden of Unemployment is Eased.

By manufacturing for stock, employers help to reduce the volume of unemployment, and, at the same time, by preserving their productive organisation, they are better able to take advantage of the trade revival when it comes.

Moreover, by keeping men at work, even if short time has to be worked, the moral and physical deterioration which prolonged unemployment causes is prevented.

Manufacturing for stock, however, is limited to certain trades and does not much affect the general position.

Further, where it is customary for manufacturers to make for stock they are unable to face the loss which would be incurred by having to dispose of stock made at the present high cost of production.

No Conspiracy to Reduce Wages.

It is unfortunate that in certain quarters it should be alleged that employers have entered into a conspiracy, having for its object the forcing down of wages.

Every employer is doing all in his power to obtain all the orders possible.

While employers, in order to lower the price of their products with a view to stimulating demand, are unanimous in their view that reductions in wages are essential, this does not imply a desire to lower the standard of living, and they are equally unanimous in hoping that the fall in rates of wages will be balanced by a fall in the cost of living, just as rapid, if not more rapid. On the other hand, none can predict with certainty what will happen over any particular period, and some change in the standard may be inevitable. The only permanent remedy for such change is increased individual output.

The Effect of the Moulders' Strike.

It is impossible to overlook the disastrous effect of the moulders' strike.

This came at a time when there was a world-wide demand for goods.

The strike interfered with deliveries, not only while it lasted, but for long after, and it occasioned financial losses far in excess of the actual loss of foundry production, because the indirect loss of production in other departments was greater than in the foundries themselves, while during its progress many orders were diverted to other countries.

The strike gravely weakened the ability of industry to stand up against the present slump, and was probably the heaviest blow ever struck against industry.

Cost of Coal Production.

The influence of wages on cost is well illustrated in the case of coal production.

The following official figures for January are of interest:

	Per ton of coal disposable commercially.	
Wages	31s.	7.01d.
Stores, timber, &c.	5s.	6.41d.
Other costs (management, salaries, insurances, repairs, office, selling and general expenses, &c.)	2s.	8.21d.
Royalties		7.80d.
Total cost	40s.	5.43d.
Deduct proceeds of miners' coal ...		2.41d.
Net cost	40s.	3.02d.

In this case it will be noticed that wages constitute just over 78 per cent. of the total cost of production.

In 1913, the average pit-head price per ton sold was 11s., while to-day £5,000,000 a month is being lost despite the fact that it is being sold at a price three times as high.

The wages per ton in 1913 were 6s. 4d., while now (March, 1921) they are about 25s. a ton, *i.e.*, nearly four times as high. In 1913 wages were about £7 10s. a month and now they are about £17 10s., or about 135 per cent. higher.

The difference between the 300 per cent. increase in the wages per ton and 135 per cent. increase in the wage per worker is due to the appalling loss of productivity.

Cost of Engineering Production.

Owing to the complexity of engineering production, statistics as simple as those for coal mining cannot be obtained for the engineering industry.

With the help of the census of production of 1907, it is possible to show the cost for the whole engineering and shipbuilding industry for a normal pre-war year of good trade.

The average number of wage earners at work on four selected days was 1,432,480, in addition to 106,926 salaried employés.

The selling value of the whole production was £375,196,000, the value of the materials used was £212,224,000, and the value of the work given out to other firms to do was £9,890,000. This last item is counted twice over, first in the return of the firm which did it and then in the value of the finished work of the firm which gave it out, so that the real total production was £365,306,000. Deducting the value of the materials used, the whole of the work done by the two industries was £153,082,000.

Now in 1906, when the last inquiry of wages took place, the average earnings for all the men, women, boys or girls in the two industries was 27s. 4d. a week.

Trade was rather better in 1907, so the average in that year was approximately 28s.

As the figures for those at work exclude all who were absent due to unemployment or sickness, we can take the total average earnings for the year for the 1,432,489 persons counted as the earnings for every week except for days when works were closed for holidays, *i.e.*, for, say, 50 weeks.

This gives an average income of £70 a year, or a total wage bill of about £100,270,000, leaving for the salaries of 106,926 staff employés (managers, draughtsmen, foremen, clerks, &c.) for all depreciation, insurances, rent, rates and taxes, power, lighting, heating, oiling, painting, maintenance, upkeep of small tools, depreciation, and other management expenses, and also for profits, the balance of the £153,082,000, namely, £52,812,000.

Wages thus absorbed 65.5 per cent. of the value added to the materials used, while staff salaries, all the almost innumerable overhead expenses referred to above and profits, represented 34.5 per cent.

It has to be kept in mind that dividends are paid out of profits, and if satisfactory dividends to the millions of shareholders are not available, capital will not be furnished for industry.

There is no reason to believe that the position was materially different just before the war.

It is evident that profits alone represented but a small percentage of turnover even though in the aggregate a large sum. Two very large firms, which published information on the subject relating to the year 1918, showed proportion of wages to profits of about 10 to 1 in one case and about 12 to 1 in the other.

Foreign Competition.

The United Kingdom is not and cannot be a self-contained unit.

It is dependent upon the outside world for half its food, all its raw cotton, more than half its wool, all its non-ferrous metals except some tin and lead, for all its rubber, and most of its oil, to say nothing of innumerable other materials.

It can only pay for this if it can sell abroad that surplus of its coal and of its manufactured products for which it has no market at home.

The 1907 Census of Production showed that nearly one-third of its total industrial output was sold abroad.

Unless we can maintain our overseas markets, one-third of our industrial labour must be idle, even if we could somehow obtain the materials on which to employ the remainder.

Productivity of Labour.

The great misfortune is that at present, for a variety of reasons, the productivity of British labour is below its pre war standard, and below that of workmen in competing countries.

It was hoped that the reduction of hours by the improvement of the physical conditions of manual labour would have led to a much higher output per hour so as to compensate for the loss of productive hours.

Up to now this desirable change has not materialised.

If output per hour is high, there is no inconsistency between high earnings per hour and a low wage per piece.

If the foreign exchange position were normal, if the burden of taxation were not inevitably so high, even apart from any increased burden due to extravagance, real or alleged, on the part of the Government, it might be possible to overcome our difficulties by increased productivity, but with all the disadvantages under which we are working, employers are regretfully forced to the conclusion that this is not sufficient and that there must also be a reduction of wage rates.

Coal, Wages, &c., and Cost of Production.

The influence of the price of coal on the cost of engineering production is of the highest importance. In the case of steel about four tons of coal are used to produce a ton of steel in the ingot.

With coal wages about 19s. a ton higher than in 1913, this alone adds practically £4 a ton to the price of steel before it reaches the stage of the plate, the bar, or the forging.

When, however, there are added the increased wages in steel represented by the increased wages of railwaymen, which shows itself in the higher railway rates on coal, coke, pig iron, iron ore, limestone, &c., another large element is added to the price of steel. (Note.—Railway wages were about £47,000,000 a year in 1913; they are about £173,000,000 to-day.)

Further wage items in steel are contained in the increased wages of the iron ore miners, the blast furnacemen, the limestone workers, and so on.

Then last of all we have the enormously enhanced wages of the steel workers themselves.

A complete analysis of the ultimate cost of producing a ton of steel would show that 80 to 90 per cent. was wages and 20 to 10 per cent. was salaries, profits, and taxation.

Necessity for Immediate Action.

It may be said that the "consumers' strike" will collapse and that foreign exchange will improve; that the financial stringency will pass, and so no reduction in the cost of production is needed.

All past experience is conclusive that the reaction from a slump is stimulated most promptly by a reduction in selling prices.

The inflation of prices has been so great and the present level of prices at which orders can be obtained is so much lower than the high level on the basis of which wages were advanced to the present height, that the needed reduction in price is something far in excess of the employers' margin of profit, even taking into account the relief which will come with cheaper coal and steel following or accompanying lower coal and steel wages.

The alternative to reduction now is a vast increase in unemployment owing to inability to obtain orders at present prices.

It has to be kept in mind that if a reduction in wages takes place there is ample opportunity for workmen, by an increase in output, to increase their earnings to such an extent as will greatly, if not entirely, compensate for reduction in wages rates.

The workman quite naturally and properly seeks the highest weekly income the industry can afford. The employer, who has to find a market for the products of the joint efforts of himself and those he employs, seeks the lowest cost per article that every aid to production can afford.

Conclusion.

The only ray of hope at the moment is that there are signs of an easing of the financial stringency. The National Debt has been reduced by nearly 230 millions since April, 1920, and the total reduction by the close of the financial year may reach a considerably higher figure.

The Chancellor of the Exchequer is of the opinion that Treasury Bills will now be received in sufficient quantities at 6 per cent. instead of the rate of 6½ per cent. which has been in force for the last eleven months.

This will help manufacturers somewhat in their efforts to reduce the cost of production.

It is hoped that this statement is as fair and as reasonable as it is possible to make it.

There has been no conscious seeking for dramatic effect, but only a straightforward effort by the employers to disclose to their workshop colleagues in the industry, those facts with which an employer, from the nature of his work, is brought into constant touch, but which facts are often unknown to the worker in the shop though bound vitally to affect him eventually.

For over 20 years the engineering industry has been able to solve its difficulties by a frank exchange of views, and in the belief that the greatest difficulty it has ever faced can only be solved in the same way, this document has been prepared as an effort to present a comprehensive and reasoned statement of the case, and thereby secure the co-operation of workpeople in bringing about the changes necessary to overcome the difficulty.

At different points throughout this statement the necessity of decreasing the cost of production has been emphasised.

It is the considered opinion of the employers that a definite reduction in hourly rates and an increase in individual output are both necessary. The effect of the reduction on the standard of life will depend on the fall in the cost of living and the extent to which the workpeople maintain and increase their actual earnings by a greater intensity of output.

Here follows an appendix of the highest importance, giving "Chapter and Verse" as to the recent vast loss of orders directly due to high costs of production, in connection with marine, agricultural, locomotive, machine tool, electrical, textile, motor, colliery, chemical, and general engineering, for which we must refer our readers to the original text.

Below we commence an abstract of the reply of the Amalgamated Engineering Union to the foregoing statement.

The reply first quotes the dividends of a number of British engineering firms for the year 1920 and the Stock Exchange prices of shares in engineering companies at April 1st, 1921. The object is to show that "British engineering firms have not been doing so badly." The writers continue:—

As a matter of fact the volume of British engineering exports during 1920 compares very favourably with that of the booming year, 1913. Here are some comparative export figures:—

	1913.	1920.
Machinery	£33,602,474	£63,457,937
Electrical apparatus	5,386,273	11,600,386
Scientific instruments ...	2,056,417	3,144,779
Implements and tools ...	2,796,538	6,837,540
Cutlery	836,129	1,897,248
Iron and steel manufactures, viz:—		
Anchors and cables ...	687,207	2,010,863
Bedsteads	747,514	1,585,808
Hollow ware	1,066,975	3,059,952
Others	4,849,055	8,247,589

If it be said that the demand has now ceased, it may be pointed out that the exports for the month of February, 1921 (the last available), were still on much the same scale. Cutlery was twice what it was in February, 1913; implements and tools, twice as much; scientific instruments, one-third more; electrical apparatus, nearly three times as much; and machinery generally, £6,397,929, as against £2,471,994. Not so bad!

The Foreign Exchanges.

The employers' pamphlet (which quotes no Stock Exchange prices, and names no dividends) starts off with an elaborate disquisition on the evil complications of the foreign exchanges—a subject, by the way, which the average manufacturer understands as little as the average workman. The disquisition may be simply disregarded. It is an impudent attempt to create a bogey by mystification. . . . But no prospect is allowed to alleviate the woe of the writer of the pamphlet. He sees nothing but obstacles to business whether the rates of exchange are favourable or adverse. At present it is the currency of France and Germany, Poland and Russia, and Italy and the Balkans which is depreciated, so that the equivalent in native money of a pound sterling is very high. This is represented as seriously discouraging the export of engineering products to these countries. What the writer does not mention is that exactly the opposite state of things prevails in the United States and Canada, India and Chile, Argentine and Uruguay, Holland and Portugal, and Sweden and Switzerland. With these countries the rates of exchange are low, and it is not the native currency but the pound sterling which is at a discount. If the rates of exchange are discouraging our exports to France and Germany, Poland and Russia, and Italy and the Balkans, in exactly the same way the rates of exchange are positively stimulating and facilitating our exports to the United States and Canada, India and Chile, Argentine and Uruguay, Holland and Portugal, and Sweden and Switzerland. But the writer of the pamphlet ignores this. He even claims to have it both ways, blaming, for the failure to make export sales, first the high rates of exchange with Germany, and then the low rates of exchange with India, where there has been such an orgy of imports (largely of engineering products) from this country that there is a temporary congestion of stocks!

It is unnecessary to pursue the matter further. Whilst the social and economic conditions of other countries are of the greatest importance to our trade, and the adoption of a wise and humane policy in foreign affairs is therefore imperative, members of the A.E.U. (or their employers) need concern themselves no more about the rates of exchange than about the readings of the barometer. Those who wish further explanation of the subject may study the able Memorandum printed as Appendix 1.

(To be continued.)

MAGNETOS FOR INTERNAL-COMBUSTION ENGINES.

DISCUSSION IN LONDON.

(*Concluded from page* 633.)

Mr. A. P. YOUNG explained that it had always seemed to him that the h.p. magneto was one of the most interesting and complicated pieces of apparatus to be found in the whole range of electrical appliances.

The armature was usually only 2 in. in diameter; it comprised some 200 turns of primary winding and from 9,000 to 10,000 turns in the secondary. The voltage generated each time the primary winding was open circuited might reach a maximum value of 11,000. Magnetos had been built to give over 250 distinct sparks per second, so from the standpoint of voltage alone the problem of satisfactorily insulating the secondary winding was quite complex, and analogous in many respects to the general problem of insulating high-voltage electrical machinery, but obviously made more difficult by the very small space occupied by the windings. Prof. Taylor Jones's mathematical treatment of the magneto showed that high-frequency oscillations occurred in the secondary circuit, which came within the range of wireless frequencies. In fact, one of the problems which had to be faced in connection with the installation of magnetos on aeroplanes fitted with wireless apparatus was the prevention of interference that might arise from high-frequency oscillations in the h.p. circuit of the magneto. A detailed consideration of the magnet's function, and the relationship between the magnetic characteristics of the steel and the electrical performance of the magneto, became a very complex problem. Such a study covered the whole range of permanent magnetism, whilst an inquiry into the influence of the composition of the steel, hardening temperature, &c., on the magnetic characteristics led one into the realms of metallurgy. The contact breaker was, perhaps, the most wonderful part of a magneto. A study of its operation introduced one to many interesting mechanical problems, whilst the phenomenon of contact arcing, if examined in great detail, led one to consider many difficult problems in the realms of metallurgy and physics. The condenser was one of the vital parts of a magneto. It had to be built into such a small compass that the problem of securing a suitable dielectric was a very difficult one. A great deal had yet to be learnt concerning the exact nature and magnitude of electrical and mechanical strains to which a condenser was subjected in service. The insulating parts, such as the distributor, slip ring, &c., were made of a moulded insulating material having a rubber base. The manufacture of those parts in moulds, starting with a plastic mass, introduced a branch of electrical engineering which had not in the past received adequate consideration, and the potentialities of that particular line of manufacture were very great. Finally, there were the interesting and complex problems involved in manufacturing magnetos. The limits of accuracy were necessarily very fine—much smaller than in any other class of electrical apparatus. For example, the air gap between the armature and pole pieces was usually about 0.005 in., a limit of only ± 0.001 in. being allowed. For a certain type of multi-cylinder aero magneto manufactured during the war period no less than 720 gauges were necessary. That particular magneto had in its composition 400 parts of different design, the total number of parts being 860. The finest limit of accuracy worked to was a tolerance of 0.0003 in.

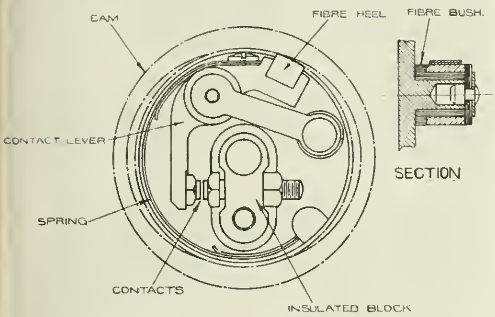

FIG. 11.—CONTACT BREAKER.

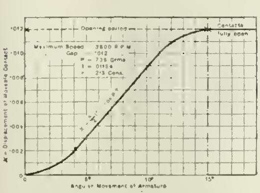

FIG. 12.—DISPLACEMENT CURVE.

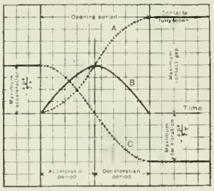

FIG. 13.—ANALYSIS OF MOTION.

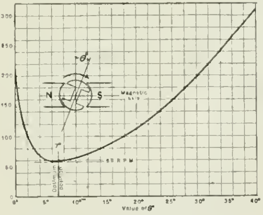

FIG. 14.—RELATION BETWEEN SPARKING SPEED AND POLE GAP.

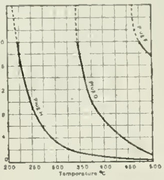

FIG. 15.—PLUG INSULATION TESTS.

NOTE.—In fig. 13, A = displacement; B = velocity; C = acceleration.

Fig. 11 illustrated the type of contact-breaker construction used on the orthodox rotating-armature type of magneto. A little steel spring-controlled contact arm was free to oscillate on an insulating bush usually made of fibre, such oscillation being imparted to the lever by virtue of the fibre heel attached to one end of it coming in contact with an annular cam which surrounded the revolving unit. The maximum gap between the contacts was only 0.012 in., but although the movement was so small, the forces that were brought into play at high speeds became relatively great. Figs. 12 and 13 showed curves which related to the relatively short period of time during which the contacts were opening, on the assumption that the heel and cam profile were such as to impart harmonic motion. The point of special interest was that at the moment of impact the acceleration was a maximum (see fig. 12 and, in consequence, the pressure between the heel and the cam at that moment, which was equal to the spring pressure, plus the force required to impart that acceleration to the lever, also reached a maximum. When operating at high speeds, the acceleration component of the force greatly exceeded that due to the spring pressure, and in a certain design of four-cylinder magneto that acceleration force might reach seven pounds at a speed of 3,000 r.p.m. On a multi-cylinder aeroplane magneto that the speaker designed during the war period, the acceleration force was as much as 14 pounds.

The phenomenon of contact arcing opened up wide fields for further research and investigation, because it was doubtful whether that phenomenon was clearly understood even at the present time. Mr. Watson suggested that the theory of sparking voltages which had been put forward in an attempt to explain what happened at the moment of separation of the contacts was hardly compatible with the theory of arcing. It was perfectly true that local heating at the final point of contact between the two contact faces was a factor of primary importance in determining whether arcing was likely to occur, and the speaker believed that other important factors were the variation in the contact resistance just prior to actual separation, the current passing at that instant, and the temperature of the contact faces as well as the degree of volatilisation that obtained, all of which tended to reduce the sparking voltage, looking at the two contacts as two electrodes separated by a short distance; and if the local heating was excessive just before separation, the resistance of the gap would be so small as to make the sparking voltage practically zero, so that from that standpoint the two theories would be brought somewhat into line.

At the present time, the most satisfactory contact metal was undoubtedly a platinum iridium alloy containing from 15 to 25 per cent. of iridium. Under certain conditions tungsten gave reasonably good results, but it was inferior to the platinum iridium alloy in respect of its range of adaptability, using that expression to denote such factors as current, flux and speed. Even so, however, it was the next best contact metal to the platinum iridium alloy, and on the battery-coil systems tungsten yielded satisfactory results. Probably, however, in the case of tungsten there was a critical value of the current which must not be exceeded no matter what the size of the contacts might be, and as the contact current in all battery-coil systems of ignition was much less than that in a magneto (see fig. 16), that was probably the reason why tungsten was used successfully in America. It would appear also that a humid atmosphere such as frequently obtained in this country had a more detrimental effect on the operation of tungsten contacts than it had in the case of a platinum iridium alloy. In a recent investigation that the speaker made on the subject he found there was a relationship between the performance of different materials, when used as magneto contacts, and the physical characteristics of the materials. Thus by arranging different metals in their order of merit, as determined by their suitability for use as contact metals, starting with the best and going down the scale to the worst metal, the density diminished, the specific resistance diminished, whilst the heat conductivity increased. There was still a large amount of research to be done on the whole subject, and a careful investigation should yield results that would be of great benefit to the magneto industry. Fig. 17 showed how in a solid-pole machine the active flux in the armature core diminished with increase in speed, solely as a result of the eddy-current damping in the solid masses of iron through which the flux had to pass. The curves were plotted from results of tests carried out on a 6-cylinder Bosch magneto built during the war period. The flux dropped from about 32,000 at low speeds to 16,000 at a speed of 5,000 r.p.m. Corresponding to this reduction in flux the energy in the spark also fell off rapidly as the speed was increased. In using laminated poles it was an advantage to make the lamination as thin as possible. The speaker some time ago obtained a comparison between the operation characteristics of a magneto when it was fitted with pole pieces made up of laminations of different thicknesses. The thickness of lamination was increased from 0.016 in. in steps up to 0.064 in., a final series of tests being made with a solid cast-iron pole piece as generally adopted by the Bosch Co. The results obtained were as follows:—

(*a*) Minimum sparking speed, 70 r.p.m., 100 r.p.m., 130 r.p.m. Thickness of lamination, .016 in., .064 in. Solid pole piece.

(*b*) Peak voltage measured across a standard 5.5 m/m 3-point spark gap, 7,800, 7,700, 7,200. Thickness of lamination, .016 in., .064 in. Solid pole piece.

The above voltages were measured at a speed of 2,000 r.p.m.

(*c*) Energy in h.p. spark, .060 joule, .059 joule, .053 joule. Thickness of lamination, .016 in., .064 in. Solid pole piece.

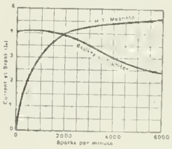

Fig. 16.—"Break" Current.

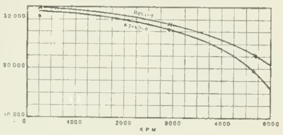

Fig. 17.—Variation of Armature Core Flux with Speed.

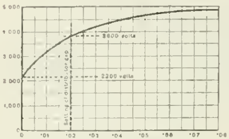

Fig. 18.—Efficiency of Auxiliary Spark Gap.

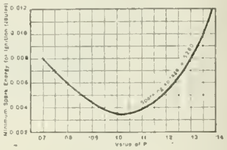

Fig. 19.—Spark Energy.

One of the difficulties that had to be contended with in the orthodox form of rotating-armature magneto was the variation in the minimum sparking speed that resulted from any adjustment of the timing lever. Fig. 14 was of special interest in that connection as showing the relationship between the minimum sparking speed and that particular gap in the case of a small laminated-pole 4-cylinder magneto. The curve was plotted from the results of tests, and showed the actual relationship existing between the minimum sparking speed and the angle θ, the latter being the inclination of the axis of the armature core to a line drawn at right angles to the magnetic axis when "break" occurred. There was a critical gap which gave the lowest minimum sparking speed, and in that particular design of machine that gap corresponded to an angle of θ of about 7 deg., *i.e.*, an actual air gap of about 2 m/m between the trailing edge of the armature core and the leading edge of the pole tip at the moment of "break." Most manufacturers "timed" their magnetos to give a gap of that order, so that when the timing lever was fully advanced, the minimum sparking speed was at its optimum value. When the timing lever was retarded, however, the minimum sparking speed increased rapidly, and various methods had been introduced, such as the use of extended pole pieces, to make that inequality as small as possible. Actually it was possible so to modify the ordinary rotating-armature magneto as to give uniform sparking over the whole timing range by introducing polar segments which were mechanically linked to the contact-breaker cam cage. Those segments were adapted to be rotated between the revolving armature and the fixed pole pieces with which the polar segments were in magnetic contact. In that construction, the air gap between the trailing edge of the armature core and the leading edge of the pole tip at the moment of "break" was constant for all positions of the timing lever, and as a result the intensity of the spark was uniform over that whole range. Such a magneto, particularly when it was used on high-powered engines, had a wonderful effect on the flexibility and performance of the engine, as it enabled the spark to be very considerably retarded, such, for example, as when going up a hill, without any appreciable reduction in power, as was likely to occur with the more usual form of magneto.

The speaker did not quite agree that from the point of view of enabling the magneto more readily to cope with excessive leakage in the h.p. circuit, the spark gap was of no material value. In support of this contention fig. 18 was of interest, which represented the results of tests made to determine the effect on the sparking voltage of a given gap connected to a magneto, of introducing in series with the gap a small auxiliary spark gap such as was used in the jump spark system. With a gap only 0.02 in. in length the sparking voltage across the main gap was increased from 2,200 to 3,800 volts, when a resistance of 112,000 ohms was connected in parallel with the main gap. The conditions obtaining in that test approximated somewhat closely to the worst conditions that might result in practice when the insulation resistance of the plug was reduced to a very low figure. Fig. 15 showed how the insulation resistance fell away very rapidly with increase in temperature in the case of three plugs fitted with different forms of insulator. Plug insulation resistances under working conditions which were as low as 100,000 or 200,000 ohms were not at all impossible, and when the magneto had to function under such adverse operating conditions, the speaker believed that the auxiliary spark gap was beneficial in enabling the voltage more quickly to rise to its maximum value than happened when there was no such spark in the h.p. circuit and the end of the secondary winding was connected directly to the plug.

The speaker could also hardly agree that the heat energy contained in the flame portion of the spark was of no value, and although Mr. Watson's contention was probably quite correct when applied to normal running conditions, it was the adverse operating conditions that really determined what the design of an efficient ignition unit should be. One of the most important considerations was that of starting, and when everything was cold the petrol entered the cylinder in the form of a mist, and the mixture to be exploded was not a homogeneous gas. Under those conditions the heat energy contained in the spark was of value in volatilising some of the minute petrol globules held in suspension in the air, thus forming in the vicinity of the spark plug electrodes an explosive mixture which approximated to the ideal.

Fig. 19 showed the amount of energy actually required to ignite an explosive mixture of petrol and air, the curve being taken from one of the papers written by Mr. Paterson and Dr. Campbell, giving the results of a large amount of research work carried out at the N.P.L. The curve showed that a spark containing as little energy as 0.0035 joule was sufficient to ignite an explosive mixture, and that amount of energy was less than one-tenth of that given by almost any form of magneto. Fig. 20 indicated the heat energy contained in the spark generated by different ignition units. In the case of the small magneto fitted with laminated poles (B), the energy in the spark was maintained over the whole range of speed, whilst in the case of the larger solid-pole machine (A) the energy quickly reached a maximum and then fell rapidly away. The battery-coil system of ignition (C), on the other hand, gave a spark containing much less energy than that liberated by any form of h.p. magneto, the spark energy being a maximum at zero speed, and falling away gradually as the speed was increased.

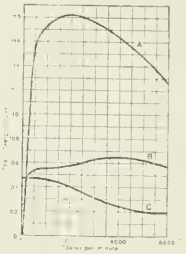

Fig. 20. Spark Energy.

Electrical Incubators.—The *Tanner and Stock Breeder* says that electricity is used for incubation to a small extent, the difficulty being in most cases distance from a source of supply. Better results can be had from electricity than from oil, gas, or coal, the temperature is always constant, there are no fumes, and labour is saved. The simple feature of this method is that the current is supplied through an ordinary plug-in terminal and cord to the machine, and a resistance with a sliding scale is fixed so that we can increase or decrease the temperature. Existing hot-air machines can be easily converted by a handy man in a short time if he has an elementary knowledge of electricity and magnetism.

THE RAILWAY BILL, 1921.

The Railway Bill which the Minister of Transport, Sir Eric Geddes, introduced into the House of Commons last week, is a complicated measure, filling nearly 70 printed pages. The present condition of the railways is the outcome of war, a reflex of trade conditions, and a result of great change in the economic handling of all great industrial undertakings. It is absolutely necessary that provision should be made to meet the changes that must ensue when control lapses in August next. Such changes should, of course, secure a greater efficiency in service, a large economy in management, and a gradual extension of the existing public facilities.

It has been decided in the first instance that the proper line of progress lies through the establishment of larger and better operating units. In order to abolish as far as possible competitive services for the same traffic, and a system of competition that exhausts competing railway lines without ultimate advantage to those they serve, it has been decided to bring about a wide measure of co-operation by organising the railways of Great Britain into six groups—amalgamating the principal lines, absorbing the smaller ones, and giving each group a strong incentive to develop the special area which it serves. In arranging these groups, operating economies and the financial position have been the determining causes, but it was clear from the outset that legislative action must stand in reserve behind negotiations.

The Railway Bill proposes to leave companies in the six groups to arrange their own amalgamation scheme, but if they cannot agree between themselves, a Railway Amalgamation Tribunal will be set up to take the responsibilities they are unwilling or unable to assume. A very large measure of assent has been obtained through negotiation with all the interests concerned, and at the time of bringing the Bill before the House of Commons only a few railways, including the Scottish companies, were in opposition to its principles. The position of the Scottish railways is a difficult one. They appear to have gone a little outside their usual practice in the matter of expenditure, and are undoubtedly rather uncertain about their own future. Scottish railway rates are on a lower basis than those obtaining in England, but the opinion is held that, with a return to normal trade conditions, they are at least sufficiently high to enable the Scottish Railway companies to maintain a standard of prosperity and efficiency.

Hitherto the principle on which rates have been regulated has been the establishment of maxima by statute. This has left the actual rates within the maxima to the discretion of the companies (subject, of course, to the Act of 1894), but this condition could not be maintained after the amalgamations outlined by the Bill came into force. Moreover, the Railway and Canal Commissioners, to whom all appeals lay hitherto, are an expensive body to approach, and their jurisdiction is limited. These Commissioners will retain very considerable powers. They will continue to act as arbitrators for the Ministry of Transport or the Board of Trade. They will exercise jurisdiction in Public or Private Acts and decide the services and facilities due from the railway companies in return for the advantages conferred upon them. But for the purpose of deciding the incidence of rating, a new Rates Tribunal is set up under the Bill, and the Tribunal will seek in general terms to impose upon each class of merchandise a fair share of the burden that railway companies must carry. The basis on which rates are to be fixed will be one designed to secure for each company a standard revenue, based upon that obtained in 1913, together with 5 per cent. upon capital expenditure made under Government control, and a further allowance in respect of large capital expenditure not fully remunerative in 1913. Rates established in the immediate future will be upon the basis of existing conditions, which cannot be regarded as stable; consequently these rates must be modified as conditions change. To this end they will be reviewed annually for three years, and thereafter at stated periods in the Minister's discretion. A standard revenue that would be invariable would go far to destroy that initiative in railway companies upon which both the general prosperity of the companies and the country must depend. Where the rates yield a return in excess of the standard, 80 per cent. of such excess will go in rate reduction and 20 per cent. to the revenue of the company earning it. We understand that the railway companies, the Federation of British Industries, and other bodies anxious to protect their respective interests and privileges are satisfied with the principles of the Bill.

The Light Railways Acts have not been nearly as effective as they were intended to be. The Ministry of Transport Act of 1919, empowers the Minister, with the consent of the Treasury, to make advances in aid of light railways without the restrictive conditions referred to. For the better promotion of enterprise in districts that would benefit greatly by the establishment of a light railway, the financial provisions of the Light Railways Acts will be repealed and the provisions of the Ministry of Transport Act will take their place. The Act in many ways encourages light railway enterprise, notably by giving such railways higher charging powers than main lines, and also securing to them a proportion out of the rates which will reflect these higher powers.

The proposed relations between the boards of management and the employés of the railway companies have lately undergone a change. The original intention of the Government was that workers should be represented on the boards of the various new groups, and although this decision was opposed strenuously by the Railway Companies' Association the Government had arrived at a very carefully considered decision and was not disposed to modify it in response to pressure. In the light of this decision, which was of definite value as a basis for bargaining, the National Union of Railwaymen, the Associated Society of Locomotive Engineers and Firemen, and the Railway Clerks' Association—the three largest unions connected with the railway service—entered into direct negotiation with the railway companies, and arrived at an agreement which makes for peace and tranquillity in the service, and is conditional, as to its principal provisions, on the understanding that the Railway Bill shall contain no other references to management or conditions of service than those to which the parties chiefly concerned have agreed. The workers have withdrawn their original demand for representation on boards of directors, and in place they have accepted a scheme of joint councils of officers and elected employés. These councils will function along the lines of Clause 16 of the Whitley Report. The agreement maintains the Central and National Wages Boards, subject to a twelve months' notice which may not be given before January 1st next (1922). Each of the parties to the agreement will have several representatives on the boards and, in default of agreement between the unions and individual railway companies on questions relating to payment, hours and conditions of service, reference will be made to the Central and National Wages Boards, provided that the constitution of this body does nothing to prejudice such appeal. Provision is made for the setting up of a committee consisting of six representatives of the companies and six representatives of the unions to prepare schemes for carrying this new agreement into effect.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR APRIL, 1921.

It is satisfactory to note that, in face of an enormous fall in the general trade figures during the month of April owing to the effects of the dispute in the coal industry, electrical goods were practically unaffected, and, in fact, showed an increase in several items and in the total export figure. This last increase was equivalent to about 18 per cent. above the March total. A large but probably easily accounted for increase was apparent in the export of submarine telegraph and telephone cables, the April value being more than four times that of the previous month. The value of railway and tramway motors exported also increased three-fold, and rises occurred in the export values of arc lamps and parts, switchboards, glow lamps, batteries, and insulated wire. Falls occurred in telegraph and telephone apparatus, unenumerated electrical goods, and other items. The total value of imports fell by just over 11 per cent., the decrease being fairly evenly distributed over the constituent items. A decline of 11 per cent. also occurred in the re-export figure, chiefly occasioned by a large drop in the value of re-exported unenumerated goods and apparatus.

Values of Electrical Exports and Imports for April, 1921.

	Exports.	Imports.	Re-exports
Electrical goods and apparatus (unenumerated)	£198,537	£81,803	£5,213
Insulated wire	392,638	7,155	—
Glow lamps	53,499	38,049	7,647
Arc lamps and parts	2,152	1,743	—
Batteries	74,436	9,680	—
Meters	43,452	16,921	9,040
Carbons	3,178	7,913	183
Electrical machinery :—			
Railway and tramway motors ...	27,421	—	—
Other motors and generators ...	219,070	—	—
Electrical machinery (unenumerated)	176,266	52,157	3,696
Switchboards (not telegraph or telephone)	22,507	106	23
Telegraph and telephone cable and material :—			
Telegraph and telephone wire and cable (not submarine)	127,081	10,605	100
Submarine telegraph and telephone cable	387,949	—	—
Telegraph and telephone instruments and apparatus	150,680	37,028	2,974
Totals... ...	£1,878,866	£263,160	£28,876

Coming Norwegian General Strike.—The Christiania correspondent of *The Times* says that Trade Union leaders and the Socialist Press emphasise that the general strike, which is to commence on May 26th, has no political character, and that its only object is to prevent a reduction of wages. Conservative and Liberal papers prophesy that the strike will prove a great failure.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

12,271. "Electric transformers." Metallurgique Electrique. April 28th. (France, October 29th, 1920.)

12,272. "Electric insulators." Metallurgique Electrique. April 28th. (France, October 29th, 1920.)

12,273. "Conductors for dynamo-electric machines." Brush Electrical Engineering Co., Ltd., and C. C. Sutton. April 28th.

12,317. "Electric motor starting and controlling switchgear." C. C. Garrard, A. H. Railing, and W. Wilson. April 29th.

12,318. "Synchronising systems." Western Electric Co., Ltd. April 29th. (United States, May 1st, 1920.)

12,344. "Means for operating track-sanding apparatus of tramway, &c., vehicles." G. A. Bradfield and M. F. Keen. April 29th.

12,352. "Sound receiving equipment for ships." Signal Ges. April 29th. (Germany, May 31st, 1920.)

12,364. "Electrical fitting connections." J. A. McKay. April 29th.

12,370. "Electro-magnetic relays, &c." Automatic Telephone Manufacturing Co., Ltd. April 29th. (United States, May 6th, 1920.)

12,379. "Electric lighting, heating, and ventilating installations for railway, &c., vehicles." A. H. Darker and J. Stone & Co., Ltd. April 29th.

12,381. "Induction train control systems." J. B. Regan. April 29th.

12,386. "Electric switches." Bristol Tramways & Carriage Co., Ltd., and B. A. Payne. April 29th.

12,397. "Magneto-electric generators for internal combustion engines." C. P. Godfree. April 29th.

12,406. "Current conducting wire for hermetically brazing in glass." W. P. Thompson (Vereinigte Gluhlampen-und Elektrizitats Akt.-Ges.). April 30th.

12,420. "Screen for head lamps, &c., to eliminate glare." V. W. Turner. April 30th.

12,450. "Electrical means for operating mechanisms by sound." C. P. Ryan. April 30th.

12,454 "Electric radiators." H. Harrison and J. R. Quain. April 30th.

12,460. "Means for obtaining high-voltage electrical impulses." N. W. McLachlan. April 30th.

12,464. "Thermo-electric generator of steam." G. Durando. April 30th. (Italy, April 30th, 1920.)

12,469. "Electric switches." R. W. Bill and H. Heath. May 2nd.

12,470. "Auxiliary electric light for use with acetylene lamps, &c., on motor vehicles." W. H. Date. May 2nd.

12,500. "Movable letter electric sign for cars." R. Winterburn. May 2nd.

12,501. "Means of generating electricity." J. Evans. May 2nd.

12,515. "Device for converting alternating into continuous current for feeding three-electrode thermionic tubes, &c." R. Vallette. May 2nd. (France December 9th, 1920.)

12,532. "Appliance for registering telephone calls." C. F. Kubec and J. Phillips. May 2nd.

12,544. "Ignition arrangements for internal combustion engines." A. E. Lamkin. May 2nd.

12,561. "Telegraphic apparatus." M. B. Rodriguez. May 2nd.

12,562. "Electric meters." F. Holden. May 2nd.

12,566. "Dynamo-electric machine group." A. F. Beach. May 2nd.

12,573. "Process for electrolytic production of potassium carbonate from potassium chloride solutions." Chemische Fabrik Griesheim-Elektron and R. Suchy. May 2nd.

12,580. "Telephone call recorder." L. Boyes and E R. Simmonds. May 2nd.

12,638. "Cable attaching device for fixing electric cables to carbon brushes." E. Gindre. May 3rd.

12,642. "Electrical controllers" Metropolitan-Vickers Electrical Co., Ltd. May 3rd. (United States, May 17th, 1920.)

12,654. "Telephone exchange systems." L. Polinkowsky and Western Electric Co., Ltd. May 3rd.

12,656. "Electrical boiling rings." Electric Fires, Ltd., F. L. Newhouse, and C. H. Smith. May 3rd.

12,658. "System of electric current distribution." C. A. Turner. May 3rd.

12,663. "Electric switches." H. Lucas and W. C. Turner. May 3rd.

12,690. "Signalling devices for telephone, &c., systems." Automatic Telephone Manufacturing Co., Ltd. May 3rd. (United States, June 1st, 1920.)

12,694. "Duplex, &c., telegraphy." H. W. Sullivan. May 3rd.

12,703. "Secondary batteries." Hart Accumulator Co., Ltd., and F. J. Holmes. May 3rd.

12,704. "Secondary batteries and secondary cell containers." Hart Accumulator Co., Ltd., and F. J. Holmes. May 3rd.

12,719. "Electric terminals." W. Owens. May 4th.

12,727 "Apparatus for switching electricity, gas, or liquids on or off." C Sugden. May 4th.

12,744 "Means for conveying electric current from overhead wires to tramcars" C. G. Millington and W. Sharp. May 4th.

12,746. "Transmitting photographs, messages, &c., by telegraphy." E. W. Whiston. May 4th.

12,749 "Arc generators and methods of regulating same." T. E. Robertson (S Davis). May 4th.

12,762. "Sparking plugs." J. F. Spalding. May 4th.

12,765 "Ignition system for internal combustion engines." C. E. James and C. Lamb. May 4th.

12,776. "Telephone exchange systems." L. Polinkowsky and Western Electric Co., Ltd. May 4th.

12,785. "Electric burglar alarms" Polyp Ges. Fur Apparatebau der Feinmachanik Ges., and G. Wittwer. May 4th.

12,810. "Manufacture of metal tubes by electrolytic deposition." M. A. Jullien. May 4th.

12,836. "Machine for registering telephone calls." S. Gayner. May 5th.

12,857. "Electrical fuse bridge." W. E. Flower. May 5th.

12,863. "Resistance grid for electric motor starters, &c." J. Schuil. May 5th.

12,881. "Electric fuses." W. Clark and Clark's Neo Electric Devices, Ltd. May 5th.

12,882. "Commutators." A. H. Steptoe and E. G. Steptoe. May 5th.

12,896. "Selective switches." Western Electric Co., Ltd. (Western Electric Co., Inc.). May 5th.

12,902 "Electrical machines with fan ventilation." Siemens-Schuckertwerke. May 5th. (Germany, May 5th, 1920.)

12,906. "Spark gaps." L. H. T. Holden. May 5th.

12,917. "Controlling mechanism of tramway, &c., switches." S. S. Wrightson. May 5th.

12,922. "Apparatus for converting alternating to direct electric currents and vice versa." J. E. Calverley and W. E. Highfield. May 5th.

12,923. "Electric switches." R. A. R. Bolton. May 5th.

12,935. "Electrical plug switches, &c." F. Jones May 6th.

12,942. "Dynamos for automobile, &c., electric lighting systems." C. A. Miller, F. J. Miller, and E. A. Sanders May 6th.

12,953 "Electric switches." F. H. Restall. May 6th.

12,962 "Electric bell set." T. Hewitt. May 6th.

12,987 "Magnetic cut-out." G. Ferry May 6th

12,994 "Alternating current motors" M. Dewhurst and Dewhurst and Partner, Ltd. May 6th.

13,010 "Method of producing drawn tungsten wires." Patent-Treuhand Ges. fur Elektrische Gluhlampen May 6th. (Germany, May 7th, 1920.)

13,021. "Electric signalling and telegraphic devices, &c." E. O. Symonds. May 6th.

13,030. "Circuit connection fittings for electric wiring systems." L. M. Waterhouse. May 7th.

13,033. "Annunciator signs." R. N. Chubb. May 7th. (United States, May 8th, 1920.)

13,041. "Joint for tramway rail." L. P. Davies and K. James. May 7th.

13,044. "Radio-signalling systems." Radio-Communication Co., Ltd., and J. Scott-Taggart. May 7th.

13,059 "Time limit relays, circuit breakers, &c." B. H. Leeson, J. Mirrey, and A. Reyrolle & Co., Ltd. May 7th.

13,063. "Automatic electric door bolt and release." S. H. Lacey. May 7th.

13,068. "Electric switches." H. W. F. Ireland and H. Lucas. May 7th.

13,069. "Electric heating, drying, &c., apparatus." W. Hayhurst. May 7th.

13,071. "Portable electric tool for drilling, reamering, tapping, &c." F. W. White and White, Jacoby & Co., Ltd. May 7th.

13,084. "Dynamo-electric machinery for electric welding." Brush Electrical Engineering Co., Ltd., and P. Huggins. May 7th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

25,403. "Wireless signalling." E. F. W. Alexanderson and General Electric Co. October 16th, 1919. (United States, October 16th, 1918.) (136,965.)

25,579. "Connecting electric currents." L. Seblini. October 18th, 1919 (France, October 19th, 1918.) (134,211.)

25,718. "Connecting electric currents." L. Seblini. October 21st, 1919. (France, June 4th.) (Addition to 134,211.) (144,242.)

27,196. "Electric heat-producing element and applications thereof to apparatus or articles." C. H. Roduis. November 5th, 1919. (Cognate application, 31,711/19.) (162,012.)

28,500. "Electric gas lamps with glow discharge." J. Pintsch Akt.-Ges. November 6th, 1917. (Patent of addition not granted.) (135,486.)

28,872. "Electricity meters." Chamberlain & Hookham, Ltd., and S. James. November 20th, 1919. (162,015.)

30,143. "Safety tram shackle." J. Leadbeater, D. Weeks, and E. D. Williams. December 3rd, 1919. (162,018.)

30,176. "Devices for electrically measuring the lengths of electric cables." W. E. Benson and Callender's Cable & Construction Co., Ltd. December 3rd, 1919. (162,019.)

1920.

452. "Electrically-heated cooking device." C. C. Armstrong. June 27th, 1916. (137,526.)

1,184. "Transmission gearing for electric motors." E. Small and W. S. Smith. January 14th, 1920. (162,286.)

1,387. "Rotating interrupting devices for high-speed sparking apparatus." O. Imray (Bosch Akt.-Ges., R.). January 15th, 1920. (162,039.)

1,467. "Machine for the automatic and continuous production of seamless boxes, lamp sockets, and other articles by electrolysis." S. O. Cowper-Coles. January 16th, 1920. (162,042.)

1,763. "Protective arrangements for electric distribution systems." A. Reyrolle & Co., Ltd. (J. C. van Staveren). January 20th, 1920. (162,059.)

1,773. "Electrical step-by-step devices for indicating and other purposes." K. Higginson and Carey-Cavey Syndicate, Ltd. January 20th, 1920. (162,061.)

1,871. "Wireless telegraphy and telephony." W. H. Eccles and J. H. Vincent. January 21st, 1920. (162,067.)

1,872. "Device or apparatus for testing the sparking plugs of internal combustion engines." J. B. Tucker. January 21st, 1920. (162,068.)

1,955. "Means for adjusting brake shoes used in tramway vehicles and the like." S. Thomas. January 21st, 1920. (162,073.)

2,354. "Electric switch of the tumbler type." S. E. Foster. January 26th, 1920. (162,086.)

2,378. "Electrically-heated irons." H. Cheshire and A. Summerhayes. January 26th, 1920. (162,088.)

2,542. "Electric protective devices." British Thomson-Houston Co., Ltd. (General Electric Co.). January 27th, 1920. (162,093.)

2,687. "Wireless telegraphy and telephony." E. Hoghton and Portholme Aircraft Co., Ltd. January 28th, 1920. (162,097.)

3,701. "Systems of regulation for electric circuits." British Thomson-Houston Co., Ltd. (General Electric Co.). February 6th, 1920. (162,118.)

3,803. "Electric switch boxes and the like." W. T. Henley's Telegraph Works Co., Ltd., and W. H. Nicols. February 7th, 1920. (162,119.)

3,922. "Electrically-operated diaphragm horns." B. A. Quint and A. R. Kearney. February 9th, 1920. (162,120.)

4,467. "Magnetic blow-out devices for electric switches and the like." T. Zweigbergk. February 13th, 1920. (162,128.)

6,229. "Electro-magnetic brakes." Igranic Electric Co., Ltd. (Cutler Hammer Manufacturing Co.). March 1st, 1920. (162,145.)

6,542. "Battery charging systems." Automatic Telephone Manufacturing Co., Ltd. June 11th, 1919. (144,611.)

9,225. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. May 28th, 1919. (143,842.)

9,236. "Method of and apparatus for manufacturing electric incandescent lamps." Westinghouse Lamp Co. April 3rd, 1919. (141,049.)

9,861. "Controlling mechanism for electric circuits." Industrial Research Corporation. April 28th, 1920. (142,451.)

11,665. "Portable electric lamps." Fullers United Electric Works, Ltd., and L. Fuller. April 27th, 1920. (162,183.)

13,780. "Electrically-heated perforator." A. B. Campbell. May 19th, 1920. (Addition to 122,771.) (162,199.)

14,186. "Electric projector lamps for motor vehicles." A. J. Curnow and Howes & Burley, Ltd. May 25th, 1920. (162,202.)

16,034. "Arrangements for the coupling of two alternating current electric systems in parallel." Ateliers de Constructions Electriques Du Nord et de l'Est. January 22nd, 1914. (145,022.)

16,310. "Suppression of sparking at the interruption of conductors, traversed by current." Siemens-Schuckertwerke Ges. July 29th, 1915. (145,072.)

18,140. "Regulating means for electrical machines." Soc. Anon. des Etablissements L. Bleriot. February 20th, 1919. (Addition to 130,575.) (145,775.

19,362. "Oil break switch in which the gas pressure generated upon its being opened accelerates the movable contact in the direction of the switching-out motion." Allgemeine Elektricitats Ges. April 1st, 1914. (147,456.)

21,541. "Covers for electric switches, and the manufacture therefor." S. S. Sodring and N. P. E. Winther. July 17th, 1920. (162,220.)

22,727. "Electro-magnetic overload cut-outs." S. Krupp Akt.-Ges. August 7th, 1919. (149,673.)

29,236. "Arrangement and construction of sparking plugs for internal combustion engines. E. L. Muller. October 16th, 1919. (152,609.)

36,084. "Electric lamps operating with luminous discharge." J. Pintsch Akt.-Ges. December 12th, 1917. (155,783.)

1921.

6,912 "Electrically-heated melting and other furnaces." Morgan Crucible Co., Ltd., and C. W. Speirs. October 7th, 1919. (Divided application on 161,603.) (162,246.)

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ELECTRICITY SUPPLY TARIFFS.

THE two papers read before the Institution of Electrical Engineers by Messrs. J. R. Blaikie and J. W. Beauchamp have effectively drawn attention to a subject which, for 30 years a matter of absorbing interest to electricity suppliers, has latterly become not merely of supreme importance, but even a question of life or death to many undertakings. In other callings that have been subject to State control since the war, if the price has been fixed the trader has at least had the option of refraining from sale; or if he has been obliged to sell, he has been allowed to secure a fair price or its equivalent for his wares; but the electricity supplier is between the devil and the deep sea—the maximum price of his product is fixed, and he is compelled by statute to supply all comers at that price or less. We have pointed out on various occasions that under the existing conditions these obligations press so hardly on the smaller undertakings that it is absolutely impossible for them to make ends meet; in the case of the municipal undertakings the inevitable deficit will have to be made good out of the rates, which are already at an excessive pitch, but the small companies are in a still graver plight—they are faced with bankruptcy. Many of them have a waiting list of would-be consumers whose demands, according to law, must be satisfied, for which purpose the plant and mains must be extended at present prices—an absurd proposition when they are actually unable to pay their way with the existing low-priced plant.

Obviously the situation is an impossible one, and it is incumbent upon the Electricity Commissioners to find a way out of it with the least possible delay. As Mr. Ll. B. Atkinson pointed out when a deputation from the British Electrical Development Association waited upon the Commissioners in November last, people are anxious to have a supply of electricity, and would rather pay a high price for it than be deprived of it altogether—the latter event would, indeed, be an anticlimax under the *régime* of a Board of Commissioners appointed to promote the supply of electricity throughout the length and breadth of the land! Six months have elapsed since that interview, at which the situation was fully explained to the Commissioners; we do not suggest for a moment that they have neglected the matter, but it is the plain fact that the situation is the same to-day as it was then. The trouble arises entirely from the rigid control imposed by the statutory provisions which cannot be varied without reference to Parliament. In the United States, the tariffs are supervised, as we recently explained, by local "Public Utility Commissioners," and in this country they should be placed under the discretionary powers of the Electricity Commissioners. Provision is made to this end in the Electricity (Supply) Bill, but the revision can only be made at triennial intervals, and as in many cases this would involve further delay, that provision is inadequate. There is also a considerable risk of failure to pass the Bill. Hence the Commissioners should secure powers independently of the Bill, for the matter is very urgent.

As regards the form of the revised tariffs, the subject has been exhaustively studied during recent years, and the consensus of opinion is overwhelmingly in favour of a tariff which shall take separate account of the fixed charges and the running cost of the supply. The arguments in favour of this type are unanswerable; more than any other sound economic tariff, it tends to develop the use of electricity for the most diversified purposes, while it ensures that even the most unprofitable class of consumer shall contribute a fair proportion to the income of the undertaking. It has been shown that some consumers would be unprofitable even if they paid 1s. 9d. a kilowatt-hour.

It is well that the industry should fully understand what is meant by the present conditions. Small undertakings are unable to raise fresh capital; extensions cannot be carried out; manufacturers and contractors receive no orders from these undertakings; the price of energy for heating and cooking is deliberately put up to prohibitive values with the express object of preventing consumers from increasing their demand and overloading the plant! It can hardly be wondered at that when the small undertakings were forced into the adoption of such methods to keep their stations running, an impression developed that the Commissioners wished to crush these undertakings out of existence, to make way for new schemes. That view has been indignantly repudiated by the Commissioners; but unless their efforts to bring about improved conditions are quickly successful, the same result will ensue. Small undertakings cannot "live on their losses."

THE PARALYSIS OF INDUSTRY.

At the moment of writing, the coal dispute has dragged its weary length along for close upon eight weeks, and it is to be hoped that the miners, the owners and the Government are by now sufficiently alive to the extent of the damage that the country is suffering, or to their responsibility for it, to make some real and effective attempt to bring it to a conclusion.

The extent to which British prosperity depends on coal would appear not to be generally realised. It is not so much that coal itself forms a convenient and quickly-handled cargo with which to load ships on their outward voyages. Many economists consider that coal is too precious to be exported, and that our whole handling of coal is wasteful in the extreme. Coal is a reservoir of valuable chemical products, of which two, coke and gas, are fit only to burn. To burn, or sell, the whole precious thing is a wasteful process of which any engineer should be ashamed. We must pay for our imports by exports, but those exports ought to be goods manufactured here by the aid of the coal with which we are providentially endowed. Sir Robert Hadfield says the world is hungry for steel. What nation is better fitted to satisfy the world hunger than Great Britain? Yet we stand idly by and leave the coal down in the mines. Let it be understood and appreciated that our trade has fallen off to such an extent that it is no longer capable of maintaining the population of these islands, even at the pre-war standard of living, let alone that better standard for which we were taught to hope.

During the war the nation proved itself capable of the highest possible degree of organisation. If we can organise successfully for destructive purposes, why not for constructive? There was much that was wrong in our war-time organisation; much that was wasteful and inefficient. But there was more that was right and good; more that was efficient and economical, in the true sense of the word. If we had lost the war, there can be little doubt that the Germans would have come here and we should have been organised, willy-nilly, for the production of whatever they chose to demand. Having proved ourselves equal to the accomplishment of a great purpose, is it not seen to be a miserable shame that we cannot, or will not, at any rate we *do* not, set ourselves resolutely to the accomplishment of a far greater purpose? For peace is greater than war. The demands of the populations of the world are greater than the demands of the greatest army. The duration of peace is longer, we may hope than the duration of war. The feeding and clothing and housing of the nation's children is a bigger business than the feeding and clothing and housing of the nation's soldiers. Then why don't we get on with the job?

The misery of the unemployed, of their wives and children, is less spectacular than the distress of a mighty army, driven backwards by the lack of means to advance or defend itself. But it is equally, or more, important that the nation should supply their needs; and, what is more, it is the purpose immediately to hand. The discipline of the war taught us all that *now* is the only time. A book, reviewed in our columns recently, said that "to-day's need is production; to-morrow's need will be selling." To-morrow has come, and the need of to-day is to get business. We can only get business if we will pay for our necessary imports with exports at a reasonable price. Our cost of production must go down. The way to reduce cost of production is to increase production. It is not necessarily the case that wages form the chief item in production costs. American wages are notoriously higher than British; yet, even at an adverse exchange, American goods are frequently cheaper, in overseas markets, than British. Considering the country as a business proposition, is it not obvious how our overhead costs are increasing during the hold-up of industry? We simply *must* get back to work, and recognise that goodwill between classes is the only way to prosperity.

For the settlement of the coal question the authorities are feeling their way toward a new solution. For other industries, let Whitley Councils be encouraged. The machinery of industrial peace has largely been thought out and prepared. It is the application of the principles which would set the machinery in motion that is lacking. In Heaven's name, let us do something NOW!

Individual Responsibility and Leadership.

There never were so many capable minds at work trying to solve the industrial wage problem. This fact alone should fill us with hope that both the right spirit and the right way will soon be found. It is useless to imagine that we are going to get over our difficulties if all we have to say is "wages must come down!" It must be understood that there is an all-round responsibility and duty. If big cuts in wages are not desirable, let the reductions be as large as they can be as the result of agreement. What neither the "working man" nor the employer can afford to overlook is the zeal of Continental workmen, and their large output for comparatively low wages. We must have our efficiency at its maximum and our costs at their minimum. Wherever it is possible we must, as Major S. G. Howard, M.P., has recently remarked, seek relief in improved methods of production by up-to-date machinery and a larger output by labour. We recognise that there is nothing new in these reflections. But we cannot secure maximum efficiency and output without the co-operation of all interests. We agree that it is better to ask for a bigger output for the same wages than to ask labour to take lower wages for the same output. When will the far-seeing minds in the unions bring their influence to bear upon the mass, and show them that the unpractical idealism of some and the deliberate destructiveness of others are doing serious injury to the interests of millions of men, women, and children? There is sometimes a call for leaders who will point out the way of sanity and safety, for spiritual leaders who will guide us with regard to the application of great Christian principles in our industrial relations. We believe that human leaders are not the need. Human leaders are discredited at present; each has his own limited following; none influences all; but we may each exercise our individuality for moderation. Deeply in the minds and hearts of the British people there are rooted sound principles which are themselves influential leaders of the race. It is known well enough what is the right thing to do. Part of the failing lies in our unwillingness to follow the leadership that reigns within.

Smokeless Air.

LETTERS written to *The Times* by artists and architects have recently drawn attention to the extraordinary clearness of the atmosphere of London, due to the absence of smoke. We have ourselves observed that the views of London and its surroundings which can now be obtained from elevated points far surpass anything within our experience, and we are glad to record that the miners' strike has thus conferred upon us one beneficial result, even if it be of no material value.

Apart from the æsthetic aspect, however, there is a very substantial gain to be derived from the purification of the air, based upon several factors—improved health, reduced expenditure of time and labour on the cleansing of houses and clothing, lessened cost of renewing decorations, and, perhaps the most important of all from the financial point of view, reduced wastage of buildings and other structures due to the destructive effects of the products of combustion. It is to the last-named item that the architects especially direct attention, urging that having experienced the benefit of clean air, we should take steps to make the reform permanent, by abolishing the use of soft coal and substituting for it gas, electricity, and hot water.

The difficulties in the way at this time are admitted; the proposal is on the same footing as many others—railway electrification, the development of electricity supply, the utilisation of water power, &c.—namely, that if the capital were available to carry it into effect, the return on the outlay would be abundant; but the capital is not at command. The nation is impoverished, and must be content to walk warily for a time.

The Electrical Wages Dispute.

THE sections of the Electrical Trades Union which ceased work to prevent a reduction in their wages have, after a short time, seen reason, and have returned to work upon the terms arranged between their union and their employers. A further conference is being called at the end of the present month, whether to confirm the tentative agreement, which apparently has not yet been officially repudiated by the E.T.U., or to postpone the date of the second stage of reduction, we know not. It is clear, however, that the other unions comprised in the Federation of Engineering and Shipbuilding Trades were not disposed to render active support to the electricians, and, indeed, even their sympathy was rather a doubtful quantity. This was not to be wondered at, having in mind the simple fact that they (the other unions) had already accepted certain reductions. The spectacle of workers on reduced wages losing even these to sustain the wages of other workers at the same level would have been too ridiculous to contemplate.

Rumour has it that the collapse of the strike was largely due to the flat refusal of many members of the E.T.U. to engage in it; that they are utterly sick of the incessant attempts of their leaders to involve them in strikes, and that there is a rod in pickle for the Executive of the London Branch. However that may be, we trust that a real and lasting settlement will be arranged at the next meeting with the employers.

The I.M.E.A. Convention.

MEMBERS of the Incorporated Municipal Electrical Association, and prospective visitors to the annual Convention, will learn with regret that owing to the prevailing conditions, over which they had no control, the President and Council have been reluctantly compelled to cancel the Convention for this year. Their disappointment will be mitigated to some extent by the fact that, for some time past, they must have felt misgivings on the subject, but none the less, the abandonment of this always enjoyable and exceedingly useful meeting will for many mar the memory of the coming summer. No one will more keenly regret the necessity of the decision than the President, Major Richardson, who with the aid of the Dundee Local Committee has exerted every effort to avoid it. If we remember aright, this is the second occasion on which he has been deprived of the pleasure of welcoming the Convention to his own town, and we extend to him our sympathy. We hope that at the annual general meeting (to be held in London on July 22nd), and at the annual dinner on the previous evening, the members will be present in great force, as the next best thing to holding the Convention.

German Competition in Norway.

ABOUT a year ago a Norwegian contemporary raised the question of the prejudice caused to the native electrical manufacturing industry through Norwegian supply works placing orders with foreign firms, particularly German and American. The newspaper now draws attention to two fresh instances in which unfair treatment has been meted out to Norwegian firms through Germans being permitted to revise their offers after the tenders had been opened. In the first place, the Christiania municipal electricity works is about to obtain a further supply of power from the Rjukan hydro-electric works, and tenders were invited for two synchronous machines and apparatus for this purpose. Offers were received from Switzerland, Sweden, and Norway, and from two German firms. The Swiss tender was for 995,000 kronen, the Swedish 674,000 kr., and the Norwegian 693,000 kr., while the German offers were 560,000 kr. and 530,000 kr. respectively. After the tenders had been opened and the competitive prices disclosed, the Germans offered to reduce their prices considerably. Instead of refusing to entertain the modified proposals, the Christiania authorities drew the attention of the Norwegian firm to them, and offered the latter the contract, but the bottom price to which the Norwegian firm could go in order to cover its expenses was 15 per cent. higher than the lower of the German initial tenders. Under the circumstances the municipal authorities accepted the German tender, which had been reduced from 530,000 kr. to 400,000 kr. Is it any wonder that the Christiania contemporary declares that this is an example of public authorities taking advantage of amended tenders, submitted after the original quotations had been announced, in order to depress prices, and that this is a course of procedure which is inconsistent with the business customs of first-class firms? The second instance mentioned is attributed to the Vestfold Power Co., which obtained tenders for plant. The lowest German offer was 60,000 kr., and the Norwegian was 69,000 kr. A representative of the purchasing company visited the works of the Norwegian firm, and everything seemed to be in order, when the German firm lowered its price to 40,000 kr., one half of the Norwegian cost of construction, and secured the order.

The Christiania *Norges Handelstidende* states that it is hopeless at present for Norwegian industry to try to compete with Germany. The wages in the latter country are about one-third of those paid in Norway, and the general expenses about one-fifth. Even raw materials are lower, as the Germans are largely buying scrap from abroad and working it up into manufactures. According to its capacity, Norwegian industry has fought against this insane competition. In the second case the Norwegian firm quoted at a price which not only would not have yielded any profit, but was 15 per cent. under the cost of production. The newspaper submits that a time limit for tenders should be fixed, and no regard paid to any subsequent offers that might be received.

It is of interest as bearing on the question under consideration to hear what the Norwegian *Tidens Tegn* has to say. Referring to the report that Herr Hugo Stinnes proposes to obtain a firm footing in Danish industry, the newspaper states that this German is already manifesting great activity in Norway. An import coal and iron business already exists in Christiania under the title of Hugo Stinnes, and through the Siemens-Schuckert works in Christiania, which is closely associated with him, he is to become a keen competitor in the electrical industry in Norway.

A COUNTRY HOUSE HYDRO-ELECTRIC INSTALLATION.

In view of the interest that has been awakened in hydro-electric schemes, the following particulars of a complete electric house installation near Oban, Argyllshire, may be acceptable to our readers.

The stream from which the power is derived drains a large catchment area, about a mile wide and two miles in length, the hills, shown in fig. 2, rising on either side to over 3,000 feet. Owing to the heavy rainfall in the district, it was thought that there would be sufficient water flowing in the stream even in the dry season, without the expense of constructing a reservoir, and this in practice has proved to be the case.

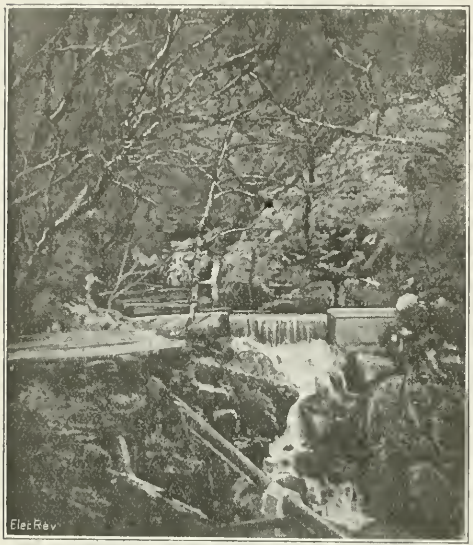

Fig. 1.—Weir and Pipe Line.

The amount of water required was 85 cubic feet per minute, and after six weeks' drought it was found that not less than 50 cubic feet of water per minute was passing through the turbine and giving fully half load. At other times after heavy rain as much as 1,000 cubic feet per minute was flowing. A substantial concrete weir was therefore built across the stream to act as an intake; fig. 1 shows this weir and the pipe line coming from it. A scour valve and pipe are provided for cleaning out the bottom of the stream. The concrete wall is about 6 ft. high, and has an overflow 9 ft. wide by 6 in. deep. In times of spate the water comes over anything up to 12 in. above the weir, over the full width of the stream.

The pipe line, which is about 2,000 feet long and almost straight, only three 150 deg. bends being used in its construction, is carried underground to the turbine house situated on the bank of the stream and at a distance of about 50 yards from the dwelling house, which is illustrated in fig. 4. The estimated difference in level between the intake and the turbine house was 287 feet. It is interesting to note that after completion the head, according to the pressure gauge fitted on the turbine, was 290 feet.

The pipe line consists of 8-in. bore, No. 7 gauge, lap-welded steel tubes, coated with preservative compound, with socket joints, the whole being wrapped with hessian cloth and re-coated. The joints were made with lead and yarn, and the pipes were in lengths of about 18 ft. each. Owing to the very rough nature of the ground a considerable amount of blasting and deep digger work was entailed, and it was also a difficult matter to get the pipes into position on the rough hillside. A small existing building on the river bank with some slight alteration has made a very good power house, fig. 3, and in this are fitted the turbine, dynamo, and switchboard and the necessary controlling valves.

The turbine, which is of Messrs. Gilbert Gilkes & Co.'s make, is capable of giving 33 b.h.p. or 22 kW at full load at about 650 revs. per minute, with an estimated net head of 268 feet at full load, there being a frictional loss of 20 ft. when passing 85 cubic feet per minute.

Owing to the fact that the water is taken directly from the stream, there was no object in fitting an economiser, but a 6-in. sluice valve is fitted with a slide on which is marked the position of the valve for the various loads. This is really only used if the water flowing in the stream is less than the full capacity of the pipe.

The turbine is fitted with a relief valve, a pressure gauge marked in feet and pounds per square inch, and a patent shaft governor consisting of a spring pendulum mounted on the shaft and coupled to the slipper deflector by means of a rocking shaft and levers. The operation of this governor is extremely quick and efficient. It was found on test with the spear valve three-quarters open, the dynamo giving 90 amps. at 255 volts, that on all the load being thrown off, the pressure only rose to 270 volts, which was practically due to the 5 per cent. rise in speed of the turbine. In a similar way, when the full load was thrown on again, the voltage dropped to 255.

The dynamo, which is directly coupled to and on the same bedplate as the turbine, is of Messrs. Horace Green & Co.'s make, compound wound and designed to give 85 amps., 270 volts at 650 revs., and no load at 265 volts at 680 revs. with all shunt resistance out, and the

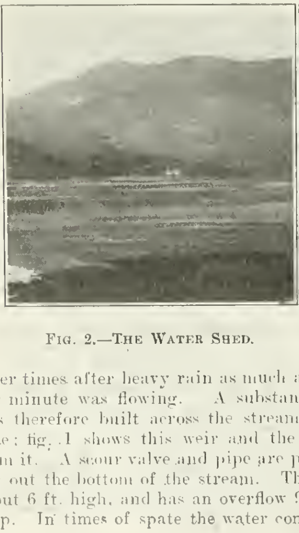

Fig. 2.—The Water Shed.

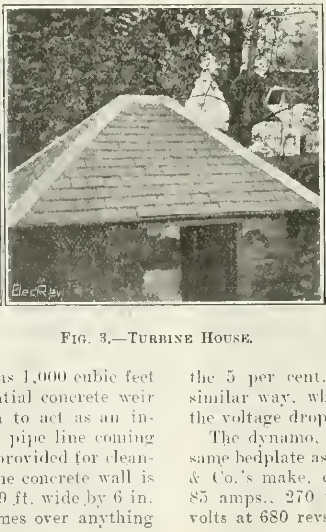

Fig. 3.—Turbine House.

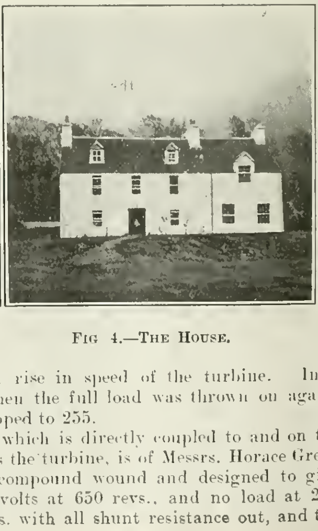

Fig. 4.—The House.

plant behaves extremely satisfactorily in operation. It was found that with the spear full open 100 amperes at 250 volts was easily obtained, and this 15 per cent. overload was maintained for an hour after a six hours' run at full load, the dynamo being perfectly cool at the end of the test.

The plant runs continuously night and day, and no batteries are installed, which makes the switchboard arrangements extremely simple. On the switchboard in the power house an 8-in. dial ammeter and voltmeter, shunt regulating switch and main switch and fuses are fitted, and from this to the house a concentric ·19/.083 paper-insulated lead-covered and armoured cable is run underground.

The switchboard in the house has mounted on it a voltmeter and an ammeter with red marks at 250 and 85 amps. respectively, and also a 100-amp. Ellison circuit-breaker. This breaker is set to come out at 100 amperes, and cuts off everything throughout the house with the exception of the lights, which are not controlled by it. In the event of the breaker coming out, some piece of apparatus has to be switched out, as although the average maximum current is only about 70 amps., the actual amount of apparatus which could be switched in would take about 130 amps.

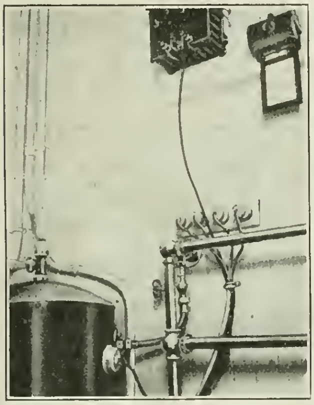
FIG. 5.—HOT WATER TANK.

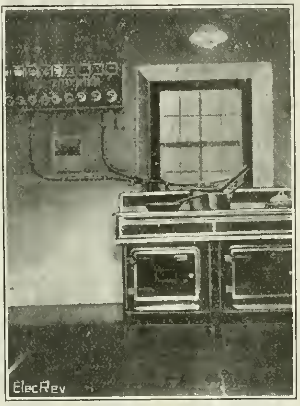

FIG. 6.—COOKING RANGE.

In the mansion house, lighting, cooking, hot-water heating, heating and drying are all electrical, and from 50 to 60 tons of coal are saved annually at a cost of £2 or £3 a year for lubricating oil, if the capital cost is written off, and even if it is not, the scheme shows quite a good return on the money invested, the house being about five miles from the nearest station, and the cartage of coal therefore being an expensive item. Throughout the house, &c., there are over 100 lamps and sockets. The installation was carried out with the Henley patent wiring system.

In the kitchen a cooking range by the Falkirk Iron Co., shown in fig. 6, is fitted, consisting of two ovens, hot cupboard, grill and six boiling rings, each of which is fitted with a ruby pilot lamp, a fuse, and a three-heat control switch; the ovens are fitted with thermometers. The total loading of this range, which is nickel plated finished as to the hot table and white porcelain enamel as to the ground plate, is 13.6 kW.

The cooking on this range is extremely efficient, and the cook who is operating it, although at first rather prejudiced against it, would not now care to go back to the old coal range after about six months' experience.

The hot water supply for the house is got from an electrically heated 45-gallon tank, which is both boiler and storage tank. That is shown in the illustration, fig. 5, and is placed in the bathroom, which room is kept warm. Four electrical elements are fitted in this tank, each loaded to 1,500 watts. The lower three of these elements are connected up through a 3-way distribution board to a clapper switch and thermostat set to operate automatically at about 160 deg. to 170 deg. F. When the temperature falls, say, 5 deg. below this, the current is automatically switched on, and in a short time, when the temperature rises again, the current is cut off. In addition, the fourth or top element is controlled by a 10-ampere Hart d.p. switch, and with the four elements in circuit it is found that the water is raised from cold or, say, 45 deg. to 160 deg in about two hours' time. There is thus obtained an abundant supply of very hot water at any time of the day or night, and three successive hot baths can be taken if required. This is one of the most satisfactory parts of the whole installation, and has run perfectly since it was installed.

Throughout the house there are fitted 21 10 to 12 amp. heating points, and 3-kW fires are used in the various rooms. No coal is therefore required at all, and if in addition to the electrical heating, which is very efficient, any fire is wanted, wood is burned from the estate; in the garage provision is made for a 10-h.p. motor and saw bench for cutting the wood.

The drying room is a small room about 10 ft. 6 in. by 7 ft., and is heated by means of three tiers of 2-in. cast-iron pipes on three sides. These pipes are supplied with water from the ordinary cistern, and heated by one 1,500-watt element, which is continuously kept in circuit. The temperature of the room is usually from 90 to 100 deg. Fah., and it is found from practice that thoroughly wet clothes put into the room at night are quite dry in the morning. This is found of great usefulness for shooting parties, as the district is rather a wet one.

In the garage, where the supply is by overhead cable, a suitable charging board for motor-car batteries is fitted, and throughout the house various apparatus, such as a vacuum cleaner, irons, kettles, hot plates, an egg boiler, &c., for various household requirements, are fitted.

The whole scheme was designed and carried out by Messrs. Allan Arthur & Ure, electrical contractors, Glasgow, and has been running with complete satisfaction since the beginning of November. Such a scheme where water power is available is an ideal one, especially for houses that are situated at a distance from a station where the cartage of coal is inconvenient and expensive, and in the Highlands should appeal to many.

The Electrical Energy in Thunderstorms. — Having defined a thunderstorm as an electrical machine, Mr. C. T. R. Wilson continued an explanation of this machine in his second lecture at the Royal Institution on April 14th. As a thundercloud moved across the country, the conditions, he said, would change as it passed over grass, forest, water, or snow. The current between the ground and the cloud varied according to the nature of the ground below. The very important question arose as to the number of storms that were going on at a given moment. This it was difficult to answer. In many parts of the world thunderstorms were of daily occurrence. If he tried to form an estimate of the number in progress at a given time he thought a thousand would be an underestimate. A thunderstorm was wasting energy in lightning flashes at the rate of one million h.p., but it was a difficult matter to say if that energy could be saved.

Apart from this wasted energy there was the question of the total transfer of electricity that took place between the ground and the upper atmosphere. Remembering the thousand thunderstorms there was probably something far exceeding a thousand amperes carried between the ground and the upper atmosphere in the showers. An important question was whether these currents were mainly currents of positive electricity going upwards or currents going in the opposite direction. Probably storms tending to produce currents of both kinds existed.—*Morning Post.*

THE ELECTRICITY SUPPLY BILL.

(Communicated.)

The old saw that "one tale holds good until another is told," applies with special force to the much-talked-of Electricity Supply Bill, and while there is no doubt that the Editorial in the last issue of the Review contains some questions which are debatable, I hope to show that there are certain fundamental matters in connection with the unification of electricity supply which scarcely admit of debate, as upon the evidence which I propose to give, the conclusion is obvious.

In order to obtain a clear understanding of the present position it is necessary to trace the growth of the super-station idea from the beginning. Many years ago, several private Bills were brought before Parliament promoting schemes for supply in bulk to London. With one exception, all these Bills were thrown out, because it could not be shown that the supply under the schemes could be produced at a lower rate than that already being given by the existing authorised undertakers, *and this was at a time when wages and the cost of materials were at their lowest*, both for the bulk supply schemes and for the existing undertakings.

For some unknown reason the super-station idea, however, continued to grow in favour, until in 1918 the Board of Trade appointed a committee to investigate the whole question of electricity supply. The report of that committee duly appeared, and consisted largely of opinions, with little or no evidence in support, and a series of recommendations mainly based upon those opinions. One statement was, however, repeated frequently, and with this everyone probably agreed. It was to the effect that a cheap and abundant supply was essential.

In paragraph 56 of the report (referring to the taking over of stations owned by existing authorised undertakers) appears the following:—

"An undertaking should in such cases be given that electricity will be supplied to them *at least as cheaply* as they could have produced it themselves in similar circumstances of coal, labour, and other costs, including capital charges, with their existing plant and output."

The main recommendations contained in this report appeared in the Bill of 1919.

Clause 7 of the Bill provides that when a station is taken over except by agreement, the district electricity board shall be *under an obligation to supply at a price not greater than* that at which it could have been so generated.

It is well known that the compulsory clauses, as well as the financial clauses of the Bill were withdrawn, and did not appear in the Act of 1919. It is also somewhat suggestive that the words "at least as cheaply as" and "at a price not greater than" were also omitted from the Act and the following substituted:—

Section 8 (1): "It shall be the duty of every Joint Electricity Authority constituted under this Act to provide, or secure the provision of *a cheap and abundant supply of electricity* within their district."

It would, therefore, appear that the promoters of the Bill were doubtful whether the Joint Electricity Authority, with its super-stations, could supply as cheaply as the existing authorities.

In the present Bill (Clause 13) appears the following:—

"The prices charged for electricity by a Joint Electricity Authority shall be so fixed by the Authority . . . that over a term of years, to be approved by the Commissioners, their receipts on income account shall be sufficient to cover their expenditure on income account (including interest and sinking fund charges) with such margin as the Electricity Commissioners may allow."

In the London area it is proposed to scrap 60 out of 77 existing stations, and if the Bill before Parliament is passed, a Joint Electricity Authority, with its super-stations, will be the only source of supply, and should it be found that it cannot supply as cheaply as the scrapped stations could have done (*which is inevitable*), the price of electricity will have to be raised to any figure that will enable the Joint Electricity Authority to make both ends meet.

It must be remembered that unless the price of electricity compares favourably with that of other forms of power, electricity will have to go under, and it will not be possible *to prove* whether or not the super-stations can supply at a lower price until all the other stations are shut down.

It is, however, possible by reading the report of the financial expert on the scheme for the London area to form a fairly safe opinion.

The generating plant of the 60 stations above referred to, and which it is proposed shall be scrapped, consists largely of modern machinery of an efficient type purchased at pre-war price. This is stated in the technical report of the London scheme. The plant referred to will be replaced by plant erected in super-stations, the capital charges upon which will be *six times pre-war cost* as stated by the financial expert in his report.

I must, therefore, join issue with the statement in your Editorial of last week that electricity supply *has ceased to be speculative*.

As a matter of fact, the financial expert, judging from his report, is firmly convinced that it is *highly speculative* when undertaken in the manner proposed.

I quite agree that the necessity of developing the electricity supply business, *as it ought to be developed*, is urgent. I only differ upon the interpretation of the words.

As regards money being spent upon the security of the rates, I am unable, and I know of no one who is able, to state definitely to what extent the rates may be liable, in the event of a deficit arising, in case the Joint Electricity Authority is unable to produce at a reasonable figure, and thus loses the commercial market for this form of power, but it may be a very considerable amount. The constitution of the Joint Electricity Authorities is such that they are not answerable directly to the ratepayers, and this alone renders their formation highly undesirable, more especially as they will have the spending of large sums of money, which do not come out of their own pockets, and in which they are not directly interested.

If the supporters of the Bill have the courage of their convictions, let them induce the promoters to include two clauses in the Bill: (1) to the effect that the rates shall on no account be charged with any deficit due to the operations of a Joint Electricity Authority; and (2) to the effect that no station of an existing authorised undertaker shall be prohibited from continuing to develop by putting down additional plant, unless a supply can be obtained *at a lower cost* than it can be generated at if the additional plant is installed.

Your Editorial states that if the financial clauses of the Bill are rejected it will "throw the whole business into the hands of the companies."

To quote your own Editorial: "This is pure nonsense" as there are no compulsory clauses either in the Act or the Bill, and therefore no existing undertaking could be compelled to take a supply from a company, and if the Clause (2) referred to above were inserted in the Bill every existing individual undertaking would be protected as well as the supply business in general.

Your Editorial states that "*The reform of London's electricity supply depends upon the passing of the Bill.*" I have tried to discover what this "reform" refers to. Your Editorial, referring to Joint Electricity Authorities, states that "the essential characteristics of the Joint Authority" scheme are to be found in active operation in France and Germany. If this refers to electricity undertakings, the illustration is ill chosen, as in statistics published in 1913-14 the average price per unit sold in London *without any traction load* was for the local authorities 1.75, companies 2.36, total 2.13 pence; Paris 5.10, Berlin (with big traction load) 1.70, Hamburg 3.08 pence.

I will paraphrase your Editorial remark by stating my emphatic opinion that the *success* of electricity supply in the immediate future depends upon the financial clauses of the Bill being deleted and the clause (2) referred to above being inserted and passed.

I agree entirely with the final lines of your Editorial as to "the prime necessity of a cheap and abundant supply of electrical energy throughout the whole country," provided the words "cheap supply" mean "at least as cheaply as it can be produced by the existing undertakings."

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The Council's Annual Report.

The Council of the Institution at the forty-ninth annual general meeting, to be held on Tuesday next (May 31st), will present its report for the year 1920-21 in which the continual growth of membership is emphasised; nearly 200 Post Office electrical engineers joined the Institution during the session. The membership on April 1st, 1921, was composed of 9 hon. members; 1,679 members; 4,605 associate members; 805 graduates; 1,897 students; and 454 associates, a total of 9,449, or an increase of 1,303 during the year; 45 members died, 135 resigned, and the membership of 35 lapsed during the year. Five candidates submitted theses during the year in lieu of the associate membership examination, and 19 honours and distinctions were conferred on members, including five knighthoods. During the past 12 months the numbers of meetings held were as follows: Ordinary, 17; special, 2; wireless sectional, 3; informal, 9; council, 16; territorial centres and sub-centres, 98; students', 47; committees, 139. Twelve addresses and two lectures were delivered, and 15 papers were read; in addition a number of papers have been accepted for publication in the *Journal* without being read at meetings. There are seven territorial centres, seven sub-centres, and four provincial students' sections in existence, as well as three local centres abroad (Calcutta, Hong-Kong, and Argentina), and there are local hon. secretaries and treasurers in 18 countries abroad. There are 15 standing committees, five sectional committees, and six special committees, and the Institution is represented on 33 bodies. The Council awarded eight scholarships valued at £50 and one valued at £25 each, tenable for one year.

The question of erecting a suitable memorial to the members who fell in the war could not be dealt with during the past year owing to the absence of the Institution from its building, but will be taken up by the War Memorial Committee as soon as it is possible to select an appropriate position in the building. In the meantime, the task of collecting data for the biographical notices to appear in the war memorial book has been in progress, and the benefaction of £2,000 five per cent. war loan referred to in the last annual report has been constituted as a trust fund under the title of the War Thanksgiving Education and Research Fund (No. 1), the trustees being Sir James Devonshire, K.B.E., Mr. Roger T. Smith, and Sir John Snell. A grant of £100 for educational purposes has been made this year by the Council, under the provisions of the trust deed, to Frederick Bernard de Steiger (Finsbury Technical College), an ex-member of the Australian Imperial Force.

The Council has been asked by the Coopers' Hill War Memorial Fund Committee and has undertaken to award, in rotation with other bodies, a sum of £25 in prizes to young professional men in commemoration of the Royal Indian Engineering College, Coopers' Hill, and of its members who fell during the war. The Council of the Institution of Civil Engineers is trustee of the fund, the interest on which is expected to yield about £50 a year. Half of this will be awarded annually by the Institution of Civil Engineers. The other half is to be awarded by the I.E.E. in rotation with the Military School of Engineering, Chatham, and the School of Forestry, Oxford.

The Council expresses thanks to the Council of the Institution of Civil Engineers for placing the library and reading rooms of that institution at the disposal of members, which arrangement will be continued until the Institution library has been redecorated and the books returned from storage and replaced on the shelves. It is hoped that this work will be completed by the summer. The Council proposes as an experiment when the library again becomes available, to keep it open during the evenings if the use so made of it justifies the expense. During the year, 163 books and pamphlets have been presented to the reference library by members and others. During the year, 818 books were issued to 408 borrowers, the corresponding numbers in the previous year being 667 and 300 respectively.

The work of the Electrical Appointments Board during the past year has been much restricted owing to the very limited number of vacancies reported to the Board. The Council hopes that firms with vacancies on their staffs will assist the Board by reporting these vacancies to the secretary of the Board at the Institution offices. There are 51 members on the register of the Board at the present time desirous of obtaining employment.

The cost of printing and publishing the *Journal* (including the supplement) in 1920, after allowing for sales, was £6,739, as compared with £3,396 in 1919. The Council is to publish in future in the *Journal* a classified index of British manufacturers engaged in the electrical and allied industries.

Regarding the comprehensive revision of the wiring rules, the Main Committee and its six sub-committees have been actively at work during the session. Each of the technical sub-committees has reported, some of them several times, and the Editing Sub-committee has nearly completed the first draft of the new rules. It is intended, after the draft has been considered and approved by the Main Committee, to forward it to the fire offices and to hold a conference with their representatives. After any necessary modifications have been made, an opportunity will be afforded for discussing the draft in London and at the territorial centres before the rules are published. The British Engineering Standards Association has been asked to draw up standard specifications for wiring accessories which, while not being definitely made compulsory, will embody the requirements of the rules.

The Ship Electrical Equipment Regulations have, with certain omissions, been adopted by Lloyd's Registry of Shipping, and are now in force for all ships built under their survey throughout the world. The sub-committee has on two occasions met representatives from the Electrical Trades Union to discuss the question of urging the Board of Trade to hold examinations and grant certificates to sea-going electricians. The Board of Trade has been approached and, though its first reply was not favourable to the proposal, the matter is still under consideration by the Committee.

The Regulations Sub-committee of the Power Lines Committee was originally appointed to prepare a digest of the Board of Trade regulations and similar matters concerning overhead lines. The Council subsequently referred to the sub-committee the results of the work of the Factors of Safety Sub-committee of the same committee for incorporation and, in addition, it has been charged with the work of suggesting amendments to the various Board of Trade regulations, (*a*) for securing the safety of the public, and (*b*) for ensuring a proper and sufficient supply of electrical energy, which regulations embody those governing overhead lines, earthing, &c., and it is expected that a report will be presented before the commencement of the next session.

Regarding the provisions of a new Electricity Supply Bill introduced in Parliament on April 12th, 1921, the Council has constituted a conference of representatives of the interested bodies which will be summoned to meet at the appropriate time.

In June last the then president (Mr. Roger T. Smith) attended a conference of presidents of technical institutions to discuss proposals put forward by the Civil Service National Whitley Council urging the recruitment and training of non-technical civil servants for technical appointments in the civil service. As a result a letter signed by the president, jointly with the presidents of the Institution of Civil Engineers and other societies, was addressed to the Prime Minister deprecating the proposals.

In November, 1920, the Council addressed a letter to the Burnham Committee of the Board of Education urging that, should it be decided by that committee to differentiate between technical teachers holding first-class honours degrees and those without such degrees, corporate membership of the Institution should be accepted as an equivalent of a first-class honours degree, which in the case of secondary teachers makes them eligible for a higher scale of salaries. The Council's recommendation is under consideration by the committee. Throughout the session under review, the Council has been closely associated, through the president, with the efforts made to secure the continuance of the work of the Finsbury Technical College, which the City and Guilds of London had expressed their intention to close in July, 1921. In consequence of the granting of a temporary annual subsidy from the London County Council and the Board of Education, it has been decided to continue the college for the next five years.

The War Office has decided that the passing of the A.M.I.E.E. examination is to be a qualification for additional pay for officers of the Royal Engineers, Royal Army Service Corps, Royal Corps of Signals, and the Tank Corps (technical). At the request of the War Office, arrangements were made in December last for eleven officers of the Royal Corps of Signals to sit for the A.M.I.E.E. examination in the subject of "military signalling (electrical)."

Considerable progress has been made during the past year in industrial standardisation in electrical matters, and nine British standard specifications have been issued.

The B.E.S.A. has undertaken the co-ordination of the Government department specifications for electrical apparatus and materials, in collaboration with the permanent Government Inter-departmental Committee set up for the purpose. Wherever possible existing British standards will be employed, and when the specifications so prepared are suitable they will be issued as British standards. The work will be carried out as far as possible by the existing committees of the Association. A recommendation of the Wiring Rules Committee that the standardisation of the dimensions of distribution boards and other accessories should be proceeded with has been adopted. The Institution has three representatives on the Main Committee of the Association and five on its Electrical Sectional Committee.

At the time when efforts were being made to establish the British Electrical and Allied Industries Research Association, the Institution and the B.E.A.M.A. each guaranteed £750 per annum for three years towards the expenses, and the Institution paid a first instalment of £375 under its guarantee. The Council has been informed by the Association that in view of the greater funds now at its disposal, funds contributed in equal parts by the electrical industry and the Research Department, the Institution has been released by the Association from its liabilities in this respect. At present, membership of the Association is confined to manufacturers, but provision is made for enrolling other interested persons as associate members, and applications will shortly be invited.

Representatives of the bodies mentioned below have been nominated to form a Standing Joint Committee of Electricity Supply Associations on Coal, constituted under the auspices of the Institution to deal with matters regarding coal as far as relates to electricity supply undertakings, both company and municipal:—The Incorporated Municipal Electrical Association; the Associated Municipal Electrical Engineers of Greater London; the Incorporated Association of Electric Power Companies; the Conference of Chief Officials of the London Electric Supply Companies, and the Provincial Electric Supply Committee of the United Kingdom. In addition, the president of the Institution is *ex officio* a member of the committee, and its honorary secretary is the secretary of the Institution.

The Institution of Engineers (India), to the formation of which the Council gave its cordial support, was formally inaugurated at Calcutta by His Excellency the Viceroy of India, Lord Chelmsford, on February 23rd last. Among the members of the Institution who were present at the meeting were Sir T. O. Callender, Mr. A. C. Coubrough, Mr. E. M. Hughman, and Mr. J. W. Meares.

The Committee of Management of the Benevolent Fund of the Institution reports that on December 31st, 1920, the capital account of the fund stood at £5,709, and the accumulated income at £2,533. The donations and subscriptions to the fund in 1920 amounted to £821. In the course of the year 32 grants were made to eleven persons amounting to a total of £341.

The annual accounts of the I.E.E. for the year 1920 show that after making provision for contingencies as in the previous year, there is a margin to the good on the revenue account for 1920 of £673. This amount, which has been carried to the credit of the general fund, compares with £1,495 in 1919, a decrease of £822. In the accounts for 1919 mortgages stood at £30,198; they now stand at £29,285.

The total of the Life Compositions Fund on January 1st, 1920, was £5,414, and a further amount was received in payment of life compositions during the year, making a total of £5,729. Out of this £52 has been transferred to the general fund, in accordance with the articles of association, on account of life compositions of members deceased during the year, leaving to the credit of the fund £5,677.

The assets amount to £109,673, against liabilities of £6,977, leaving a surplus of £102,696, which, in comparison with that of the year 1919, shows an improvement of £4,906.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Cardboard Slide Rules.

In these days of high prices, devices which make for economy are more than ever welcome, and we are pleased to find that a British firm has taken up and perfected the manufacture of slide-rules of compressed cardboard, formerly a German industry. The Cavendish Press, of Cheam, Surrey, the firm in question, has brought to our notice the "Cavendish helical spring slide-rule," which has been designed by Mr. V. B. Harley-Mason, A.M.Inst.C.E., to reduce the calculation of helical springs—a troublesome process by the usual methods—to a matter of a few seconds. One setting of this slide-rule gives a complete selection of coil diameters and thicknesses of wire, round or square, in 32nds and in S.W.G., without reference to tables of any kind; similarly a single setting gives the number of convolutions for any required deflection per inch, and a third setting enables allowance to be made for any modulus of elasticity. It is claimed that the rule furnishes the most complete information on helical springs ever published, and in the most useful and compact form; and all the working instructions are given on the back of the rule, together with the formulæ on which the scales are based.

The rule is of substantial construction, and is faced with celluloid, which protects the scales from abrasion and dirt; the cursor is made of a single piece of celluloid. We have made trial calculations which fully bear out the claim made for facility of working. We understand that the firm is prepared to make rules to specification for any special purpose.

Incidentally, we may remark that cardboard slide-rules of standard pattern are on the market, and can be obtained from Messrs. Halden & Co., Ltd. They form excellent substitutes for the more expensive rules.

A Portable Electro Hydraulic Crane.

Messrs. J. W. Flower & Co., of Wimborne, have sent us particulars of their "Eclipse" portable crane (fig. 1). This is mounted on a cast-iron carriage with swivelled wheels or castors which are mounted on ball bearings to provide easy movement. On this carriage a cast iron pillar is erected inside which is fitted a hydraulic cylinder free to revolve on a ball bearing. Three double action pumps are mounted inside the base of the pillar, and these are driven through machine-cut worm gearing by an electric motor. The pumps send oil from a reservoir through a control valve operated by a handle. The position of this handle decides whether all, part, or none of the pumped oil goes to the hydraulic cylinder. Oil entering the cylinder forces up the ram and jib, and raises the load. To lower, the oil is allowed to return to the reservoir. The dimensions of this crane are as follows: Length of jib, 3.5 ft.; height of ram lowered, 9.5 ft.; height of ram raised to full extent, 13.5 ft.; lift of chain hook, 12 ft. The crane can be made to lift 7, 10 or 20 cwt.

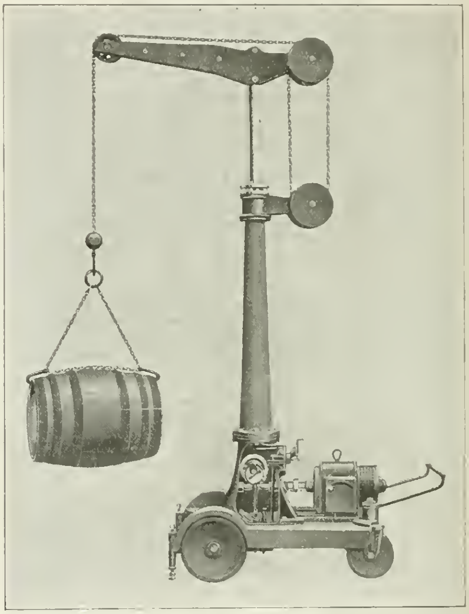

Fig. 1.—Portable Electro-Hydraulic Crane.

The lifting and lowering rate can be varied between an almost imperceptible motion and a speed of 50 ft. per minute. Overpumping and overloading of the motor is prevented by automatic relief valves.

A New Wiring Connector.

The N.V. Electriciteits Maatschappij Electrostoom, of Rotterdam, refer to a wiring connector recently described in this column (April 15th, 1921, p. 477), and draw our attention to what they claim to be a cheaper connection designed on similar lines which they have recently placed upon the Dutch market. This consists of a red fibre insulating cup, the bottom of which is solid with a bushed "blind" hole. In this hole a spring is fixed. In jointing, the ends of the wires are twisted together (and they have to be twisted very carefully), and are then screwed into the spring which cuts a thread on them and retains them in position. The cup is only ½ in. in diameter and ⅞ in. long, and so there is ample room for three or four of them in an average sized connector box.

LEGAL.

The "Paragon" Patents.

On May 4th, at the Patent Office, the Comptroller-General heard two cases of opposition to the grant of letters patent in connection with the electrical propulsion of ships, locomotives, &c. The first was in respect of an application by Messrs. Brown, Boveri & Co. for the use of a self-starting synchronous three-phase motor with power-factor correction, and the second was in respect of an application by the Oerlikon Co. in connection with the control switchgear for ships and locomotives. Capt. W. P. Durtnall, who opposed the applications, conducted his case in person. In both cases the Comptroller-General reserved his decision.

Keeling & Walker, Ltd., v. Sturtevant Engineering Co., Ltd.

The Court of Appeal recently had before it an appeal by the plaintiffs from an order of a Divisional Court and a decision of an Official Referee who disallowed their claim against the Sturtevant Co. for the alleged failure of a zinc-oxide recovery plant supplied by them. The defendants agreed to supply and erect the plant for £2,725. Plaintiffs alleged when the matter was before the Court, about six months ago, that the plant wholly failed to collect oxide at the promised rate of 250 lb. of fume per hour, and they claimed £8,525 damages. Defendants contended that the claim was barred by the terms of the contract, providing for goods to be returned if not satisfactory.

The appeal was argued before Lords Justices Bankes, Scrutton and Warrington, and judgment was entered for the Sturtevant Co. with the costs of all hearings.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Thermostatic Switches.

At the present time there appears to be a demand for an inexpensive and practical thermostatic switch capable of dealing with from 10 to 20 amperes, and made to operate automatically on and off between ordinary ranges of room temperatures.

I should esteem it very much if any firms manufacturing apparatus of this class would communicate with me.

British Electrical Development Association (Inc.),
J. W. Beauchamp,
Director and Secretary.

London, W.C. 2.
May 20th, 1921.

The Maintenance of Intercommunication Telephones.

With reference to the letter subscribed by the B.E. Co., published on page 635 of your issue dated 13th inst., under the above heading, we beg to point out to your correspondent that we have built up a large connection on trade telephone work.

We, however, do not advertise this branch of our work, owing to the fact that we represent the contractor on his job, and our men are his men while so engaged. Our view of the matter is that no person undertaking trade work should advertise the fact as your correspondent has done.

Surprised.

May 17th, 1921.

Fire Prevention and the Insurance Companies.

I have read with very much interest the article which appeared in your issue of April 15th, and your editorial comments, because there is much to be said, in my opinion, for the views taken by your correspondent.

The very fact that the great majority of insurance companies have combined to form a tariff in protection of their interests certainly gives such companies a bias not to take cognizance of improved fire-prevention appliances until they have been proved over a long period of time to be thoroughly efficacious, and it is only reasonable that the tariff offices should not move until pressed to do so by competition of other insurance companies, by the energy of the makers of such appliances, or by the pressure of public opinion. It must be remembered in this connection that all fire-prevention devices tend to reduce the income of insurance companies. For this very reason, active competition with non-tariff companies (which can take an independent view and can give expression to their opinion without being hampered by the views of more conservative companies) is of distinct benefit to the insuring public. It is true that there have been many absorptions of non-tariff companies during recent years, but we think your correspondent is not correct when he says that the tariff companies have to-day obtained a practical monopoly in insurance matters. There are several strong and vigorous independent companies, with ample resources, outside the tariff ring, which can deal with the largest risks.

With regard to the statistics which are mentioned, of the amount of property protected by automatic fire alarms, and the loss ratio for the last ten years, if these are reliable (and I am not doubting the fact) then the matter calls for very serious reconsideration.

Speaking for this company, I can say that we shall certainly take steps to get into touch with the actual facts as mentioned, and we are prepared to consider, immediately, special terms for premises so protected. I do not think that insurance companies, as a whole, need fear the result of any investigation by the Royal Commission which has been appointed to inquire into the existing provisions for the avoidance of loss by fire.

Having regard to the enormous liabilities which are carried, the margin of profits shown in the accounts of the companies proves that moderate premiums are, on the whole, charged, but the difficulty which those firms who take the keenest interest in fire prevention have to face is that their specially good risks are not always recognised by adequate reductions in premiums on account of the tariff regulations above referred to.

It is surely in the hands of the traders themselves to see that competition has full play.

In short, the trader has only himself to blame if he does not take advantage of the independent advice and consideration which only a non-tariff office can give.

The English Insurance Co., Ltd.,
Percival J. Alexander,
Managing Director.

London, E.C. 2.
May 20th, 1921.

[Our correspondent remarks that "all fire-prevention devices tend to reduce the income of insurance companies"; they tend, to a still greater degree, to reduce the *outgoings* of the companies—hence the special terms that can be offered to properly protected risks.—Eds. Elec. Rev.]

The Grading of Mains Engineers.

I do not propose to make any attempt to justify my position as a mains engineer to please two disgruntled charge engineers, but I should like to make one or two comments.

First, with regard to those elusive B.th.u.'s. Unless the ignorance of "P. S." is abysmal, he must realise that it would be of no avail to obtain the highest possible efficiency in the station if the units generated were allowed to run to waste unchecked, through the numerous channels that there are in every mains system. The losses in the mains are not all leakage-to-earth losses, as some seem to imagine.

Secondly, I would tell a true story: A charge engineer, and a very good one at that, was offered the position of mains superintendent on the undertaking at which he was employed. He was willing to accept on one condition, and this condition in his own language was as follows: "Supposing I make a b . . . s of the job, shall I be able afterwards to go back to my old job?" He was informed that that could not be promised as someone else would be appointed in his place; and, easy and simple as is a job as mains superintendent, that charge engineer would not take his chance, and to-day is still on shift.

Thirdly, and most important of all, what brilliant reasoning leads either "N. B." or "P. S." to think that the ideal method of airing their grievance, if they have one, is to write to you, who, beyond backing the E.P.E.A. handsomely in their efforts to obtain an adequate remuneration, have no interest whatever in the salaries schedule?

If these men are E.P.E.A. members, it is about time that they learnt that the only way to obtain redress is through the Association itself, and if they are not satisfied with their present representatives on the N.E.C., or their present section or divisional officers, why, in the name of goodness, do they not themselves do a little of the work or elect others who will suit their requirements?

Merely a Mains Engineer.

May 23rd, 1921.

My colleagues and I, all charge engineers and members of the E.P.E.A., have read the letter of "P. S." with the greatest satisfaction, but up to now have not followed up the matter, hoping that more able and fluent pens than ours would receive a "brain wave."

Now that charge engineers are learning to what extent the "mains," heads of departments, and lesser "fry" have gained under the schedule, they are beginning to realise how badly they have been sold. When one considers that charge engineers comprise from 30 to 40 per cent. of the E.P.E.A. membership, it is easy to see why the official body of that organisation has now got the "wind" so badly over the "grading" question.

Without the charge engineers, nine out of ten stations cannot be run, and without the support of the "charge men" the "mains," heads of departments, &c., cannot hold what they have obtained in such bad faith. Hence their now frantic efforts on the re-grading question, with the knowledge that the E.T.U. are proposing a special section and programme for that body of men. The quaint fact of it is, the E.T.U. have already got in the thin end of the wedge with the sub-station men, and many charge engineers are already scenting the finer fruit offered in that quarter, and a quarter, too, be it remembered, where it is not *infra dig.* to accept payment for work done, as at present under the sickness clause charge engineers, as a body, can have no sympathy with the putrid sentiment of "Professionalism"—they have been starved too long, and are still "that bottom dog." They can still afford to leave such beautiful ideals to the I.E.E., with the comfortable knowledge that it is no disgrace to be paid for honest work.

While on the subject of the schedule, we should like to give some instances brought to our knowledge of the way in which this has been interpreted and "operated" upon. First, the six-day week has been seized upon to provide a petty form of promotion for the "pets." The regular men certainly get relief, but on what days?—none on night shift, only on evenings and days, in order to provide a soft job for the "pet." And so the poor charge engineer has to work a seven-day night shift once in three weeks, instead of a six-day shift once a month.

Secondly, the holidays. Men are asked to take their holiday at any odd time between May and October inclusive. May we ask all chiefs who may happen to read this to look up the National Joint Council's definite statement for shift workers?

When more prosperous days arrive, we engineers have made up our minds to quit this mess of pottage.

In conclusion, we are tempted to ask what becomes, eventually, of 99 out of every 100 charge engineers; are they found a job in the office to fill their declining years, or is an outsider put there, and the poor forsaken charge engineer—sacked?

Three Charge Engineers.

May 23rd, 1921.

I am in entire agreement with the remarks of your correspondent "P. S." in the current issue of the REVIEW.

The charge engineer is by no means the bottom dog in the electricity supply industry, and by the grade he is allocated it is evident that he was not represented when the E.P.E.A. salary schedule was drawn up.

In stations up to Class F and G, what are the positions from Grade 3 to Grade 8? I am sure a good number of engineers would be interested to know what these four grades are, and what they are designated.

The shift man seems to have been entirely forgotten by the Schedule Sub-committee. He is not the fortunate individual to be continually under the observation of the chief engineer, but has to rely on himself in all cases of trouble, and it is when trouble occurs that the chief or his assistant realises that the undertaking has been running— evenings, nights, and during week-ends, under the supervision of the charge engineer, and possibly a little more trouble during these times would bring the shift engineer more to their notice, and his grading more into ratio with his arduous duties and responsibilities, and gain for him a little more appreciation.

I have no desire to belittle the responsibilities of the mains engineers, as I feel sure that the majority of them agree that the grading of the charge engineer is a disgrace to our association and the profession.

As an after-thought, and a loophole for wangling, more grades have been introduced into the schedule, but again the same indifference is shown to the shift worker, as Grade 8a and 8b might very well have been over and above Grade 8.

Had the schedule been submitted to the members before acceptance, I think that shift engineers would have had more to say regarding their grading, and although we are promised great changes, I think it time the grading of the charge engineer should be altered, to at least G. 4, and the A, B, C business entirely abolished.

Unity.

May 23rd, 1921.

Cables for Hot Situations.

Your contributor "Two-Phase" recommends C.T.S. cables for hot situations; while this type may be more suitable than V.I.R. in conduit, please note that we do not consider it so satisfactory as lead-covered cables to withstand heat.

While we have never heard of any trouble arising from C.T.S. in hot situations, we know that the sheathing, however suitable for other conditions, will sooner or later be affected by a high degree of heat continuously applied, and we think it only right to give this fact equal publicity to the recommendation made of it.

St. Helens Cable & Rubber Co., Ltd.,
J. H. C. BROOKING,
General Manager.

Warrington.
May 21st, 1921.

Conservative Methods.

I was very interested in reading "Twice Shy's" criticism of conservative methods of packing, whereby fragile goods are packed in cases which must be almost smashed open before the goods can be released.

With the very bad handling which goods are now receiving *en route* by rail and steamer, firm and adequate packing is more than ever necessary, but this should also focus more attention on the method employed. Every removable batten, pad, and wedge requiring pinning in position, should be screwed and not nailed, and, when empties are returnable, the case lids should also be screwed—with stout screws having plenty of grip. An important though fairly obvious point to be remembered is that wherever possible all the removable screws in a case should be of one size.

As regards returnable cases, there is another side to the question, and it is this: The consignee should, on receipt of a screwed case, recognise that it indicates a more expensive mode of packing, and treat it accordingly. "Twice Shy" evidently would do so; Mr. "Work Shy" would not, and does not. I have carefully designed such cases for many years for our consignments of recording instruments, thermometers, &c., but when the cases have been inspected on return from their first journey, they have often been found to have been opened and closed again very roughly. The lids, naturally not a universal fit, but carefully marked with the "way round," have often been replaced another way and the halting screws driven in with a hammer.

There is certainly room for a great improvement in casing goods. One can see how seldom screwed cases are used when one orders some from his packing-case makers, and notes their surprise, and the poor job usually made of the screwing. Packing-case makers do not employ a cabinet-maker, but apparently they could employ, say, one carpenter to great advantage.

Walker, Crosweller & Co.

London. W. CROSWELLER.
May 23rd, 1921.

A Peculiar Phenomenon.

In reply to "H. E.," the following remarks may assist him in finding the reason of the different luminous effects in his X-ray tubes.

The X-rays, it must be understood, play little or no part in the fluorescence of the glass. This fluorescence is produced by reflected cathode rays which proceed from the anticathode and produce a luminous hemisphere in the glass.

These cathode rays or electrons are due to ionisation of the gases within the tube, and are the means of our getting the X-rays. They are affected by electric and magnetic fields, and "H. E." will observe that on bringing a magnet near an excited X-ray tube the luminous effects on the glass will move as the magnet's position is changed or poles reversed. (The magnet should be suitably constructed.)

The difference in colour is caused by small quantities of different chemical substances in the glass.

Apple-green fluorescence is very common in X-ray bulbs, being due to the presence of manganese, and makers often add a small amount of manganese dioxide so as to yield this colour.

The bluish fluorescence is characteristic of bad and lithium glasses, whilst yellow-green indicates that soda glass has been used.

In marked contrast to the ordinary X-ray tube is the Coolidge tube, in which the vacuum is 1,000 times or so higher than that found in gas tubes, the discharge being conducted by electrons given off from the hot tungsten filament, and not by ionisation of the air left in the tube; the glass walls do not show fluorescence except perhaps a slight illumination in the anode neck or a minute chip in the glass gives rise to a momentary flash as also will a small evolution of tungsten vapour.

This absence of illumination is due to the formation of a negative layer on the inside of the tube, thus preventing the glass from acting as a target to the cathode rays.

C. R. Chadfield.

Melton Mowbray.
May 14th, 1921.

Architects versus Electrical Engineers.

In view of the forthcoming discussion at the I.E.E. on May 31st next, would it not be opportune to raise the question of nomenclature?

For instance, anyone gifted with a certain amount of gumption recognises the architect as a person who is acting in a professional capacity, and therefore is neither commercial nor contracting, being entirely distinct from the builder, both in actual title and functions.

Turn up Whittaker's, and you find the architect's figures under "Professional Fees." Now look for the fees of a kindred profession, consulting electrical engineers. Apparently a nonentity. Perhaps the granting of a Royal Charter may remedy this omission.

Sad to relate, although we find that surveyors, architects, and others can glean such information from their professional handbooks, the well-known "Electrician Blue Book" gives no information, so far as I can gather.

But stay, the Blue Book is a *Trades* directory, and although it gives two lists—consulting electricians and consulting electrical engineers (the necessity for these two different titles I fail to understand by the way)—it may be contended that it is strictly for the use of the trades and not the profession.

Think of the variety of titles. Besides the last two mentioned we have illuminating, constructional, contracting, installation, and, plain, electrical engineers.

There is no clean cut as in the case of Architect *v.* Builder. And now we are faced with, probably, Chartered Electrical Engineer!

One wonders whether the Institution of Electrical Engineers will attempt to remedy the state of affairs in the first place by approaching the Royal Institution of British Architects, under the plea of professional etiquette, to bind its members to the practice of seeking the advice and guidance of those who act in a similar professional capacity to them on the electrical side.

A contractor complained to me recently that he was persuaded by an architect to visit a country house as it was a hardly big enough job for a consultant. Consequently the architect received his advice free of charge, and the contractor came away empty-handed!

I mention this because the contractor will equally benefit by some such arrangement with the R.I.B.A. as will keep each individual in his proper sphere of action.

The architect's clients would immediately benefit by the results of competition alone.

They would realise that they had obtained the best, the most efficient equipment, at the lowest possible price. Result: Satisfaction all round, and the prestige of both the architect and his professional electrical colleague enhanced.

Consultant? A.M.I.E.E.

May 20th, 1921.

The Training of Kinema Operators.

I have noticed with great interest the correspondence in the Electrical Review on the subject of the training of kinema operators, and was specially struck by the letter of "An Electrician Operator," who deplores the lack of training amongst kinema operators. He further expresses his great regret that there is no practical handbook in print on the subject.

I am glad to say that I have recently purchased a new handbook on the subject of kinema operation, which appears to me to be an excellent work, admirably suited for the instruction of young operators or even to improve the knowledge of men of some years' experience.

This book contains the practical knowledge that is necessary for successful kinema operation.

It deals in a non-mathematical manner with the mechanical and optical properties of the projector and with the motor, dynamos, and electrical instruments or parts comprised in the operation of supplying light to the lantern, and also the mechanical manipulation of the parts of the lantern and films.

The book costs the popular price of 4s. 6d., and can be thoroughly recommended to the trade. It is published by Messrs. E. & F. N. Spon, Haymarket. Author, Mr. Ibbetson.

H. M. K. McPherson.

London.
May 17th, 1921.

Copper Losses in a Three-phase Motor Stator.

I read with much interest Mr. Nash's article on a method of determining the copper losses in a three-phase alternating-current stator. However, it may be of some importance to remark that the copper losses calculated according to this method would not be the same as those which really arise in a three-phase stator. As a matter of fact in 50-cycle machines the copper losses when determined in another way, for instance, by determining the short-circuit losses, would appear to be 15 to 30 per cent. (or even more) higher than those found by Mr. Nash.

The fact has been overlooked that the alternating-current resistance of a winding is not the same as the direct-current resistance of the same winding. This is due to the eddy currents which are energised in the copper by some of the leakage lines of force, and the factor which must be introduced to take into account. This difference is, therefore, different for all machines, and different also according to the load of the machine in this way, that the alternating-current resistance increases when the load decreases.

In testing small three-phase machines, I myself found that this factor could reach a value of 1.4 and even 1.6. In any case, whatever three-phase machine it may be, the copper losses will be at least 15 per cent. higher than those calculated according to Mr. Nash's method, and it might be advisable to multiply the so found amount of losses with a factor of at least 1.15 to obtain a more exact result.

N. A. J. Voorhoeve,
Electrical Engineer of Delft University, Holland.

May 16th, 1921.

Charging for Idle Current.

When writing my letter of the 2nd inst., I was certainly under the impression that the tariff outlined in Prof. Kapp's letter of the 14th ult. was his own, but I note from his letter in reply that the tariff is one instituted by a leading power supply undertaking. Prof. Kapp asks how I would apply the principle of a bonus for leading power factor under the Midland tariff which I advocate. The Midland or two-part tariff, kVA charge plus running charge, involves the use of two separate meters, and if a bonus for power factor is necessary, the following is what I would suggest:—

For recording the unit consumption an ordinary cosine or kilowatt-hour meter would be required.

For ascertaining the kVA demand whether unity, lagging, or leading, a sine meter would be installed to record the component of the load which is 90 degrees out of phase with the voltage, either leading or lagging. This meter would be arranged to run, say, in a forward direction with lagging component, when it would run in a backward direction with leading component. Two trains of gears each fitted with recording mechanism would be fitted and each arranged with a ratchet mechanism so that in the forward direction of rotation the lagging train of gears would operate and the leading train free-wheel and *vice versa*. Each train would be fitted with a Merz demand dial (with time-setting period of, say, 15 minutes) to give a reading in kVA demand. By this means the dial fitted to the train operating in a forward direction would give the resultant average kVA demand lagging, and the train running in the backward direction the resultant kVA demand leading. These two indications of demand would be separate and distinct, so that at any time the maximum demand lagging or leading which occurred during the period could be ascertained. Although the *integrations* as shown on the dials giving kilovoltampere-hours of the reactive and capacity components respectively would give some approximate indication as to the time period when the demand was leading or lagging respectively, I confess that I cannot see how the charge could be equitably adjusted as between lagging and leading. In fact this problem appears to become somewhat complex. Perhaps one of your readers can make some useful suggestion on these lines.

I wish to make it quite clear that in suggesting that a bonus for leading power factor is desirable, I did not wish to convey the impression that all supply companies would welcome such a charge, as in many cases a leading power factor would be very undesirable from the point of view of the supply undertaking. There must, however, be a number of instances where the opposite is the case.

Reverting to the tariff set out in Prof. Kapp's letter of the 14th ult., which differs from the above-mentioned tariff in that it is based on *integrations* only of the cosine and sine meters (and not on kVA demand and units), whilst with this system of charge the policy of bonus for leading power factor may be easily applied, I do not consider it commercially sound, as it would compel the supply authority to prohibit the use of static condensers for the improvement of power factor in other than load hours, and this might be difficult to enforce. In explanation I give the following example (figures are approximate only):—

Taking a demand of 50 kW at 70 per cent. p.f. = 71.5 kVA and eight hours a day steady load for 25 days—

Cosine meter records 10,000 units.

Sine meter records 10,200 apparent units.

Now if a static condenser of 17 kVA be connected to the circuit permanently, *i.e.*, 24 hours a day, it will take 17×24 (hours)×25 (days) = 10,200 apparent units at zero p.f. leading, which, as will be seen, exactly neutralises the lagging apparent units as given above, with the result that the sine meter would read zero, and the consumer would be assumed to have run the whole time at unity power factor. Actually during the load period the power factor with the condenser in circuit would have been raised from 70 per cent. to 82.5 per cent. only, *i.e.*, the demand would be 60.5 kVA and not 50 kVA, as would be assumed by the supply authority charging under such a tariff. It is for this reason that I consider the tariff commercially unsound.

Referring to Mr. J. D. Watson's letter of May 8th, could he give one or two practical examples (actual results preferred) showing how his method is applied and justified? Personally, I cannot agree with the principle that the running or unit charge should vary with the power factor, as for all practical purposes the only additional extra running costs due to low power factor are those represented by a small percentage increase in losses.

I maintain that a multi-tariff based on kVA demand and running charge per unit consumed is the only just and commercially sound basis to work upon, and this is the tariff which is being increasingly adopted by the leading supply undertakings.

E. W. Dorey.

London.
May 23rd, 1921.

Direction of Rotation of a.c. Motor.—"Inquirer" desires to thank Mr. S. S. Pilgram for the answer to his query.

Coal Supplies.—Priority List.—The Government has arranged to import coal to meet the essential needs of the country. Arrangements have been made through four firms which are acting as Government agents, and have been given instructions that they are to dispose of the coal only to consumers in accordance with a priority list, which places them in four main groups—namely:—(1) Railways; (2) public utility works, including electricity works; (3) domestic and household purposes; and (4) food producing and preserving concerns.

BUSINESS NOTES.

Bankruptcy Proceedings. — P. DOWNIE, electrical engineer and factor, 355A, Westborough Road, and 88, Ronald Park Avenue, Southend-on-Sea. Receiving order made May 18th, on creditor's petition.

H. E. CARR, electrical contractor, Carlisle Street, Goole.—Receiving order made May 13th, on debtor's own petition. First meeting, May 27th, at the Station Hotel, Goole; public examination, July 7th, at the Court House, Wakefield.

W. A. DAVIS, electrical engineer, late of 3, Coronation Street, Farnley, Leeds.—First meeting, June 2nd; public examination, June 21st; both at Leeds.

ALFRED JOHN HARRISON, electrical and gas engineer, trading as the Xtra Lighting Co., 4, 5 and 6, Old Market, Sunderland, Durham.—The public examination of this debtor was held recently at the Court House, John Street, Sunderland. According to the statement of affairs, the gross liabilities amounted to £422, of which £381 was expected to rank for dividend, and there were no assets. Debtor attributed his failure to slackness of trade, heavy living expenses, and cost of putting his property in order. The examination was adjourned.

Company Liquidations.—AMPERE ELECTRICAL ENGINEERING AND PLATING CO., LTD., South Shields.—The creditors interested herein were called together recently at the offices of Messrs. Hannay & Hannay, solicitors, Bank Chambers, Fowler Street, South Shields. The company had previously gone into voluntary liquidation. According to the statement of affairs presented by the liquidator, the liabilities amounted to £1,828, of which £1 227 was due to the trade, while the bank were scheduled for £501. The balance of £100 was in respect of other claims which had not yet been admitted. After allowing £4 for preferential claims, the assets were estimated to realise £586, or a deficiency of £1,242. It was reported that the company was formed in November, 1919, with a nominal capital of £3,000. The issued capital was £1,300, which was fully paid. The loss on the profit and loss account for the three accounting periods totalled £1,511. It was pointed out that being a comparatively new concern, the company had to purchase its initial stock and equipment at the highest prices. As a result it was now suffering owing to the exceptional conditions of the market. The bank had been guaranteed by the directors. A resolution was passed confirming the voluntary liquidation of the company, with Mr. Hammond as the liquidator and it was suggested that he should realise the estate either by private treaty or public auction.

AMALGAMATED ELECTRICAL WORKS, LTD.—Winding up voluntarily; liquidator, Mr. J. L. Mahon, Windsor House, Kingsway, W.C. Meeting of creditors called for May 31st, at Winchester House, E.C.; particulars of claims, &c., should be sent to the liquidator by June 18th.

R. B. HAND & CO., LTD.—Meeting of creditors June 2nd, at 175, Lavender Hill, London, S.W. 11. Liquidator, Mr. P. J. Hooper

GRONDAL KJELLIN CO. (1917), LTD.—Meeting of creditors June 1st, at 20, Abchurch Lane, E.C. Particulars of debts, &c., to be sent to the liquidator, Mr. F. W. Paddon, by June 18th.

Dissolution of Partnership.—ALLPORT & DAVIES, motor, electrical, and agricultural engineers, Underhill Street, Bridgnorth. Messrs. J. H. Allport and H. Davies have dissolved partnership.

Trade Announcements.—MESSRS. MAURICE & COWARD, of 139, Oxford Street, W. 1, have been appointed sole selling agents for Messrs. Townshends, Ltd., heating and cooking appliance manufacturers, Ernest Street, Birmingham, and have an extensive range of samples on view at their showrooms in London.

THE ELECTRICAL SPECIALITIES CO., LTD., of 21, Woodstock Street, London, W. 1, now have the telephone installed at their London office: "Mayfair 5603." Their London telegraphic address has been changed to "Dunspecos, Wesdo."

MR. LOUIS H. EULER has been appointed joint managing director of the Saxonia Electrical Wire Co., Ltd., Greenwich, manufacturers of flexible wires and cables. Mr. Francis S. Thomas, the founder of the company, still continues chairman and managing director.

THE STERLING TELEPHONE AND ELECTRIC CO., LTD., 210-212, Tottenham Court Road, W. 1, inform us that they have commenced the manufacture of electric lamps and horns for motor cars on mass-production lines.

By arrangement with United Water Softeners, Ltd., Mr. J. J. Lassen has taken over the meter department of that company, and has formed it into a separate concern under the style of the LASSEN METER AND ENGINEERING CO., Holders Hill House, Hendon, London, N.W. 4, which is specialising in the manufacture of the Rheograph water-flow recorder and Lassen patent tipper meter for boiler installations.

MR. T. ACKROYD, electrical engineer and contractor, has opened business at Unicorn Passage, Burslingate, Bradford.

Catalogues and Lists.—MR. ALBERT MORGAN, A.M.I.E.E., 138, Gower Street, W.C. 1.—Two illustrated leaflets dealing respectively with wall cranes and lift and crane controllers.

MESSRS. J. W. FLOWER & CO., Eclipse Works, Wimborne.—Two well-illustrated publications describing "Eclipse" electro-hydraulic portable cranes.

MESSRS. MAURICE & COWARD, 139, Oxford Street, W. 1.—An illustrated and priced catalogue of "Calor" electric cooking and heating appliances, including toasters, kettles, hot-plates, irons, &c., manufactured by Messrs. Townshend's, Ltd., of Birmingham.

MESSRS. SIEMENS BROTHERS & CO., LTD., Caxton House, Westminster, S.W. 1.—A set of four catalogues of artistic production. No. 600 is a volume dealing with primary cells and batteries, dry and fluid. The illustrations are very clear, and the details presented are sufficient to give the reader a correct idea of the article described. Many types and forms of cells are dealt with, including Leclanché with central zincs, agglomerate six-rod type, and "sack" form; Daniell cells of the original pattern, Minotto pattern, Meidinger or "balloon" form, Callaud type, and numerous other designs; and also Bunsen and bichromate cells and accessories and materials for all types. Catalogue No. 531 A deals with Leclanché fluid cells and batteries, and is equally clear as regards illustrations and details. No. 531 B is devoted to various forms of Leclanché cell and dry batteries, and includes cycle and motor-cycle lighting sets. No. 537 is a catalogue of many types of dry cells and batteries, including "inert" cells.

MR. J. W. BARNARD, 4, Great Winchester Street, E.C. 2.—Leaflet advertising accumulators, electromedical appliances, X-ray apparatus, &c., as well as an accumulator repair service.

MESSRS. HERBERT MORRIS, LTD., Loughborough, Leicestershire.—Book 90, a catalogue giving illustrations and prices of worm and spur-gear pulley blocks, electric hoist blocks, triple-gear pulley blocks, travelling trolleys, &c.

MESSRS. RICH & BUNDY, 13, New Road, Ponders End, N.—An illustrated list giving details and prices of "Hot-Spot" electric fires, grill stoves, irons, table stoves, kettles, immersion heaters, &c.

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C. 2.—Leaflet F. 2.481, giving illustrations, prices, and a description of the Haydn T. Harrison system of directive street lighting.—Leaflet No. F. 2 451, an illustrated and priced folder of pendants for semi-indirect lighting with gasfilled lamps.

THE RELAY AUTOMATIC TELEPHONE CO., LTD., Marconi House, Strand, W.C. 2.—A well-produced illustrated brochure dealing with the relay automatic telephone system. The description sets out very clearly the simplicity of operation and other advantages of the system.

THE SUN ELECTRICAL CO., LTD., 118 and 120, Charing Cross Road, W.C. 2.—Five illustrated pamphlets dealing with the "A.B.C." electrical "laundress," together with a list of prices of the machine and its accessories.

MESSRS. NEWTON & WRIGHT, LTD., 471-473, Hornsey Road, N. 19.—An illustrated and priced leaflet describing a new radioscopic couch for X-ray treatment and examination.

MEDWAY'S SAFETY LIFT CO., LTD., 1 and 2, Bucklersbury, E.C. 4.—A splendid example of publicity matter illustrating a large number of electric and hydraulic lifts installed for various purposes. The pictures show lifts of excellent workmanship and taste. Controllers are also illustrated and described.

SWEDISH GENERAL ELECTRIC, LTD., 5, Chancery Lane, W.C. 2.—Three illustrated price lists:—No. 41, stock list of d.c. and single-phase motors and d.c. drills; No. 41A, stock list of two- and three phase motors, single phase commutator motors, transformers, &c.; No. 41F, a leaflet dealing with "Century" electric fans.

MESSRS. T. SHEPHERD & CO., 4, Charles Street, Hatton Garden, E.C. 1.—An illustrated catalogue giving full details and trade prices of Bergmann's d.c. and a.c. motors, ranging from $\frac{1}{10}$ to 93 h.p.

STERLING TELEPHONE AND ELECTRIC CO., LTD., 210-212, Tottenham Court Road, W. 1.—Publication No. 297, describing, with illustrations, ships' navigation light indicators for d.c. circuits. Items, which are priced, include fuseboards and alarm bells. Also Publication No. 300, dealing with "Sterling" electric lamps and horns for motor-cars. Illustrated and priced.

MESSRS. GENT & CO., LTD., Faraday Works, Leicester.—Folder 54, giving illustrated and priced details of "Regent" industrial telephones of various patterns.

TWISS ENGINEERING AND ELECTRIC TRANSMISSION, LTD., 62 and 63, Queen Street, E.C. 4.—List T L 3, illustrating and describing Twiss solderless cable connections.

Catalogues Wanted.—MESSRS. RANSON & SPARK, electrical engineers, &c., Victoria Square, Felling-on-Tyne, desire to receive catalogues.

Lead.—MESSRS. JAMES FORSTER & CO., reporting on May 21st, said:—"The London Metal Exchange has had an active week in all metals, the sentiment being 'bullish,' on the belief that stocks in consumers' hands are low, and that with the end of the miners' strike material will be wanted. In lead this is undoubtedly the case, as for a long time past consumers have bought from hand to mouth."

Plant for Perth.—Quoting a local newspaper report, a correspondent says:—"Mr. J. Lambert, Corporation electrical engineer, Perth, has been the means of saving £10,000 in the purchase of new generating plant by advising the committee to go outside the trade ring for their purchases."

Wages, &c., in Czecho-Slovakia.—Owing to the reduction of hours from 48 to 32 per week and a reduction of wages by 10 per cent., 20,000 workmen in the metallurgical industry struck work on May 20th.—*Reuter's Trade Service* (Prague).

Book Notices.—"*Transactions* and Year-Book" of the University of Toronto Engineering Society. April, 1921. Pp. 176. Published by the Society.—In addition to it's being a chronicle of social and athletic events, this publication includes a number of interesting papers dealing with many branches of engineering. Papers on "Switchboards" and "Power Plant Instruments and Meters" are reproduced.

"The *Bulletin* of the Hydro-Electric Power Commission of Ontario." Vol. VIII, No. 1. January-February, 1921.—This number contains a detailed description of the Nipigon development, the first stage of which is nearing completion. It is illustrated by many clear photographs. The "Lincoln" graphic demand meter is described, and notes on "Safety first" are also included.

"The English Electric Journal." Vol. I, No. 6. April, 1921. London: The English Electric Co., Ltd. Price 1s.—This number of the journal deals with the directors' annual report, and includes articles on "Electric Winders," by J. Kirkwood, B.Sc; "The Modern Steam Condenser," by E. R Briggs, M.Inst.C.E.; and "Electric Locomotives for Industrial Purposes."

"The Mining Electrical Engineer." Vol. I, No. 8, May, 1921. Manchester: Association of Mining Electrical Engineers. Price 1s. net.—The papers reproduced in this issue include:—"Coal Cutting by Machinery," by George Mullin; "The Installation of Electric Plant Underground," by James Keir; "The Characteristics of the Multi-speed Induction Motor," by F. Creedy; and "Modern Steam Condensing Plant," by J. McGhee

"Power Factor Correction." By A. E. Clayton. Pp. xii + 108, 36 figs. London: Sir I. Pitman & Sons. Price 2s. 6d. net.

"Heat Transmission by Radiation, Conduction and Convection." By R. Royds. Pp. viii + 238. 102 figs., 27 tables, price 24s; "Heat Transmission in Boilers, Condensers, and Evaporators." By R. Royds. Pp. viii + 302 136 figs., 43 tables; price 21s.; "The Measurement of Steady and Fluctuating Temperatures." By R. Royds. Pp. xii + 162, 82 figs., 4 tables, price 16s. London: Constable & Co., Ltd.

"Science Abstracts, A and B," Vol. XXIV, Part 4 April 30th, No. 280. Price 2s. 6d. each net. London: E. and F. N. Spon, Ltd.

"*Proceedings* of the Physical Society." Vol. XXXIII, Part 3. April 15th. London: Fleetway Press, Ltd. Price 6s. net.

Glasgow Electricians Resume Work.—In accordance with a decision of a mass meeting of the Clyde district members of the Electrical Trades Union, held on May 12th, the men resumed work on May 23rd. The total number of electricians on strike in the Glasgow district was 900. The majority of these, who were employed mainly in the house building trade, had been idle for 11 weeks. The shipbuilding section had been idle for two weeks. Apart from the shipyards, the dispute arose through the Employers' Association giving notice of a reduction of 3d. per hour in wages, which would have made the wages 2s. per hour as from the first week in March.

Postal Rates Raised Again.—The trade of the country is to be saddled with yet one more burden. When will the last increase in business expenses be recorded? The Postmaster-General announced on Tuesday that in order to meet the deficit on the Post Office Services, postal rates will be raised as from Monday, June 13th.

The *Home* postcard rate which used to be ½d, and is now 1d., will become 1½d. Printed papers up to 1 oz. will be advanced from ½d. to 1d., with ½d. for each additional 2 oz. Registered letters will be 3d. in place of 2d.

Foreign postage rises from 2½d. to 3d. for letters, and from 1d. to 1½d. for postcards. Printed papers will be 1d. for every 2 oz., instead of ½d., and commercial papers will be 1d. for 2 oz., instead of ½d., and the minimum will be 3d. Samples will be 2 oz. 1d. (instead of ½d.) with a minimum of 2d.

Letters for the British Empire and U.S.A. will remain at 2d. for the first oz., but 1½d. (instead of 1d.) will be charged for each additional oz.

Manufacturing in Holland.—The report of the Algemeene Nederlandsche Electriciteits Maatschappij (late Groeneveld, Ruempol & Co.), of Amsterdam, states that although the turnover at the beginning of 1920 took an upward course, the company suffered from the general depression and the continued fall in the market, thus rendering it necessary for estimates to be based upon the prices of that day in order to be still able to compete. The value of the turnover amounted to 2 500,000 florins, and the orders on hand at the close of the year reached 1,000,000 florins, which has now increased to 1,400,000 florins. It was necessary to raise a 7 per cent. loan for 600,000 florins in order to provide for the completion of the new factory and warehouse, which were now being brought into use. The sum of 527,000 florins has been written off for depreciation, as against 21,900 florins in 1919, and 516,000 florins of the former applies to stocks on which nothing was written off in the previous year. The final result of the year has been a loss of 1,480 florins, this comparing with a distribution at the rate of 12 per cent. on share capital of 1,500,000 florins in 1919.

New Zealand Customs Tariff.—In February last Sir W. Peter Rylands, on behalf of the 18 000 British manufacturers in the Federation of British Industries, addressed a letter to the Prime Minister of New Zealand, requesting that, in the proposed revision of the Customs Tariff, British goods imported into New Zealand should be accorded a continuance of the preferential treatment at present in operation. The Rt. Hon. W. F. Massey has now replied from Wellington, giving the assurance that, when the new tariff is being framed, the interests of British industries will not be overlooked.

The British Engineers' Association.—The annual general meeting of this Association took place at 32, Victoria Street, London, S.W.1, on Thursday, May 12th. At a meeting of the Council of the Association that followed, Mr. Nevile Gwynne, late chairman of the Executive Committee, was elected President of the Association, in place of the retiring President, Colonel O. C. Armstrong, D.S.O., who had occupied the position of President for three years, and to whom a very hearty vote of thanks was accorded. Mr. E. W. Petter was elected chairman of the Executive Committee in succession to Mr. Nevile Gwynne.

Demand for Power in China.—After approximately nine months of quiescence, signs are not wanting of a revival in the demand for power plant in China. From the middle of 1919 to the summer of 1920, says the *North China Daily News*, a great number of orders for power plant for all purposes were placed—for cotton and flour mills, silk mills, tramways and electric light works. The south of China was not especially active, and the further cities in the west showed few signs of industrial awakening. Changsha was slightly interested in cotton mill machinery, but, generally speaking, the wealthier communities beyond Hankow confined their enterprises to electric and tramway undertakings. In the north, enterprise was very pronounced, for instance, in Tsingtao and especially Tientsin, while Manchuria, particularly Dairen and Harbin, ordered much machinery. In common with other articles of commerce, machinery felt the slump in exchange badly, and consequently it was not surprising to find that orders fell away almost completely during the last six months of 1920. Since then, however, a rather different sentiment has displayed itself, and both in the north and here a distinct inquiry has again been seen for power plant for practically all purposes. More confidence in the future is visible in the north, and seeing the large profits which other industrial concerns are making, the Chinese are prepared to invest larger sums in such undertakings. In the meantime a considerable amount of the power machinery is coming forward, although labour conditions, both in Europe and America, have delayed deliveries to quite a considerable extent. With reference to the machinery ordered during the twelve months between 1919 and 1920, it is highly satisfactory to know that well over 75 per cent. of the boiler plant was of British manufacture. In this line of engineering the United Kingdom has always been pre-eminent, a fact which is fully appreciated by the Chinese, so much so that even to-day in quoting for power requirements, German agents are still looking to Great Britain to a considerable extent for boilers. The contracts for boilers have in some instances been very large. In addition, Great Britain took an ample share in orders for other machinery, and besides cotton and other mills, contracts for tramway and electric light installations have been placed with British firms. —*Reuter's Trade Service* (Shanghai).

The Coal Dispute.—The substitution, or partial substitution of oil burners for coal firing apparatus in power stations proceeds in all parts of the country. Estimates of the cost of substitution show wide variations. For instance, the cost of converting a boiler as an experiment at Aberdeen was recently given as £30. At Dundee the cost of conversion, according to the engineer's estimate, would be from £2,000 to £2,500. The number of boilers is not stated, but upon the same basis as the Aberdeen figure this sum would cover the expenditure upon 80 boilers. The estimated cost of conversion at Swansea is £1,000; the capacity of the Swansea station is about half that of the Dundee undertaking.

A peculiar kind of reserve is being utilised at Bradford. Over £20,000 worth of small coal lay in the filter beds at the Corporation sewage works, where it served as a filtration medium. The quality of this coal was found to be practically unimpaired, and the greater part of the 14,000 tons has now been removed to supply the electricity and gas works.

Despite the "embargo" placed upon the importation of foreign coal by the National Federation of Transport Workers, supplies are coming in at a fairly rapid rate, although the cost has in many cases been increased by delay in off-loading at the ports. Nevertheless, the Federation officials declare themselves satisfied with the results of their restrictions.

The strike at the L.C.C.'s Greenwich station continues, but the substitute labour has kept the London tramways running. Seeing that their action was having little effect the trade unions concerned, induced the United Vehicle Workers' Union to ballot upon the question of withdrawing drivers and conductors from cars kept running by power supplied by means of "blackleg" labour. The result was an emphatic vote against the course suggested.

Further restrictions upon the use of electricity have necessarily been imposed. In Birmingham low-pressure supplies have been cut off between the hours of two and seven p.m., and it is significant, in view of the oft-repeated assertion that this has become a pleasure-loving country, that the onus will fall most heavily upon the proprietors of theatres and kinemas.

The "live" registers of the Employment Exchanges show an ever-increasing growth of unemployment. The *Morning Post* quotes figures showing that during the week ended May 13th, 63,600 persons were added to the total, making it 1,990,700. Persons on reduced wages owing to curtailment of working hours numbered 1,129,400.

Cape Town Contractors.—A deputation representing the Electrical Contractors' Association, the Electrical Trades Union, and the Building Trades recently waited upon the Administrator for the purpose of supporting the proposed Ordinance for the registration of electrical contractors and the licensing of wiremen. The deputation was well received by His Excellency, and informed that the Ordinance was being put forward immediately.

Wire Production in Russia.—Work in connection with the electrification of the Northern railways of Russia has produced a great demand for small gauge wire, the reserves of which are remarkably small in Russia at the moment. In order to increase the supply, the cable factory of Petrograd has been re equipped and started to work. This factory can produce 270 poods of wire per day.

Summer Sports.—The Social and Athletic Club of Electrical Installations, Ltd., opened their cricket season on Saturday, May 7th, at their grounds at Perivale, Middlesex. They were successful both on that date and on May 14th. Last Saturday, 21st inst., they were playing a match against the General Electric Co., Ltd., Athletic Club.

Oil Fuel.—Messrs. Johnson & Phillips, Ltd., Charlton, S.E. 7, advise us that they have now converted their boiler plant to burn oil instead of coal. They have ample stocks of raw material, and will, therefore, be able to continue full supplies to their customers of all their products (cable switchgear, transformers, instruments, &c.), no matter how long the coal stoppage may last.

Ericsson Losses in Russia.—An Exchange telegraph dispatch from Copenhagen credits the Gothenburg *Handelstidning* with stating that the L. M. Ericsson Co., the Swedish manufacturers of telephone apparatus, is considering the desirability of writing off about 50,000,000 kroner in respect of losses in three associated companies in Russia. The share capital of the Ericsson Co. is 73,260,000 kroner, and it has a reserve of 9,820,000 kroner.

Trade Conditions in Australasia.—Although merchants do not expect an early improvement in turnover, a more cheerful feeling prevails in trading circles. The tone on the Stock Exchange is also brighter. Similar reports are to hand from Sydney. The local metal market is quiet. Goods from overseas are arriving more rapidly than they can be absorbed. Business is quieter in New Zealand, and there is a continuance of heavy importations. The building trade is picking up. Hardware prices have dropped. American plain wire is quoted at £30 per ton, but an improvement in demand is setting in. There are indications that the Japanese trade boom in New Zealand has definitely ended.

The banks are maintaining credit restrictions. Merchants anticipate that business will improve after June. The financial stringency is very real. Reports from Auckland show active trade in necessities with numerous reductions in price.—*Reuter's Trade Service* (Melbourne).

The "Paragon" Super-Diesel Engine. — Captain Wm. P. Durtnall, the inventor of the above new engine, informs us that he has made manufacturing arrangements with one of the largest Diesel engine manufacturers in Europe to make these engines for general industrial purposes. It is stated that this engine is lighter, cheaper, and has a higher thermal efficiency than the ordinary Diesel type ; it is of the multi-cylinder type, and has no flywheel. The exhaust temperature and pressure are very much lower, and the engine may be installed in situations where the ordinary engines are barred. The engines will be placed on the British market by the Piggott Electrical Co., Ltd., of 24, New Bridge Street, London, E.C. 4.

E.D.A. Activities.—E.D.A. 160, just issued by the Electrical Development Association, Hampden House, Kingsway, W.C. 2, is a card entitled "Seed Time." This represents the Association as sowing the seed of electrical progress, the results of which will be a rich harvest for industry. It points out that the greater the support given by manufacturers, the greater will be the outcome in the future. Apathy only results in "weeds and tares."

We have also received a publication, "Electricity on the Farm," by Mr. R. Borlase Matthews, A.M.I C.E., M.I.E.E. (E.D.A. 161). This deals with such questions as cost and efficiency. The number of applications electricity can find in farming is legion ; Mr. Matthews gives a long list of them. The concluding remarks answer the questions regarding the way to obtain a supply of electricity—if there is an undertaking operating in the neighbourhood.

Inquiries.—The name and address of the manufacturers of "A.R.A.R." electric lamps (presumably Dutch) are required.

The correct address is required of a firm in London and Birmingham whose initials are O. G. & Co., and who are makers of vibrators, &c.

Copper.—The Wallaroo copper miners have agreed to a temporary reduction of wages and it is now hoped that the mines will reopen shortly.—*Reuter's Trade Service* (Wallaroo, S.A., May 2nd).

Hungary.—The first calcium carbide factory in Hungary has just been started by the Ungarische Allgemeine Kohlenbergbau Gesellschaft at their power station at Tatabanya in Fellsö Galla. The factory is equipped with a 700-kVA single-phase furnace, to yield 80 wagons of carbide yearly. Three men working 10 hours a day, and four working eight-hour shifts, suffice to man the factory. The output it is estimated will cover one-fourth of Hungary's total consumption of carbide.

International Exhibition at Lima.—In connection with the International Centenary Exhibition to be held at Lima, in July, the Peruvian Government has informed the Consul-General for Peru that manufacturers' goods, including machinery, &c., intended for exhibition purposes will be admitted free of Customs duties and Consular fees.—*Reuter's Trade Service.*

German Exports Indemnity.—Reuter's correspondent in Berlin says it was officially announced that the German Government had decided to indemnify exporters in paper marks for the levy imposed by the Entente States on German exports.

Engineering Wages.—A deputation of representatives of the Amalgamated Engineering Union and the National Federation of Engineering Trades attended at the Ministry of Labour, on May 20th, to state their case for a Court of Inquiry under Part 2 of the Industrial Courts Act into the employers' demand for a reduction of wages, affecting about one million skilled and semi-skilled workmen. The deputation was received by Sir David Shackleton.

China.—A new electric company has recently been established in Shelwei, a salt centre in Yangchow. All departments were to start work on March 20th, 1921.

International Exhibition at Belgrade.—The *Journal* of the Royal Society of Arts states that an international exhibition will be opened at Belgrade in June, under the auspices of the Museum of Industry and Commerce of that city. The Serbian Government has placed at the disposal of the promoters an area of 20,000 sq. metres (about five acres), and the necessary work is in progress.

Swedish Telephone Manufacturing.—The fusion of the L. M. Ericsson Telephone Co. and the H. T. Cedergren Telephone Manufacturing Co. has now been effected. One share in the Cedergren Co. will equal 10 shares in the Ericsson concern, or Kr. 500. The fusion will be reckoned as from January 1st, 1921.—*Reuter's Trade Service* (Stockholm, May 22nd).

Revision of Spanish Customs Tariff.—A totally new scale of Customs duties is in force in Spain from 21st inst. The old regulations have been revised in every tariff, the new ones including considerable increases over those now revoked. Although the new tariffs are already in force, there are excepted from its regulations, with regard to goods from Great Britain and the British Empire, all merchandise with a bill of lading in which it is stated that they left the country of origin before 21st inst., but that document must be *visé* by the Spanish Consuls. Goods which were awaiting release by the Customs Houses on 21st inst., and those in bond which are to be declared for consumption within seven days from the day on which the new Customs duties came into force, are also excepted from the new regulations. It is advisable for every British firm dealing with Spain to consult with the Spanish Chamber of Commerce (40, Trinity Square, E.C. 3), about the amount of the duties, which in some particular cases are lower than in the preceding tariffs.—*Reuter's Trade Service.*

Copper and Lead Prices.—Messrs. F. Smith & Co. report May 24th :—Copper (electrolytic bars), £77, £4 increase ; ditto sheets, no change ; ditto wire rods, £93, £4 increase ; ditto h.c. wire, $11\frac{5}{8}$d., $\frac{1}{16}$d. increase ; silicium bronze wire, 1s. 4d., $\frac{1}{4}$d. increase.

Messrs. James & Shakespeare report May 24th :—Copper bars (best selected), sheet and rod, £116, £2 increase ; English pig lead, £25 5s., 5s. increase on last week's quotation.

Coming Reduction in Petrol Prices.—*The Motor* learns on good authority that a considerable reduction in the price of petrol is imminent, owing to the large stocks held in this country. Imports have recently exceeded those of any previous period. The reduction, it is thought, will probably be as much as 1s. per gallon, bringing the price to within the region of 2s. 6d.

Chinese-German Relations.—A treaty putting an end to the state of war and re-establishing diplomatic and commercial relations between China and Germany was signed, says the *Daily Mail*, at Peking on May 20th.

Large Lamp Contract.—The General Electric Co., Ltd., has received a half-yearly contract for the supply of metal, gasfilled, and carbon-filament lamps to H.M. Office of Works. The contract runs into many thousands of lamps.

U.S. Electric Motor Exports.—Exports of electric motors from the United States in 1920 were valued at $13,420,076. In 1919 the total was $10,635,476. Canada was the largest buyer in both years, taking 18 per cent. of the motor exports in 1920, and 15 per cent. in 1919. Japan came second in both years, and England third.—*Reuter's Trade Service* (Washington).

Irish Railways and the Bill.—As Mr. J. W. Hill pointed out at the annual meeting of the Dublin and Lucan Electric Railway Co., the plan adopted for the British railways cannot meet Ireland's needs. It would simply mean that the majority of the Irish lines would be compelled to close down before the end of the year. The circumstances of individual concerns must be considered, and all of them must receive fair treatment. One great danger is that the Government may try to leave the final settlement to the phantom Council of Ireland. Any suggestion to that effect must be resisted strenuously. The final settlement must not be delayed beyond the appointed day.—*Irish Times.*

The Electricians' Wages Dispute.—The outcome of the Blackpool conference of the Electrical Trades Union, referred to in our last issue, was the issue of instructions to the men on strike to resume work at the reduced wages, pending the next meeting between the employers and the E.T.U. Consequently work was resumed on May 23rd, and we are informed that the meeting of the two sides of the industry is to be held on May 31st. As a result of the dispute, we learn that dissensions have arisen within the E.T.U., and that developments of a startling nature are on the way.

English Electric Shield.—Mr. John Sampson, C.B.E., one of the directors of the English Electric Co., Ltd., has offered a shield for annual competition by physical training teams representing the various works of the company. Major the Marquis de Bucy, Director Physical Training, War Office, has consented to act as judge in the competition.

LIGHTING AND POWER NOTES.

Australia.—Perth.—The accounts of the Government's electricity undertaking for the financial year 1919-20 show a total revenue of £119,656, as compared with £102,774 in the previous year. Working expenses amounted to £74,216 as against £58,652, leaving a gross profit of £45,440 (£44,122). The net result was a profit of £18,093.

Barnsley.—Cost of Electricity.—In presenting the annual report upon the electricity undertaking, the chairman of the Electricity Committee spoke of protests by consumers against charges twice those prevailing before the war. He reminded the Council that coal was costing about 425 per cent. more, and wages 180 per cent., in addition to the increased cost of money. Having due regard to these facts, he considered it rather to be wondered at that electricity was so cheap. They were enabled to sell at such a price because of improved efficiency by which coal consumption had been halved.

China.—Railway Co. to Install Electric Plant.—The Tientsin-Pukow Railway Co. has decided to install an electric plant at a cost of $900,000 at Pukow.—*Reuter's Trade Service* (Shanghai).

Coleraine.—Electric Lighting Scheme.—The Urban Council has agreed that the laying of the mains in connection with the public electric lighting scheme should be completed within six months from September next. Messrs Curran Bros., Belfast, the chief contractors, hope to complete the whole of the electrical installation in 10 months unless prevented or delayed by some unforeseen circumstances.

Colwyn Bay.—Loans.—The Council is applying to the Electricity Commissioners for sanction to borrow £25,000. This will be lent to the North Wales Power Co. to defray the cost of erecting transmission lines to Colwyn Bay from the Dolgarrog station. Sanction is also being sought to the borrowing of £48,348 for the provision of mains, sub-stations, &c.

Continental.—Russia.—The Electricity Bureau of the Soviet Government reports that there are at present in Russia, including what are termed the autonomous territories, 643 electrical stations, of which 246 are in country districts. The scarcity of fuel still presses on present and immediately prospective industry in Russia; so much so that it has been decided to close certain power stations in Petrograd between May 5th and August 15th, solely for the purpose of economising fuel. Advantage, however, will be taken of this enforced idleness to have the stations completely overhauled and put into good running condition.

Greece.—The water resources of Greece have recently been the subject of a detailed survey by a Swiss engineer, appointed by the Government, with the object of their utilisation for the production of electricity. According to the report presented, the waterfalls of Western Macedonia are capable of yielding 350,000 h.p., equal to a yearly output of 120,000,000 kWh. This energy would suffice for the needs of the cities of Athens, Salonica, the Piræus, and the Larissa railway. The cost of installation is reckoned at 180,000,000 drachmas. The use of water power would free Greece from the need to import coal, and would tend vastly to develop the native industries.

France.—The central station of the Société de l'Electricité de Valenciennes-Anzin, which was seriously damaged during the war, has been completely reconstructed, and is now in full working order.

Electric steelworks and furnaces, over 100 ft. long, were carried away by a formidable landslide of rocks at Allevard, Isère, recently. The damage reaches several million francs.—*Evening Standard.*

Derby.—Cause of Fire.—Later reports concerning the fire which broke out at the power station on May 13th (Electrical Review, May 20th), indicate that it was due to the bursting of an oil-cooled transformer which had been in service for 12 years. Many cables and a switchboard were damaged, and the replacement and repair of these occupied a great deal of time.

Dundee.—Oil Fuel.—At a meeting of the Electricity Committee on May 17th, the question of using oil fuel at the power station was discussed. The engineer said that at present prices, and estimating that 70 tons of oil could do the work of 100 tons of coal, the cost would be respectively £490 and £300 for those quantities. The cost of fitting oil burners would be between £2,000 and £2,500. In the circumstances it was decided not to proceed further, as considerable expense, which would have to be met by higher charges, had already been occasioned by the coal dispute.

Edinburgh.—New Sub-station.—A new electric sub-station is to be constructed at Causewayside from plans prepared by Sir Alexander B. W. Kennedy.

Electricity District. — Mid-Lancashire.—The Electricity Commissioners give notice that the time within which objections and representations may be made, and schemes submitted, in connection with the above named district has again been extended from the last day of this month until July 30th, 1921.

Glasgow.—Dalmarnock Station.—On May 11th an additional 18,750 kW Metropolitan-Vickers turbo-generator set was put into operation at the Dalmarnock station. Since the station was started, many economies have been effected in the generation of electricity. In the older stations the average coal consumption per kW-hour generated was 3·42 lb.; at Dalmarnock this figure has been reduced to 1·71 lb. In this way it is estimated that a saving of £62,784 has been made. In addition to the economy in fuel consumption, charges for coal and ash-handling, and wages have been reduced considerably.

At the Port Dundas station oil fuel burners have been installed on one or two boilers, and an extension of the system is being considered.

Grampian Scheme.—Postponement.—The Grampian electricity supply scheme is to be held over, the promoters having decided not to proceed with the Bill this year.

Hamilton (N.B.).—Extensions.—The Electric Lighting Committee is carrying out extensions consisting of new cables and pillars, costing £6,000.

Herne Bay.—Revocation of Order.—The Ministry of Transport has revoked the Herne Bay Gas and Electricity Order, 1913. Similar action has been taken with regard to the Mid-Sussex Electric Lighting Order, 1913.

Heywood.—Year's Working.—The past year's working of the electricity undertaking of the Corporation has resulted in a profit of £829. In the previous year the profit was £841.

Hull. — Extension of Supply.—In connection with the arrangement under which the Corporation is to supply electricity to Hessle, the City Electricity Committee has acceded to a request to light those streets in which electric mains are laid, and to charge no more than the current rate for gas.

Ipswich.—Loan.—After a long discussion at a recent meeting of the Town Council, the Electricity Committee was given permission to apply for sanction to borrow £20,000 for mains extensions, £5,000 for consumers' services, and £5,000 for meters, &c.

Kilmarnock.—Extension of Area.—The Corporation is applying to the Electricity Commissioners for permission to extend its area for the supply of electricity. The new area includes the important burghs of Ardrossan, Saltcoats, and Kilwinning.

Leicester.—Protest Against Restrictions.—A correspondent, signing himself "Manufacturer," writes to the *Leicester Mail* protesting against the restrictions which have been imposed upon the use of electricity for power purposes, while gas has been exempted. He says:—"Many progressive manufacturing firms have discarded gas and replaced it by electricity—a cleaner and healthier method of working. Why these firms and their workpeople should be penalised by the change when both gas and electricity are supplied by the same authorities, is a question that at this time many are asking, and one that requires some explanation and readjustment."

Leith.—Electrical Pumps for Dock.—The Prince of Wales's Dry Dock will be out of service for the next six or eight weeks, as the steam pumps are being replaced by electric pumps, which are to be operated by power supplied from the Commissioners' own power station. The cost will be approximately £4,000.—*Scotsman.*

London.—St. Pancras.—The chief electrical engineer has recommended the installation of a number of mercury-vapour rectifiers. It is proposed to obtain them from Switzerland, and the engineer and the chairman of the Electricity Committee are to visit Baden for the purpose of inspecting rectifying plant in operation.

Battersea.—The Electricity Committee recommends the provision of an additional ·5 sq. in. concentric feeder to cope with the increasing supply of electricity to the north-western part of the area. The estimated cost of the cable is £1,126.

Hammersmith.—The Borough Council is recommended to apply for sanction to borrow £2,500 part cost of laying a duplicate main between the Hammersmith and Fulham generating stations under the Battersea-Fulham-Hammersmith linking-up scheme.

Stoke Newington.—The Electric Lighting Committee reports the receipt of sanction to borrow £9,934 for the extension of mains and services.

Mytholmroyd.—Electricity Supply.—The Council has decided that it cannot at present approve of a draft agreement with the Yorkshire Electric Power Co. for the lighting of public lamps. It was decided to support the application by the Electrical Distribution of Yorkshire, Ltd., for a special order authorising that company to supply electricity within the Mytholmroyd urban area, on the understanding that Caldene Avenue was included in the area of supply; that the charges were reasonable in comparison with other districts; and that supply would be given as early as possible (a verbal assurance of a supply in August having been given).

Newcastle (Staffs.).—Year's Working.—The accounts of the electricity undertaking for the year ended March 31st last show a total income of £20,817, as against £16 810 in the previous year. Working expenses amounted to £15,984, as compared with £11,992, leaving a gross profit of £4,833 (£4,818). After payment of income-tax, interest charges, &c., the net result was a credit balance of £1,365, from which a deficit of £864 brought forward was deducted.

Rathmines (Dublin).—Strike.—The electricity supply remains suspended, owing to a strike of Council employés on a question of working hours.

Reading.—Low-grade Fuel.—The Reading Electric Supply Co., Ltd., has issued a notice to consumers stating that the poor quality of the low-grade refuse coal being supplied may necessitate temporary suspension of supply. In this event consumers are asked to make sure that all switches are immediately switched off.

Salford.—New Generating Set.—On May 9th, the Mayor, members of the Council, and many leading citizens visited the Frederick Road works to inspect the new 5,000-kW turbo-alternator supplied by the Metropolitan-Vickers Electrical Co., Ltd. The Mayor started up the set, and afterwards presided at a dinner at the Town Hall, when Alderman Worsley, in a speech, described the wonderful progress of the electricity department. The new set is designed to run at a speed of 3,000 r.p.m., and gives a three-phase, 50-cycle supply at 6,600 V. The steam consumption varies from 12·75 to 13·92 lb. per kWh, at full and half loads respectively. The rated power of 5,000 kW is given at 0·8 p.f.

South Africa.—Durban.—The accounts of the electricity undertaking for the year ended July 31st, 1920, show a gross profit of £65,399.

Southampton.—Extensions.—At a meeting of the Corporation on May 18th, the Electricity Committee recommended the acceptance of a tender for the construction of boiler foundations, &c., at the electricity works at a cost of £14,570, subject to the sanctioning of a loan of this amount by the Electricity Commissioners. Negotiations are to be entered into with the Eastleigh and Bishopstoke Urban District Council which requires a supply of electricity from Southampton as an alternative to setting up works of its own. The Pirelli-General Cable Co., Ltd., is establishing a factory at Eastleigh.

Swansea.—Oil Fuel.—At a meeting of the Electricity Committee the borough electrical engineer reported at length upon the question of utilising oil fuel at the electricity station in an auxiliary capacity to coal. He was authorised to make inquiries as to the working of similar plant elsewhere.

United States.—Power Company Statistics.—In an interesting article upon the American and Canadian electricity undertakings during 1920, the *Electrical World* gives figures indicating the magnitude and rapid growth of this important industry. A list is given of 80 companies which had outputs exceeding 100,000,000 kWh, and nine of these supplied more than 1,000,000,000 kWh each during the year. The Niagara Falls Power Co. heads the list with an output of 2,328,326,064 kWh, and the next in order is the Commonwealth Edison Co. with 1,883,570,000 kWh. This last company also had the largest simultaneous load—478,820 kW.

TRAMWAY AND RAILWAY NOTES.

Australia.—Brisbane.—In connection with the proposed purchase of the Brisbane tramways by the Government, Mr. J. S. Badger, manager of the Brisbane Tramway Co., recently said that the future of the tramways was very much in the hands of the Government. He denied that the company was holding up the Government for a high price. A figure much less than £3,000,000 had been suggested as a basis of negotiation, but if the parties could not agree about the price there was nothing to prevent the Government going ahead and acquiring the undertaking at once. Negotiations had not been broken off nor had an extension of time been granted the company.—*Daily Telegraph* (Sydney).

Bournemouth.—Year's Working.—The report of the general manager of the Corporation tramways for the year ended March 31st last, shows a total revenue of £196,833, compared with £190,028 in the previous year. Working expenses amounted to £152,044, as against £114,271, leaving a gross profit of £44,789 (£75,757). After crediting bank interest and debiting loan charges (which were heavy on account of the cost of reconstruction) and taxes, the result was a net deficit of £14,868. The number of car-miles run increased from 1,684,874 to 1,857,576, and the number of passengers carried from 27,080,255 to 27,403,523.

Brazil.—Electric Locomotives.—The *Railway Review* states that the first Baldwin-Westinghouse freight locomotive for the Paulista Railway Co., in Brazil, has been completed and tested. The passenger locomotives are now nearing completion. These locomotives are to be used in main line freight service on the Paulista Railway, which is a broad gauge trunk line through the most prosperous and productive part of the State of Sao Paulo. The freight locomotives for the Paulista Railway weigh 105 metric tons, and have six driving axles, each equipped with one 280-h.p. d.c. motor, arranged for operation with two motors in series on the 3,000-V line. They are designed to handle trailing loads up to 700 metric tons over a line having a maximum grade of approximately 2 per cent.

Continental.—France.—The Valenciennes section of the Société des Chemins de Fer Economiques du Nord, which was seriously damaged during the war, has now been repaired, and nearly the whole system is again in working order. The lines cover a distance of about 38 miles, of which 22½ miles have been electrified, while arrangements are in hand for the electrification of the remaining steam-operated portion.

Demerara. — Car Construction. — The Demerara Electric Co., which operates a tramway service in and around Georgetown, is now constructing its own cars in the Colony. Native wood, for which British Guiana is famous, is used for the purpose. Already 16 such cars have either been rebuilt or constructed at the company's works.—*Times Trade Supplement.*

Edinburgh.—Tramway Electrification.—The Tramways Committee has decided that the work of erecting the overhead equipment for the electrification of the tramways is to be done by the Council's own department.

Egypt. — Cairo Strike Riots.—On May 18th, at Shoubrah, a bomb was thrown at a volunteer tramwayman. Nine persons, including three policemen, were injured. The incident was the outcome of the resentment felt by the strikers against the loyal workers and volunteers who are assisting in keeping the public service running.—*Morning Post.*

Falkirk. — Broken Trolley Wire. — An overhead electric wire at Falkirk snapped and fell on the top of a tramcar. One of the passengers, a nurse, was struck across the face and badly burned, and a soldier, in order to get clear of danger, jumped from the top of the car, fracturing an arm and spraining an ankle. With great presence of mind, a miner who was on the car rolled his handkerchief tightly round his hand, and seizing the live wire, threw it over the side of the car.—*Daily Telegraph.*

Glasgow.—Oil Fuel.—The Tramways Committee has authorised the manager to have one of the boilers in Pinkston power station altered as an experiment in connection with the proposed introduction of oil fuel.

Huddersfield.—Year's Working.—The accounts of the tramway undertaking for the year ended March 31st last record a total income of £275,407, as compared with £261,147 in the previous year. Working expenses amounted to £242,033, as against £217,526, leaving a gross surplus of £33,374 (£43,620). Loan interest, taxes, &c., totalled £34,135, making the net result a deficit of £761; last year a net profit of £485 was made.

Leeds.—Restoration of Services.—As a result of the adoption of oil fuel at the generating station, practically the full tramway service has been restored on most routes, and on May 23rd running was resumed—partly in full and partly restricted—on the routes on which services had been entirely suspended.

London.—Oil Fuel at L.C.C. Station.—Replying to a question put to him at a recent meeting of the L.C.C., Mr. Squires, chairman of the Highways Committee, said that hitherto the use of oil fuel at the Council's Greenwich station had not been considered an economic proposition. The coal dispute had altered the perspective, and the installation of oil fuel burners was now receiving careful consideration.

Bank Holiday Record.—In spite of the coal dispute, Whit Monday proved to be a record day for the L.C.C. tramways. It is reported that about 2,000 000 passengers were carried, and fares totalling £19,000 were paid.

Oldham.—Offer of Purchase.—The directors of the Oldham, Ashton, and Hyde Electric Tramways, Ltd., report that an offer to purchase the system for £125,000 has been received, and they recommend acceptance by the shareholders. This has since been agreed to.

Southport.—Accident.—An electric tramcar, which was descending Eastbank Street Bridge, on Whit Monday, ran into a cab, which was overturned. There were three passengers in the latter, two ladies and a gentleman, but, fortunately, no one was hurt.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—Telephone Service.—An application has been made by Mr. J. Duncan, of 136, Danks Street, Albert Park, Melbourne, for the patent rights for a device which he has invented with a view of saving the time of subscribers to the telephone system. It is claimed that when the device is attached to a telephone it may be adjusted so as to automatically notify the Exchange when the subscriber is out. By this means other people calling for his number can be immediately notified by the Exchange that the subscriber is absent, and they need not waste their time waiting for replies to their calls.

"I must have £1,721,000 this year if the telephone service is to be put on a decent footing. There is no shortage of material now." So said Mr. J. M. Crawford, State electrical engineer of the Postal Department, in giving evidence on March 21st, before the Federal Public Works Committee. The department's engineer added that £2,500 a year would be saved if workshops on modern lines were constructed. A staff of 300 men engaged in the workshops turned out work valued at £60,000 a year. Switches for Queensland were made in New South Wales. Everything was in readiness for the establishment of two new city exchanges. But work could not proceed without approval, and had to remain in abeyance until Parliament met. "Expenditure in my branch has dropped from £620,000 to £250,000 a year, but still I am expected to maintain a standard the same as that existing before the war." Mr. J. M. Paxton, president of the Chamber of Commerce, urged the construction of a Sydney-Brisbane trunk telephone line. It would, he said, be a distinct gain to the commercial community and be extensively used.

Greenland. — Meteorological Station. — Lieut.-Col. E. Gold, assistant director of the Meteorological Office, reports that it has been decided to establish a wireless station in Greenland fo daily weather reports. Another development expected in the near future is the establishment of daily weather communications between Britain and Canada.

Ireland. — Wireless Station Attacked. — Dublin Castle reported that at midnight on May 16th fire was opened on the wireless station and the naval wharf at Kingstown. Troops returned the fire, and after an exchange of shots lasting half an hour, during which reinforcements were landed from destroyers in the harbour, the attackers were dispersed.

Luxemburg.—Trunk Telephone Cable.—The installation of an armoured trunk telephone cable 22 miles long has recently been completed between Luxemburg and Diekirch for the Luxemburg Posts and Telegraphs Administration. The cable is a composite one of 36 pairs in multiple-twin formation, and is balanced and loaded for phantom working. It is the first trunk telephone cable to be installed in the Grand Duchy, and is particularly interesting on account of the extremely low values of cross-talk which have been obtained, a very high standard in this respect having been called for. Freedom from cross-talk depends very largely on the skill and care which are exercised in the joining-in of the loading coils, as well as on the balancing of individual loading-coil sections. On loaded lines in this country the coils are usually connected up by the Post Office, so that contractors obtain very little experience of this work, but in this case it was carried out under the supervision of Messrs. British Insulated and Helsby Cables, Ltd., who did all the testing and were responsible for the final results. The loading coils were of the latest dust-core type, and were supplied by the Western Electric Co., Ltd., Woolwich.

On the completed cable, the values of cross talk obtained in any quad, the unit of measurement being one-millionth of the electromotive force applied to the interfering circuit, were as follows:—

Average of all quads, 50 between side circuits and 105 between side and phantom circuits. The three greatest values were 130, 130, 120 between circuits, and 350, 250, 200 between side and phantom circuits.

There is no doubt that this cable far excels any other cable on the Continent in freedom from cross-talk, and Messrs. British Insulated and Helsby Cables, Ltd., are to be congratulated on having achieved this success for British industry.

Orkney Isles.—Proposed Telephone Service.—The secretary to the Orkney Branch of the National Farmers' Union of Scotland, has been informed by the Edinburgh G.P.O. that the Department has promised to make a canvass for subscribers as soon as the present exceptional pressure of telephone work has been dealt with, and that a list of the names and addresses of prospective subscribers would be helpful. A telephone exchange at Kirkwall was an essential preliminary to the linking up of the rural districts with the town. The tariff rental was £1 17s. 6d per quarter for circuits within one mile of an exchange; but a higher charge would be necessary, unless a considerable number of persons rented circuits. Calls would be charged at 1½d. each, with additional fees for connections to exchanges beyond five miles. Agreements would be for an initial term of three years, and quarterly thereafter. It would not be possible to provide telephone connection with the mainland of Scotland.

Railway Wireless.—Mr. Kellaway informed the House of Commons on May 10th that the Midland Railway Co. and, in the case of the London and North-Western Railway Co, the Marconi Co. had been given permission to conduct wireless telegraphic experiments on those two systems. The permission was temporary and could be withdrawn whenever it was considered desirable. The wireless on the railways was to be used solely for the company's business. Wireless was used by the railways during the last railway strike.

Russia.—The "Simuraphon."—Some days ago, at the general meeting of the Russian Society of Road Engineers, the engineer Ap. Phedoroff-Lukoyanof reported on his invention for telephoning any distance through ordinary railway telegraph wires. He calls his apparatus the "Simuraphon," and claims that it is adaptable to wireless telephony over unlimited distances with the aid of a special high-speed generator. He proposes the "substitution of the voltaic arc usually employed" and a special dynamo machine. The "Simuraphon" can, it is said, be connected to any telegraph station, and opens a way to new fields in radio-telephony.

Telegrams Accepted.—The Postmaster-General gives notice that telegrams for all parts of Russia (including Russia-in-Asia as far east as Lake Baikal) are now forwarded over the Anglo-Russian Government cable between Peterhead and Alexandrovsk in Northern Russia, but can only be accepted at the sender's risk. The rates are 5½d. a word for ordinary telegrams and 1s. 4½d. a word for telegrams sent by the "urgent" service. Telegrams can also be forwarded under the same conditions by the Great Northern Co.'s route *via* Libau (Latvia) at 6d. a word for ordinary telegrams and 1s. 6d. a word for "urgent" telegrams.

Spain.—Telephone Service.—A commission appointed by the Spanish Government is visiting Stockholm in order to investigate and report on the Swedish telephone system and Sweden's manufacturing capacity in this line. It is possible that the Spanish Government may enlist the assistance of the leading Swedish telephone concerns, Messrs. L. M. Ericsson and H. T. Cedergren, for the rebuilding and reorganisation of the Spanish telephone system.—*Reuter's Trade Service* (Stockholm).

South Africa.—Telephone Service.—The *British South African Export Gazette* hints to manufacturers of telephone and telegraph supplies that even at the present time the South African demand is in excess of the supply. Although as much as £532,630 has been spent by the Union Government on developing the telephone service since the Armistice, well over 2,500 long-standing applications for installations are still unfulfilled, and the Government has not lost sight of its previous proposals for new automatic systems at Johannesburg, Cape Town, and Pietermaritzburg. Moreover, although much war-time depreciation has been made good, considerable repairs remain to be done, especially in the country areas, and each week sees heavy additions to the list of districts awaiting telephonic communication with the larger towns. In South Africa, too, the demand for equipment by private consumers, as apart from the Government, is on the increase, and last year the imports solely on this account amounted to approximately £30,800, as against only £17,475 in 1919. Add to this a reminder that on last year's official estimates an item of £600,000 appeared for telephonic improvement, additions, and renewals, and that at least a similar sum is expected from Mr. H. Burton's new estimates, and it will be seen that a market of more than ordinary importance is materialising. British makers have, of course, the additional satisfaction of knowing that their pre-war supremacy, temporarily lost to Sweden, has been regained, and that to-day both the latter country and the United States have very little hold on the trade.

U.S.A.—Wireless Fog Signals.—The Secretary of Commerce announces that in view of the important development of a radio compass by the Bureau of Standards, three wireless fog signals are to be immediately installed at the entrance to New York Harbour. Each of these three stations will be equipped with an automatic set which will send out signals continuously during fog or thick weather which may be picked up on shipboard by means of the new radio compass, which indicates the direction from which the signals are sent out, and by taking observations on the different stations the captain of a vessel may determine his exact position without being obliged to rely on the former unsatisfactory method of locating himself by the sound of whistles and fog horns. The method has been developed as the result of co-operative experiments by the Bureau of Standards and the Lighthouse Service, and more especially through the research work of the Bureau of Standards in improving the radio compass. It differs from all other systems in use for determining radio direction in that the navigator himself can determine radio bearings, just as he uses his magnetic compass for bearings in clear weather, and he does not have to depend upon expert radio operators. The other advantage is that the sending apparatus is easily installed and can be operated by the regular light keepers without any skilled personnel, and that any number of vessels at sea equipped with radio compasses may obtain their position at the same time without interference.—*T. & T. Age*,

Miami Cable Dispute.—The endeavours of the State Department to prevent the Western Union from laying the cable to Miami, on the coast of Florida, from the Bahamas, were expected to reach a climax on May 31st, when the Supreme Court was to decide the issue, says *The Times*. The action of the State Department is due to the fear that, if the cable is laid, the Western Union will be enabled to send American cable traffic over the British cable to South America. All the American cable interests object to this, and a Bill has been prepared forbidding cable landings in the United States except by Presidential licence. The Western Union had a cable ship waiting outside the 3-mile limit in readiness to make a landing should the decision of the Supreme Court be adverse to the State Department. The authors of the Bill, spurred on by the State Department, arranged to rush the Bill on

May 16th through both Houses, and thence on to the White House for the President's signature, before the Western Union could act on the expected favourable decision of the Supreme Court.

Both Houses of Congress have accepted the report of the Conference on the Kellogg Bill, which empowers the President to regulate cable landings in the United States, and the measure now goes before the President.—*Reuter's Trade Service* (Washington).

The *Nacion* comments in an unfavourable strain on the decision of the U.S. Congress to prevent the landing of the cable by the Western Union Co. The article points out that the measure affects the interests of Argentina and other countries in South America, and establishes a far-reaching monopoly in favour of American cable companies. The *Nacion* says that in this and other questions which have arisen recently the United States appears to have taken up an attitude of aloofness from the traditions of international co-operation, and has displayed a Pan-Americanism which has each time been more misdirected.—*Reuter's Trade Service* (Buenos Aires).

The Telephone Service.—The amount produced by the telephones in 1914 was £6,645,464, and in 1920 £9,327,418. Charges of collection in the first case were £5,886,536, and in the second £10,792,580, leaving in the latter a deficit of £1,466,086, says the *Daily Mail*.

Wireless Messages to Ships.—SIMPLIFIED PROCEDURE.—Post Offices in London and the provinces will now accept wireless messages addressed to persons on ships at sea (which are within range of the coastal wireless stations of the United Kingdom), without requiring the sender to specify the wireless station through which the message should be transmitted. This new arrangement removes what undoubtedly has been a serious obstacle to the free use of wireless telegraphy between this country and ocean travellers. The counter clerks in the London and provincial offices have instructions to accept messages for ships of all nationalities provided it is known that those ships can be communicated with direct by the coastal wireless stations of the United Kingdom. The messages so accepted are sent to a "routing bureau" in London, whence they are distributed according to the movements of the vessels to which they are addressed.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia. — MELBOURNE. — June 15th. Victorian Government Railways. 50 oil-immersed single-phase track and signal transformers for power signalling (Contract No. 33,901).*

June 22nd. One electric lifting magnet (capacity ½ ton), one 440-V motor generator.*

June 29th. Supply of 1-ton platform type industrial storage battery trucks, also battery-charging equipment.*

August 10th. 250 core-type impedance bonds for power signalling, with a capacity of 1,000 amperes per rail; also 50 miles of solid insulated copper wire, No. 14 Brown & Sharpe gauge, and 50 miles of solid insulated copper wire, 16 standard gauge.

August 17th. 3,000 sets of renewals for caustic soda primary cells.

August 30th. Board of Works. Four electrical centrifugal pumps, each with a capacity of twelve million gallons daily.

Belgium.—June 30th. Municipal authorities at Lokeren. For an underground system of electricity supply mains. Particulars (15 francs) from the Directeur des Services du Gaz et de l'Electricité de la Ville de Lokeren. Tenders to the College des Bourgmestres et Echevins, Hotel de Ville, Lokeren, by registered post.

June 8th. Post and Telegraph authorities at La Salle Madeleine, Brussels. Telephone cable. Particulars (3 francs) by applying for Cahier des Charges Special No. 605.

Municipal authorities of Ghent. Installation of electric lighting in the sheds of the outer port, the small dock, and the new maritime buildings.

Brighton.—June 7th. Electricity Department. Oil fuel plant. (May 20th.)

Dundee.—June 6th. Electricity Department. One coupled motor-generator, consisting of two interpole machines; motor, 400 V, d.c.; generator, 75 V, 130 amp.; also regulator, 60 to 70 V. (May 20th.)

Glasgow.—May 31st. Electricity Department. Cables (including small i.r. cables and flexibles) and meters for twelve months. (May 13th.)

Greenock.—June 6th. Corporation. Electric lighting work in connection with the Upper Cornhaddock housing scheme (18 tenements and six double cottages). Schedules, &c., from Office of Public Works, Greenock.

Huddersfield.—May 28th. Electric light installation in United Methodist Church and School, Outlane. Mr. F. Roberts, Maplin Lea, Lindley Moor, Outlane.

Lanark.—County of Lanark (District of the Lower Ward). Electric lighting work in connection with housing schemes. Mr. J. A. McCallum, District Clerk. 15, West George Street, Glasgow.

Leytonstone.—June 16th. West Ham Union. Three months' supply of electrical fittings. Mr. T. Smith, Clerk, Board Room, Union Road, Leytonstone, E.11.

Liverpool.—June 6th. Liverpool Overhead Railway Co. Stores, including electrical fittings for twelve months. General Manager, 31, James Street, Liverpool.

London.—SHOREDITCH.—June 7th. Electricity Department. Constructional steel and ironwork building, 20-ton weighbridge, h.p. steam pipes, valves, &c., for Whiston Street generating station. (May 13th.)

New Zealand.—June 28th. Public Works Department. Ten s.p. oil-filled transformers for the conversion of three-phase energy at 50 cycles, the voltage ratio being 50,000/11,000, for Waikato power scheme.*

June 28th. Supply and delivery at Lyttelton of two 50-kVA, two 100-kVA, and two 200-kVA condensers in connection with the Lake Coleridge electric power supply (Section 116).*

WELLINGTON.—June 14th. Post and Telegraph Department. 7,460 lamps, various voltages.*

August 9th. Public Works Department. Suspension-type porcelain insulators for the Waikato power scheme.*

South Africa.—July 5th. Electrification of Capetown-Simonstown and Durban-Maritzburg railway lines.

RHODESIA.—BULAWAYO.—August 3rd. Municipal Council. Electric light and power plant. (See this issue.)

TRANSVAAL.—Rand Water Board. September 9th. Erection of a complete installation of mechanical or other filters capable of filtering 5½ million gallons of water per 24 hours at the Vereeniging main pumping Station (Contract No. 232). Copies of the contract documents may be obtained from the Chief Engineer, Rand Water Board, Johannesburg, upon a deposit of three guineas, but specifications, blue prints, &c., may be inspected at the Inquiry Room of the Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W. 1.

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—MELBOURNE.—Morwell electric scheme. The tender of the American Aluminium Co. has been accepted for aluminium steel conductors at £91,416 at port of shipment. At the present rate of exchange the landed cost in Melbourne will be £30,000 less than the lowest tender for copper conductors. The whole equipment will be manufactured and shipped from Canada. —*The Times*.

Victorian Railways. Accepted:—

Four 4,500-kW converter sets (for Jollmont sub-station), with all accessories, £90,010; extra for magnetic blow-out d.c. brushgear, £1,370; eight 1,000-kW automatic converter equipments for various sub-stations, £92,305; extra for magnetic blow-out brushgear, £1,100.—British Thomson-Houston Co., Ltd. —*Tenders*.

Littleborough.—The Housing Committee of the Urban District Council has recommended acceptance of the tender of E. Taylor & Co. for electric lighting in connection with the housing scheme.

London.—ST. PANCRAS.—Electricity and Public Lighting Committee. Supply of l.p. and h.p. cable, various lengths and sizes:—

Firm.	L.p. cable.	H.p cable.
Hackbridge Cable Co., Ltd.	£9,739	£2,461
Enfield Ediswan Cable Co., Ltd.	10,519	2,682
Siemens Bros. & Co., Ltd.	10,916	2,451
Western Electric Co., Ltd.	10,987	2,429
B.I. & Helsby Cables, Ltd.	11,029	2,461
Johnson & Phillips, Ltd.	11,049	2,481
W. T. Henley's Tel. Works Co., Ltd.	11,118	2,461
W. T. Glover & Co., Ltd.	11,149	2,472
Union Cable Co.	11,341	2,528
Callender's Cable Co., Ltd.	11,605	2,599
Pirelli-General Cable Co., Ltd.	12,163	2,487
Watshams	13,116	2,318
Macintosh Cable Co., Ltd.	12,741	2,728
New Gutta-Percha Co., Ltd.	12,316	4,015

The Committee recommends the acceptance of the offer of the Hackbridge Cable Co., Ltd., at £9,739, for the supply of l.p. cable; and that of the Western Electric Co., Ltd., at £2,129, for h.p. cable.

HAMMERSMITH.—Electricity Committee. 425 house service and joint boxes of various descriptions:—

W. Lucy & Co., Ltd., £369 (recommended).

Mains extension sub-station equipment.

Hammersmith feeders.—Two 150-amp. split-conductor feeder panels, £601; one 2,000-kW splitter panel, £259; one 2,000-kW 2-phase panel, £217; total, £1,077. Kensington feeders. Two 125-amp incoming feeders, £333; two 125-amp. outgoing feeders, £343; one 2,000-kW splitter panel, £216; synchronising gear, £41; two wattmeters, £166; total, £1,099.—Ferguson, Pailin & Co. (recommended).

Eight 250 amp., h.p. switch panels, £276.—Park Royal Engineering Co. (recommended).

Two condensate pumps for Nos. 12 and 15 turbines, £293.—Gwynne's Engineering Co., Ltd. (recommended).

New Zealand. — WELLINGTON. — Municipal Council. Subject to a satisfactory arrangement regarding the proposed loan of £500,000 for electric supply purposes, the Finance and Legal

Committee of the Wellington, N.Z., Council has recommended for acceptance the following tenders :—

Section A—Generator plant, British General Electric Co., £93,675. Remainder of machinery, British Thomson-Houston Co., £77,150.
Section B—Boilers, Babcock & Wilcox, £81,000.
Section C—Cables, Callender's Cable Co., £17,500.
Coal-handling plant, £15,700 ; total, £285,025.

The Electrical Engineer recommended the acceptance of the lowest tender in each section, the list being as follows :—

Section A—English Electric Co., £191,000; Metropolitan-Vickers, £181,000; British Thomson-Houston Co., £186,000; Brush Co., £218,000; British General Electric Co., £172,000.
By selection of the British General Electric Co.'s price for the generator plant and that of the British Thomson-Houston Co. for the remainder of the machinery, the whole will be obtained for £1,175 less than the lowest tender for the whole.
Section B—Babcock & Wilcox, £81,000; Stirling Boiler Co., £82,525.
Section C—Callender's Cable Co., £17,500; British Insulated & Helsby Cables, Ltd., £18,450; W. T. Henley's Telegraph Works Co., Ltd., £17,625; Western Electric Co., £2[illegible],22[illegible]; Siemens Bros. & Co., £19,550; Glover & Co., £20,500; Pirelli-General Cable Co., £18,300; Johnson and Phillips, Ltd., £21,850. —*Tenders.*

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, May 27th. At the Institution, Storey's Gate, Westminster, S.W. At 6 p.m. Special meeting.

Junior Institution of Engineers.—Friday, May 27th. At Caxton Hall, Westminster, S.W. At 8 p.m. "Notes on Electrical Transformer Breakdowns," by Mr. S. A. Stigant.

Physical Society of London.—Friday, May 27th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary meeting.

Royal Society of Arts.—Friday, May 27th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "Industrial (including power) Alcohol," by Sir C. H. Bedford.

Faraday Society.—Tuesday, May 31st. At Burlington House, Piccadilly, W. General discussion on "Physico-chemical Problems Relating to the Soil." Afternoon session, 4.30 to 6.30 p.m. Evening session, 8 to 10.30 p.m.
Wednesday June 1st. Visit to Rothamsted Experimental Station.

Illuminating Engineering Society.—Tuesday, May 31st. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8.15 p.m. Discussion on "The Use of Artificial Light as an Aid to Various Games and Sports," to be opened by Mr. J. S. Dow. Annual meeting.

Institution of Electrical Engineers.—Tuesday, May 31st. At 5 p.m. At the Institution, Victoria Embankment. Annual general meeting, 6.45; special general meeting, 6.30 p.m. Lecture on "Research Work in the United States," by Dr. F. B. Jewett.

Institution of Railway Signal Engineers.—Wednesday, June 1st. At the Midland Grand Hotel, St. Pancras. At 3 p.m. Resumed discussion on "Track Circuit Nomenclature and Track Circuit Record Forms."

Chemical Society.—Thursday, June 2nd. At Burlington House, W.1. At 8 p.m. Ordinary scientific meeting.

Engineers' Club.—Thursday, June 2nd. At the Hotel Cecil, Strand. At 2.30 p.m. General meeting of supporters.

International Rubber Exhibition.—June 3rd to June 17th. At the Royal Agricultural Hall, Islington.

NOTES.

Protection for X-Ray Operators.—The preliminary meeting of the X-Ray and Radium Protection Committee has been held. The Committee is composed of radiologists, physicists, pathologists, and others nominated by the Electrotherapeutic Section of the Royal Society of Medicine, the British Association for the Advancement of Radiology and Physiotherapy, the Institute of Physics, the Röntgen Society, and the National Physical Laboratory, and is under the chairmanship of Sir Humphry Rolleston. The intention of the Committee is to issue very shortly a considered statement as to the urgency of affording adequate protection to the worker, indicating the best means whereby it may be carried out. For this purpose a sub-committee has been appointed. It is the Committee's further intention to collect data bearing on the effect of irradiation, with particular reference to protection ; to carry out special research, if necessary ; to act in a consultative and, possibly, advisory capacity, and to publish from time to time such reports as are considered necessary.—*Morning Post.*

Women Engineers.—The Hon. Lady Parsons presided on May 20th at the general meeting of the Women's Engineering Society. It was stated that the industrial upheavals and consequent depression in trade had not been particularly favourable to the efforts of women to gain a firmer foothold in the engineering world. The most significant sign of the progress made was that practically all the engineering institutions had decided to admit women to membership, provided that they had the necessary qualifications. An increasing number of women were taking an active part in the control of engineering works, and another interesting development had been the formation by members of the society of a small engineering company.—*Morning Post.*

Post Office Managed by Workers.—The annual conference of the Union of Post Office Workers concluded at Edinburgh on May 13th. A resolution moved by the executive proposed to add to the objects of the Union "the organisation of Post Office workers into one comprehensive industrial Union, with a view to the service being conducted and managed as a national guild." Mr. Larsen, who moved it on behalf of the executive, said that when all grades of postal workers were in one Union, they would go to the community and say : "We will take on this job and provide a postal service, running it on democratic lines with the primary object, not of making a profit, but of meeting the needs of the community." The resolution was carried by a very large majority.—*The Times.*

Mme. Curie's Gift of Radium.—Mme. Curie was presented, on May 20th, with one gramme of the precious metal (about $\frac{1}{30}$ oz.), worth £20,000, by the women of the United States. The presentation took place at the White House, in the presence of President and Mrs. Harding, Mme. Jusserand, the wife of the French Ambassador, and Princess Lubomirski, the wife of the Polish Minister. Mme. Curie was accompanied by her two daughters. "We welcome you as an adopted daughter of France, our earliest supporter among the great nations," said the President in making the presentation. "We greet you as foremost among scientists in the age of science, as leader among women in the generation which sees woman come tardily into her own."—*Daily Mail.*

Carnegie Funds Awards to Scientists.—The committee of the Carnegie Foundation met on May 21st at Paris, under the presidency of M. Emile Loubet, the former President, and made the following awards :—

Gold medal to Dr. Infroit, who has had several fingers amputated as the result of disease contracted in the course of his X-ray experiments.

Gold medal and £2,000 to M. Vaillant, head of the X-ray laboratory at the Saltpetriere Hospital, who has continued his work in spite of losing his left arm.

Gold medal to the late Dr. Leray, who died on March 26th from burns contracted during his work on radiology.—*Sunday Pictorial.*

Finsbury Old Students' Association.—In connection with the recently formed Manchester Section of the Finsbury Technical College Old Students' Association, a smoking concert was held at the Grand Hotel on April 29th. Those members who were fortunate enough to be present were treated to an excellent programme, and altogether a most enjoyable evening was spent. Although the membership is gradually increasing, it is felt that it should do so much more rapidly, and to this end any old students desirous of joining the Section are asked to write to the Local Honorary Secretary, Mr. H. F. Coucher, 9, Cartright Road, Chorlton-cum-Hardy, or to Mr. Eustace Thomas.

Appointments Vacant.—Lecturer in electrical science, including electrical engineering science (£300-£350), demonstrator and laboratory assistant, mechanical engineering (£200-£250), for the Birkenhead Education Committee ; e.h.p. plumber-jointer (106s.), for the Newport Borough Council Electricity Department ; electrical engineer and manager, for the Wallasey Corporation. See our advertisement pages to-day.

Educational.—Finsbury Technical College, Leonard Street, City Road, E.C.—Prof. W. H. Eccles, F.R.S., Dean for the session 1921-22. The entrance examination for the forthcoming session will be held on September 20th. Applications for admission should be forwarded to the College by September 15th on forms to be obtained from the Registrar, Leonard Street, E.C. For further particulars see our advertisement pages to-day.

Electrical Trades Benevolent Institution.—We have received a publication embodying the report of the Committee for the year 1920, a report of the annual general meeting, a report of the annual festival held on December 15th, 1920, a list of governors, members, subscribers, and donors, and the rules of the Institution.

An Electricity Advisory Committee.—To enable a closer link to be formed between the Liverpool University and the electrical engineering in the district, there has recently been appointed an advisory committee by the Faculty of Engineering to advise it as to the best course of training for prospective electrical engineers. The committee has just held its first meeting, and in addition to the professors of the Department of Electrical Engineering and the Engineering Faculty, there were also present Mr. H. Dickinson, Liverpool city electrical engineer ; Mr. A. P. M. Fleming, C.B.E., of the Metropolitan-Vickers Co. ; Mr. R. D. Livingstone, of the English Electric Co., Preston ; Mr. B. Welbourn, of the British Insulated and Helsby Cables, Ltd. ; Mr. H. H. Harrison, of the Automatic Telephone Co., and others.

A New Photo-Electric Cell.—The report of the spring meeting of the American Electrochemical Society, appearing in *Chemical and Metallurgical Engineering*, states that B. S. Cushman, of Auburn, N.Y., presented a highly interesting paper, by T. W. Case, on a photo-electric effect in audion bulbs of the oxide-coated filament type. Mr. Case reported that he had been able continuously to record daylight intensity for several months past. The photo-electric effect on barium and strontium filaments in audion bulbs furnishes a current of 100 to 150 micro-A, which actuates an automatic recorder. Mr. Cushman showed two strontium cells, and reproduced on the screen a number of daylight records which had been automatically registered by a Leeds & Northrup potentiometer. One of the cells had almost the same sensitivity as that of the human eye to light. The barium cells are sensitive to the longer rays, the strontium cells to the shorter rays.

Vegetable Electricity.—The inaugural lecture of a series of eight on "Experimental Studies in Vegetable Physiology and Vegetable Electricity" was delivered by Dr. A. D. Waller, assisted by Mr. J. C. Waller, at the University of London, on May 18th. A distinct analogy, said the lecturer, existed between animal and vegetable electricity. He connected a plant by two electrons (*sic*) to a keyboard, submitted it to electrical excitation, and obtained an electrical response. The response of the plant was always in the same direction. The plant was next electrocuted without being destroyed. The lecturer said it would take two hours for the plant to recover.—*Morning Post.*

Report on the Metric System.—In September last we reviewed the report issued by the Metric Committee appointed by the Conjoint Board of Scientific Societies, and pointed out that the report had not been adopted by the Conjoint Board, but was issued solely on the authority of the Committee.

Recently we have received from the secretary to the Committee a "Brief Account of the Report," written by him, and "approved by the chairman for the information of the Press," but not submitted to the Metric Committee. This abstract is a fair one, and we take no exception to its composition; but we do protest against its issue at this time, eight months after the issue of the report, as a result of which it has been dealt with in many periodicals as though it related to a recent report, an impression which is assisted by a covering note which refers to "the report . . . communicated to you some little time ago." Eight months is not a "little time," and whatever the object of the communication, its issue now has the air of an attempt to secure fresh publicity for a document which, even in the first instance, was not approved by the Board.

Service Notes.—Commissioned Electrician J. B. Clough has been posted to the battle cruiser *Hood*, from the 17th inst. Commissioned Electrician T. R. Brotheridge joins the *Defiance* from the battle cruiser *Hood*. Warrant Electrician J. H. Whittaker has been appointed to *H.M.S. Vernon*, for duty with the Royal Navy Torpedo Factory, Greenock. On recommissioning, Warrant Electrician W. H. Smallwood has been appointed to the battleship *Conqueror*. Lieutenant R. Sharp, O.B.E., and Lieutenant E. H. E. Woodward, M.C., Tyne Electrical Engineers, have been appointed temporary captains, from the 12th and 17th ult. respectively, in the Defence Force.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Visit of Dutch Engineers. Under the auspices of the Institution, a party of Dutch electrical engineers is on a visit to this country. The visitors, who are representative of Governmental, municipal, and commercial activities, are Messrs. J. G Bellaas Spruty, G. J. F. Bakker, and C. Noone (respectively president, secretary, and second secretary of the Association of Managers of Dutch Electricity Undertakings), and Messrs. E. van Dijk, E. B. van Doesburgh, H. Lohr, J. C. van Staveren, W. Lulofs, and A. B. van Hamel. A very full programme was arranged. On May 22nd the party arrived, and was conducted to the Hotel Cecil, and in the afternoon the visitors went up-river to Tagg's Island and Weybridge. On May 23rd visits were paid to the I.E.E. Building, St. Stephen's Club, and Henley. Oxford, Eltington Park, and Hereford were the itinerary on the 24th. The next day (25th) the places seen were Shrewsbury and Manchester; and on the 26th various Manchester works were visited, and the day concluded with a dinner given by the municipality. The party returns to London to-day, leaving for Holland to-morrow morning.

Incorporated Municipal Electrical Association.—The President and Council have very carefully considered the possibility of holding the Convention in Dundee and neighbourhood, from June 13th to 17th next, and have reluctantly come to the conclusion that, in view of the conditions prevailing, they have no other course open but to cancel the Convention for this year. The annual general meeting will be held in London on July 22nd, and in order that members may have an opportunity of meeting one another, the Council proposes to hold the annual dinner (to which ladies are invited) on the previous evening.

Institute of Metals.—In connection with the annual autumn meeting to be held in Birmingham from September 20th to 23rd, a Reception Committee has been formed under the presidency of Sir Gerard Muntz, Bart., and an attractive programme has been arranged. This includes a garden party and motor excursion to Warwick, Kenilworth, and Stratford-on-Avon.

The Röntgen Society.—At the general meeting of the Society on May 19th, Madame Curie, of Paris, was elected an hon. member, and the fourth Silvanus P. Thompson memorial lecture was delivered by Prof. A. V. Hill, F.R.S., of Manchester University, who took as his subject "Electrical Instruments and Phenomena in Physiology." The annual general meeting of the Society will be held on June 16th, and the Society's exhibition will be held at the Royal Photographic Society during the whole of June, 1921. It is hoped that a set of prints of outstanding interest will be contributed, and the Council expresses the wish that members will do their best to support it and make the exhibition an unqualified success. The President, Dr. Robert Knox, offers silver and bronze plaques for the best and second-best collection of four prints, the work of an assistant employed at a hospital or working for a qualified radiologist. This section will be open to workers whether members of the Röntgen Society or not. The President of the Royal Photographic Society has consented to judge the entries in this section and his awards will be final.

Royal Institution.—The Friday evening lecture on June 10th will be delivered by Dr. A. G. Webster, on "Absolute Measurements of Sound." An extra discourse will be given on June 17th by Sir J. J. Thomson, on "Chemical Combination and the Structure of the Molecule."

Wireless Societies.—The Wandsworth Wireless Society has just been formed, with headquarters at the Wandsworth Technical Institute, the Governors of which have offered the use of the physics laboratory for the work of the Society. Mr. F. V. Copperwheat, 9, Birdhurst Road, Wandsworth, has been elected secretary, and a general meeting of the Society was to be held at headquarters this evening (May 27th), when Mr. D. N. Griffiths, B.Sc., A.M.I.M.E., was to preside.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Hammersmith Borough Council Salaries and Wages Committee has had under consideration the recommendation of the Electricity Committee on the subject of increasing the salary of the borough electrical engineer, Mr. G. G. Bell. In 1919 the Council approved the application of the formula of the A.M.E.E. (Greater London) with regard to his remuneration, which yielded approximately £1,200 per annum; at present it is slightly below this amount. Having regard to the growth of the undertaking since the electrical engineer's salary was last revised, the schemes which the Council adopted for the extension of the generating plant and mains without the assistance of a consulting engineer, and the reduction in generating costs effected by the use of powdered fuel (which reductions will be increased as the plant is extended), the Electricity Committee is of opinion that the basic salary in the formula should be increased from £750 to £900, the rest of the formula to be applied as at present, subject to the provision that the total remuneration shall not exceed £1,500 per annum without the position being further reviewed. By this variation, the present salary would be fixed at approximately £1,330 per annum. The Salaries and Wages Committee recommends that the remuneration should be increased as proposed.

At the conference of the Electrical Trades Union, at Blackpool, on Saturday, a gold watch was presented to Mr. J. W. Ball, of Manchester, by Mr. Humphries, of London, in recognition of 20 years' service to the Union. The conference decided against affiliation with the Third International.

Hammersmith Borough Council Electricity Committee has appointed Mr. C. E. Acock to the position of engineer-in-charge, and Mr. F. V. Jordan assistant mains engineer. The total number of applications were 68 and 39 respectively. Mr. Acock has since intimated his inability to accept the appointment.

Mr. Cyril Morgan, late of the Newport Corporation electrical staff, has gone to Madras to take up an appointment.

Mr. A. E. Val Davies has resigned his position as assistant city electrical engineer to the Cape Town Municipal Council, and has been appointed consulting electrical engineer to the Pretoria Portland Cement Co.

Mr. A. S. Benni, vice-chairman of Messrs. Ercole Marelli & Co., S.A.I. Milan, and a director of Messrs. Ercole Marelli & Co., Ltd., London, was returned Member for Milan (National Party), at the recent General Election in Italy.

Mr. James M. Wakeman has resigned the position of general manager of the Society for Electrical Development, Inc. (U.S.A.). Mr. William L. Goodwin, assistant to the President, is taking over the duties.

Mr. Harry Hughes, electrician at the Fochriw Colliery, was married at Rhymney, South Wales, on May 17th, to Miss Mary Tyler.

The Times announces that Dr. J. Russell Reynolds has been appointed radiologist at Charing Cross Hospital, in succession to Dr. Ironside Bruce, who died a month ago as the result of continued exposure to high power X-rays.

Obituary.—Mr. A. R. Connal.—We regret to record the death which occurred at his residence at Shortlands, Kent, on Saturday last, of Mr. Allan Ramsay Connal, A.M.I.E.E. The deceased gentleman, who was 41 years of age, was London manager and engineer of Messrs. Johnson & Phillips, Ltd. The funeral took place yesterday at Highgate Cemetery.

Mr. R. Robertson.—Mr. Robert Robertson commercial manager of the Clyde Valley Electrical Power Co., died suddenly at his residence, Llangsernie, Prestwick, Ayrshire, on Thursday last week, from heart failure. Mr. Robertson, who was well known and greatly esteemed in commercial circles, was only 47 years of age.

Mr. H. Gun.—The death took place on May 14th of Mr. Henry Gun, a former Mayor of Okehampton, who for many years carried on the business now conducted by Messrs. Blatchford, electrical engineers. He was 75 years of age.

Dr. E. B. Rosa.—*The Times* announces the death of Dr. Edward B. Rosa, chief physicist at the Bureau of Standards, Washington, U.S.A., on May 17th. One of America's leading scientists he was known to scientific men in England from his attendance at meetings of the British Association, and by his numerous publications on electrical investigations. He had been secretary of the International Scientific Association.

Sir James Pender.—We regret to record the death, in his 80th year, of Sir James Pender, eldest son of the late Sir John Pender, one of the pioneers of submarine telegraphy. Sir James was a director of the Telegraph Construction and Maintenance Co., Ltd., the Globe Telegraph and Trust Co., Ltd., the Direct United States Cable Co., Ltd., the Electric Construction Co., Ltd., and other undertakings.

Mr. P. D. Hollings.—*The Times* records the death, at Woking, at the age of 35 years, of Mr. Percival D. Hollings, a well-known chemist, who rendered great service to the Government during the war. "A talented linguist, he went to Russia in 1913 to organise the works of Leitner's Electrical Co., at Moscow, and in 1915 was appointed superintendent of train-lighting on the Great Western Railway. At the time of his death he was acting as manager of Accumulators of Woking, Ltd."

Mr. A. Spark.—Mr. Alexander Spark, electrical engineer and scientific instrument maker, at Aberdeen, passed away on 18th inst., at the age of 73 years. He had been in business on his own account at Aberdeen since 1871.

Mr. Charles Louis Oechsner.—Mr. Oechsner, to whose decease we referred briefly last week, was a man of genial personality, which made for him a large circle of friends in the engineering world. He was 55 years of age, having been born in 1866, at New Orleans, La., U S A. He had been associated with various activities of the British Thomson-Houston Co. since 1888, joining the London staff in 1899, and the Rugby staff in 1901. He will be greatly missed, not only by his many friends in the B.T.H. organisation, but by those who knew him during his long association with the company. The funeral took place at Bournemouth, on Thursday, May 19th.

The death occurred at Tredegar, on Sunday, of Mr. James Phillips, for many years assistant chief electrician to the Tredegar Iron and Coal Co.

Will.—The late Mr E. R. Sheldon, of Cowans, Sheldon & Co., Ltd., of Carlisle, left £100,797 gross, and £89,960 net personalty.

NEW COMPANIES REGISTERED.

British Scott Telecator Co., Ltd. (174,725).—Private company. Registered May 17th. Capital, £25,000 in 22,500 10 per cent. cumulative shares of £1 and 50,000 ordinary shares of 1s. each. To acquire a certain invention relating to an apparatus known as the telecator for indicating and locating defects in the working of internal combustion engines, and to carry on the business of manufacturers of or dealers in motor vehicles and conveyances of all kinds, &c. The permanent directors are: W. T. Parez, "Upwood," Haywards Heath; A. J. Barber, 16, Eldon Street, E.C.2; Qualification £100. Secretary: A. J. Barber. Solicitor: P. W. Butcher, 13, Bouverie Street, Fleet Street, E.C. 4. Registered office: 16, Eldon Street, E.C. 2.

Flash Gun, Ltd. (11,727).—Private company. Registered in Edinburgh May 17th. Capital, £2,000 in £1 shares. To carry on the business of electricians, mechanical engineers, toy makers, electric gun, rifle, revolver and pistol makers, &c. The first directors are: W. G. Paterson, 37, Garnethill Street, Glasgow, engineer; G. A. Rannie, 39, Smith Street, Hillhead, Glasgow, mining agent; C. Kirkwood, 61, West Regent Street, Glasgow; J. G. Aitchison, 1732, Shottleston Road, Shottleston, Glasgow; R. Carswill, 204, St. Vincent Street, Glasgow. Secretary: R. Carswell. Registered office: 204, St. Vincent Street, Glasgow.

Allan & Magowan, Ltd. (11,725).—Private company. Registered in Edinburgh May 16th. Capital, £15,000 in £1 shares. To take over the business of power engineers and contractors carried on by A. M. Allan, W. J. Magowan, A. Forrest, and J. A. Barr as "Allan & Magowan" at 288-292, Shields Road, Glasgow, and elsewhere. The first directors are: A. M. Allan, 288-292, Shields Road, Glasgow, power engineer and contractor; W. J. Magowan, 288-292, Shields Road, Glasgow, power engineer and contractor; A. Forrest, 288-292, Shields Road, Glasgow, power engineer and contractor; J. A. Barr, 288-292, Shields Road, Glasgow, power engineer and contractor. Solicitor: W. G. Shaw, 97, Wellington Street, Glasgow.

Youldon & Keeling, Ltd. (174,576).—Private company. Registered May 5th. Capital, £600 in £1 shares. To carry on the business of general engineers, motor and dynamo manufacturers, scientific instrument makers, &c. The first directors are: C. A. Youldon, 240, Camden Street, N.W.; T. H. J. Keeling, St. Cuthbert's, Salters Hill, Upper Norwood, S.E.19. Registered office: 26-31, Eyre Street Hill, Clerkenwell Road, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Worcester Electric Traction Co., Ltd.—Satisfaction in full on April 20th, 1921, of mortgage dated February 12th, 1914, securing £1,000.

High Temperature Generators (1918), Ltd.—Debenture dated April 28th, 1921, to secure £5,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: J. H. S. Hanning, 3, Copthall Buildings, E.C., and others.

Scarborough Electric Supply Co., Ltd.—Mortgage on certain premises in Scarborough and company's undertaking and property, including uncalled capital dated April 29th, 1921, to secure all moneys due or to become due from company to London County Westminster & Parrs Bank.

Milford-on-Sea Electric Supply Co., Ltd.—Particulars of £400 debentures authorised March 29th, 1921, whole amount issued. Charged on the company's property, present and future.

Anglo-Mexican Electric Co., Ltd.—Satisfaction in full on March 15th, 1921, of trust deed dated March 2nd, 1906, securing £300,000.

Lancashire United Tramways, Ltd.—Trust deed dated April 26th, 1921 (supplemental to trust deed dated April 27th, 1906, securing £300,000 debenture stock), charged on a mortgage for £145,517 7s. granted by South Lancashire Tramways Co. to trustees in lieu of certain land and premises in Hindley and Atherton, Lancs. Trustees: Rt. Hon. Viscount St. Davids and M. B. Snell, 5, Copthall Buildings, E.C.

Tutbury Engineering Co., Ltd.—Satisfaction to the extent of £1,000 on February 11th, and £1,000 on February 22nd, 1921, of debentures dated July 1st, 1915, securing £2,000.

Thermal Syndicate, Ltd.—First mortgage debenture dated April 21st, 1921, to secure £20,000 charged on the company's undertaking and property, present and future, including uncalled capital. Holders: J. J. Garnett and W. D. Forster, Collingwood Street, Newcastle-on-Tyne.

Franklin Engineering Co., Ltd.—Further charge dated April 25th, 1921, to secure £3,000, and debentures of even date (as collateral security) to secure £8,000 (both additional securities for mortgage dated October 21st, 1920, securing £5,000). Charged on Royal Oak Inn, Canton, Cardiff, and the company's undertaking and property, present and future, including uncalled capital. Holder: P. Evans, Holme Tower, Penarth.

T. Beadle & Co., Ltd.—Mortgage dated May 2nd, 1921, to secure £1,000, charged on 3, 4, and 5, Castle Street, and Boyes Yard, Castle Street, Hull. Holders: Dr. L. Carrol, Butler House, Barkerend Road, Bradford, and others.

Northampton Electric Light and Power Co., Ltd.—Issue on April 20th, of £28,554, on April 30th, of £450, and on May 2nd, 1921, of £700 second debenture stock, parts of a series already registered.

Kensington & Knightsbridge Electric Lighting Co., Ltd. (26,193).—Return dated March 31st, 1921. Capital, £350,000 in £5 shares (50,000 ordinary, 10,000 first preference, and 10,000 second preference), 21,000 ordinary, 10,000 first preference, and 10,000 second preference shares taken up. £179,840 paid. £25,169 considered as paid. Mortgages and charges, £140,000; also guaranteed jointly by this company and the Notting Hill Electric Lighting Co., Ltd., under the Kensington & Notting Hill Electric Lighting Co.'s Act, 1899; £225,000.

Lancashire United Tramways, Ltd. (87,044).—Return dated March 15th, 1921. Capital, £200,000 in £1 shares. 192,878 shares taken up. £7 paid. £192,871 considered as paid. Mortgages and charges, £546,500. Deferred stock issued having no charge over company's assets, £83,330. Note.—A further £20,000 of this stock has been deposited as security for possible advances.)

Oxford Electric Co., Ltd. (34,685).—Return dated March 21st, 1921. Capital, £175,000 in 20,000 ordinary and 15,000 preference shares of £5 each. 20,000 ordinary and 11,000 preference shares taken up. £122,550 paid on 13,200 ordinary and 11,000 preference, including £1,550 paid on 310 ordinary shares forfeited. £34,000 considered as paid on 6,800 ordinary. Mortgages and charges, £75,000.

Para Electric Railways & Lighting Co., Ltd. (85,368).—Return dated March 25th, 1921. Capital, £780,000 in £1 shares (390,000 preference and 390,000 ordinary). 325,000 preference and 390,000 ordinary shares taken up. £25,040 paid. £689,960 considered as paid. Mortgages and charges, £618,016.

CITY NOTES.

Siemens Bros. and Co., Ltd.

Mr. G. Mure Ritchie presided on Monday at the annual meeting of this company. He dealt at some length with the balance sheet items, and pointed out that, while the total assets amounted to £3,552,341, the total liabilities, other than share capital, were only £1,561,272, leaving a balance of assets of £1,991,069 to represent the share capital of £1,259,062. The profit and loss account showed a net profit of £253,254, as compared with £211,209 in 1919. With the amount brought forward, £315,776, there was a balance of £569,030 available for appropriation. Already an interim dividend of 5 per cent., free of tax, had been paid, and £30,000 had been transferred to special surplus fund. A final dividend of 1s. per share, free of tax, making 10 per cent. for the year, was recommended, leaving £435,218 to be carried forward. With regard to the proposed increase of capital and bonus distribution, the whole of the authorised capital, £1,500,000 was issued and fully paid up. Any addition to the ordinary share capital was to be avoided if the company could issue new capital on another basis. The creation of £1,000,000 of 10 per cent. preference shares would place at the disposal of the board capital powers for future requirements. In a progressive and prosperous business the necessity for additional capital recurred, and it should be provided, in order to expand operations and augment profits. It seemed right to the directors before admitting new shareholders to a participation in the capital of the concern, to distribute among existing shareholders a portion of the surplus assets so that they and the newcomers would stand on something approaching an equal footing. The preference shares proposed to be created would rank for dividend as from July next, and would be allotted to existing shareholders in the proportion of one new preference share for every five ordinary shares held. He wished to make it clear that the bonus distribution did not trench upon the company's various reserve funds, which amounted to over £212,000. As to the trade position, the total value of orders received in 1920 amounted to £4,025,685, against £2,834 712 in 1919. The company was fortunate in having a world-wide reputation and far-reaching trade connections in Britain and her overseas dominions, and in foreign countries. The variety of their more important manufactures was such that, as in 1920, if orders fell off in some lines, they increased in others, so that on balance the business and profits had grown in the year. He was glad to say that, while last year was substantially better than 1919 the directors expected 1921 to be better than 1920, and no difficulty was anticipated in maintaining for 1921 the 10 per cent., free of tax, ordinary distribution. Of the more remote future, he could not be expected to prophesy, but he had every confidence that on the whole Siemens Bros. would continue to expand and prosper. Speaking of the various departments of the business, he first referred to cables. During the year this department had been fully occupied, particularly the submarine telegraph section, and those dealing with underground super-pressure power mains and trunk telegraph lines. With regard to submarine cable, which had been made at Woolwich for more than half a century, the output in 1920 was greater than in 1919. During the year submarine telegraph and telephone cables were made for use in many parts of the world, and in the Atlantic and Pacific Oceans, the Mediterranean, the Red Sea, the Baltic, the Sea of Japan, and along the coasts of Chile and Peru their manufactures were playing an important part in communications. In underground telephone cables the demand for the paper-insulated type had increased.

and the factory had been fully occupied. The export business in loop cables had also increased. The volume of business in the apparatus department in 1920 was much greater than in 1919. Close co-operation had been effected with the associated firm of Elliott Bros., whose reputation for certain highly specialised lines was world-wide. Business in telephone exchange apparatus, both automatic and manual, had also grown satisfactorily. For manual exchanges contracts for no less than 14 were obtained during the year from the British Post Office. Four public exchanges were put into satisfactory operation, others were being installed, and the remainder were in an advanced state in the workshops. There was a marked rise in the orders for land-lines in 1920, and with the reduced prices now prevailing a further increase might be expected, as land-lines had developed inadequately during the past few years. In raw materials there had been large fluctuations in prices. At the beginning of the year these prices were on the up grade, but later fell rapidly. No loss was anticipated on purchases of material or stocks in hand. The difficulties of manufacture were accentuated by numerous industrial disputes. Every industry was so dependent on others that a disturbance of normal conditions in one was felt in all others; than which no more calamitous illustration had ever been experienced than the present coal strike. To compete in the world's markets, raw materials must be obtained at reasonable prices. For a long time these prices had been exorbitant, due chiefly to the excessive price of coal, in itself due in the main to the extravagant wages paid to the miners. Coal was the base of practically all British industry, and the evil of the exalted price of fuel swept through every branch of industry. The chairman then moved the adoption of the accounts, which was seconded by Lord Queenborough, and carried.

Subsequently an extraordinary general meeting was held, at which it was agreed to increase the capital by £1,000,000 by the creation of a million 10 per cent. cumulative preference shares of £1 each. Resolutions were also passed respecting an alteration in the articles of association.

British Thomson-Houston Co., Ltd.

The annual meeting was held on May 18th at 83, Cannon Street, E.C. Mr. H. C. Levis, who presided, in alluding to the fact that the company had completed the first quarter century of its existence, said that for many years its growth was very slow, because of the depressed state of the electrical business in this country, and the competition which existed, due not only to the fact that there was no restriction of imports, but also because the manufacturing facilities in the country, when taken in conjunction with the imports, largely exceeded the demand. About 1912, however, matters commenced to improve, and that improvement had been steadily maintained up to nearly the end of the year under review, when a reaction began. Notwithstanding that falling off, the year, as a whole, was a record one, and as a result, the volume of orders on hand on January 1st, 1921, was larger even than on January 1st, 1920, particularly in heavy plant. The depression which began towards the end of last year had continued so far during the present year. It was to be hoped that the present industrial conditions would be so settled in the near future that a revival of trade would take place, and he could not help feeling that such a revival would take place soon after the present strikes were settled, for the reason that the number of important inquiries they were receiving was large, and it was to be assumed that those making the inquiries contemplated making purchases. It must also be remembered that there was a great shortage of electrical machinery which must be made up when prospective purchasers were in a better position to finance their requirements. The issues of shares which he mentioned a year ago had been substantially completed, with the result that the company had outstanding on December 31st last 2,000,000 ordinary shares of the par value of £1 each, and 1,500,000 cumulative preference shares, of a like par value, making the total shares issued £3,500,000. The proceeds were used to liquidate debts, and for other purposes of the company. The debenture stock outstanding amounted to £152,295; £5,300 was retired annually by drawings at 105. The total amount redeemed from the date of issue was £59,705. The loss in exchange, in connection with the amount owing to the International General Electric Co. of New York was almost entirely settled prior to the last annual meeting, and the exchange on the balance of the debt had been so adjusted that no further loss was likely to be incurred. During the year there was expended on factories the large sum of £595,000. That included payment for the factory at Birmingham, which, although purchased in 1919, did not come into their possession until the middle of 1920; also certain additions at their Willesden factory which had considerably increased their manufacturing facilities there. Also further work on the important additions to their Rugby factory, and finally, in connection with new works now being constructed at Chesterfield. Building progress, particularly on the extensions at Rugby, had been painfully slow, due to causes beyond their control, and the relief they anticipated, particularly in relation to the manufacture of heavy plant, had not been fully realised. The total floor space of the various plants of the company amounted to about 1,650,000 square feet. The number of employés at December 31st last was over 9,000. The profits for the year, after deducting all expenses and charges, other than interest on debentures and loans, and after making provision for estimated war taxation for 1920, were £470,470, which showed an increase of nearly £60,000 over 1919. That was realised because of the fact that the amount of unfilled orders on their books at January 1st, 1920, was, up to that time, the largest in the history of the company, and further, that the volume of orders received during the year formed a new record. To that amount of profit must be added the amount brought forward from the previous year. Including £208,431 brought forward, they had the total £678,901 to be dealt with. From that there had to be deducted interest on debentures and loans £179,990; the plant account had been depreciated by £60,000, and a reserve of £150,000 had been made in connection with inventories, &c., leaving to be carried to the balance sheet £288,910. That was subject to adjustment of the reserves made for excess profits duty for 1918, 1919, and 1920, and it was believed that those reserves were ample. Out of that amount it was proposed to pay dividends aggregating £63,019, and to carry to the new account £225,891, which was about £17,000 more than was carried forward last year. Many of their employés having from time to time expressed a desire to become financially interested in the company, the directors had arranged to offer to them savings certificates in multiples of £10, bearing interest at the rate of 7 per cent. per annum, free of income tax, up to 6s. in the £, and with a right of participation in the earnings of the company under certain conditions. They were to be paid for on an instalment plan, which would spread the payments over a period of nearly two years. At any time an employé could apply for repayment, and, on the other hand, the company could pay off the certificates. They were personal to the employé, and not negotiable or assignable. Later on, the company might decide to offer some of its shares to its employés on a deferred-payment basis, but for the present it was felt that those certificates, with a fixed and attractive rate of interest, and with participating privileges, would answer the purpose, and prove to be a sound and attractive savings investment. In conclusion, the chairman bore testimony to the efficient and loyal work done by all of the company's employés.

Lord Carmichael seconded the motion, which was carried unanimously.

West London & Provincial Electric Supply Co., Ltd.

Mr. H. Kahn presided at the annual meeting, held at 14, Ironmonger Lane, E.C., on May 18th. He said that the increase of £321 in the balance was chiefly owing to the fact that the dividend of 8 per cent. on the shares in the Chiswick Co. was ½ per cent. over that of the preceding year. They had £5,202 for distribution, and were paying the dividend on the cumulative preference shares at 6 per cent. for 1920, and arrears of interest on the funding certificates for 1917, 1918, and 1919, and the interest on the funding certificates for 1920, and carrying forward £230. As foretold last year, they had now cleared off the arrears of interest on the funding certificates. The results both at Chiswick and at Aberystwyth had shown improvement, and the number of consumers was steadily increasing. At Aberystwyth they had also made a profit of over £1,200 on installation work. There the sale of current was up by £8,131 to £38,817. The speaker reviewed the accounts in some detail. He thought the results would be considered quite satisfactory, but at the risk of being considered a pessimist, he would express the opinion that the year 1921 would not prove so good for the Chiswick Electricity Supply Corporation, Ltd., as the year just reviewed. During the first quarter of 1921 the cost of fuel had gone up enormously, wages had also increased, and as to what the future might bring in regard to the coal position it was impossible to foretell. Luckily, the Chiswick company was not entirely dependent on coal for the generation of its current either at Chiswick or at Aberystwyth, and that was the only bright feature at the present moment.

Prospectuses.—*Metropolitan Electric Supply Co., Ltd.*—The list was originally intended to close to-morrow in an issue of £500,000 7½ per cent. extension debenture stock 1921 at 95 per cent. It is required to meet the cost of installing plant at the company's main generating station at Willesden to the extent of 20,000 kW, thereby increasing the plant installed to 40,000 kW, together with the necessary boilers and auxiliary plant, and of trunk mains to link up with the generating station at Uxbridge, in order to provide for the large and growing demand for power and light, particularly in the company's western area of supply. The list was actually closed on Monday for town, but applications received from the country by Tuesday morning's post were considered.

General Electric Co., Ltd.—The underwriting was completed some days ago of an issue of £3,500,000 7 per cent. debentures at 93.

Shanghai Electric Construction Co., Ltd.

The accounts for the year ended December, 1920, show a profit of £174,637, compared with £154,567 in 1919. £3,779 was brought forward. There has been put to reserve for renewals £10,000; to reserve for taxation £50,000; and to general reserve £45,000. Two interim dividends, each of 6 per cent., have been paid, absorbing £38,400, and a final dividend of 8 per cent., less income tax (making 20 per cent. for the year) is recommended on the 32,000 shares of the original capital, requiring £25,600. Since the date of the accounts the share capital has been increased to £400,000, and £80,000 standing to the credit of general reserve account has been capitalised and applied in paying up in full 8,000 new shares of £10 each, which are distributable as a bonus in the ratio of one new share for every four shares held. The new shares do not rank for the final dividend, but will participate in all dividends declared out of current profits. The loss by exchange on subsidiary coinage in 1920 was £65,857, which is equal to 20.58 per cent. on the capital. The ratio of depreciation to gross takings increased during the year, and still shows an unfavourable tendency. The traffics and net receipts for the current year continue to be satisfactory. The incidence of E.P.D. came to an end, so far as this company is concerned, with the period under review, and its removal will offset to a material extent the effect of the less favourable rate of silver exchange. The Municipal Council has authorised the addition of five new trailer cars, bringing the number of the company's passenger vehicles to 194, made up of 90 motors, 90 trailers, and 14 railless cars (of which seven are in course of construction). Negotiations with the Municipal Council for the extension of the traffic system under railless electric traction are continuing. The directors have under consideration proposals for a provident fund for the benefit of the European staff in Shanghai.

Oldham, Ashton & Hyde Electric Tramway, Ltd.

Mr. E. Garcke, presiding at the annual meeting on the 23rd inst., said that the receipts had improved, but the expenses had increased to a much larger extent, due to higher wages paid and higher prices of all materials. The speaker referred at some length to the question of the sale of the undertaking. The local authorities gave notice to purchase in May, 1918, but owing to war conditions the arbitration was considerably delayed, and the award was issued last September. Certain points had since been argued in the Courts, and the company early this year appealed against the decision, and the finding being given against them, they decided to accept it, and not to appeal to the House of Lords. The position, therefore, as left by the Court of Appeal, was that they were entitled to £132,641, plus the whole, or part, or nothing of the £2,880—the item referred back to the arbitrator—plus also the taxed costs of the arbitration, less the costs of the appeal, which the company had to pay; and, of course, they were entitled to the value of stores and sundry other assets. Now the local authorities had advanced a claim that inasmuch as the value of the undertaking which they were purchasing was fixed by the arbitrator as at May 1st, 1918, they were entitled to some deduction from the purchase price thus fixed in respect of depreciation of the undertaking since May, 1918, regard being had to the fact that the company had had the benefit, and the obligations, of working the undertaking since that time. The purchasing authorities offered to pay the company £125,000 in settlement, and they said that if the company did not accept their offer they would pay the larger amount without prejudice to their claim for depreciation. The directors had given the matter their serious consideration, and on balance of all the pros and cons they were prepared to advise the shareholders to accept the offer of £125,000, but they thought it right to leave the matter to the decision of the shareholders. The best estimate he could make at the moment was that there would be something like 24s. per share available as return of capital to the shareholders. The ordinary shareholders had had a regular return of about 6 per cent. per annum since the formation of the company, and both they and the holders of the preference shares had the prospect of receiving the return of the whole of their capital, with an appreciable premium, which was a better result than was expected a few years ago. The improved result was entirely due to the fact that the undertaking had been sold at a time when prices were high.

The meeting unanimously resolved to accept the offer of the purchasing authorities.

Dublin & Lucan Electric Railway Co.

Mr. W. J. Hill, chairman, at the annual meeting of this company, said the receipts had largely increased, but the amount shown in the accounts had been made up by including the Government subsidy of £8,000 to meet losses of working. On the expenditure side there was an increase of 24.4 per cent., mainly due to increased cost of labour and coal. As compared with 1913, the expenditure had increased by 184 per cent., while last year's coal bill was £5,357, as against £1,575 in 1913. The balance now available was £1,055, and the payment of preference dividend for one half-year would absorb £475, leaving £580 to be carried forward.

Referring to the railway settlement, Mr. Hill remarked that if the Government withdrew the subsidy from the company without making adequate arrangements for the carrying on of the line, the position would be that they would have to close down the line immediately. The recent reduction of wages affected the company only to the extent of £300 or £400 per annum, and the Transport Ministry had increased passenger and goods rates to an almost prohibitive figure. If a sum of money were to be allocated to Irish railways by the Government, it would be only common justice that the small railways should share in it entirely out of proportion to the share received by the large lines.

Lancashire Dynamo & Motor Co., Ltd.—The annual report shows an increase in the net profits of £6,555, the figures for the past year being £26,492, against £19,937 for 1919. As the directors state, this result is satisfactory having regard to labour troubles and disputes which adversely affected deliveries and cost of materials used. The final dividend recommended on the ordinary shares is 6¼ per cent., making 10 per cent. for the year, tax free (including additional capital). This is the same as for each of the two preceding years, while for 1915, 1916, and 1917 12½ per cent. was paid. It is proposed to transfer £10,000 to reserve for investments and to carry forward £2,444. A year ago £477 was placed to reserve and £5,542 carried forward. The company's liability for E.P.D. from 1917 to 1920 inclusive is still unsettled, but full provision has been made to cover this.—*Manchester Daily Dispatch.*

Potteries Electric Traction Co., Ltd.—Mr. R. J. Howley said at the annual meeting that the results were not as satisfactory as they could have wished; the period under review had been one of the most difficult he could recollect. A further increase of 9s. per week in wages of tramway workers made a total increase of 43s. a week since 1914. During 1920 they paid in wages £147,934, as against £42,933 in 1914. Relatively the cost of power for working the tramways had increased to an even greater extent than the cost of labour, amounting to £31,509, as compared with £7,677. This was mainly due to the higher price of coal, £22,564 in 1920, and £5,318 in 1914. Rates had increased from £6,026 in 1914 to £11,983 in 1920. After referring further to the accounts and to the competition from char-a-bancs, the speaker said that the traffic receipts for the first three months of the current year were satisfactory, but, owing to the coal strike, the number of passengers had fallen considerably.

The Felten & Guilleaume Co.—It is stated that the directors of the Felten & Guilleaume Karlswerke A.G., of Cologne-Mulheim, propose to pay a dividend at the rate of 20 per cent. for 1920, as compared with 15 per cent. in the previous year, and also to repay 50 per cent. of the existing share capital. The amount required for the latter purpose is derived from the premiums realised on the issue of shares last year to the Luxemburg (Terres Rouges) group so as to enable Luxemburg interests to participate in the company.

Buenos Ayres.—The Compania Hispano-Americana de Electricidad, of Madrid, which is the successor of the German Transmarine Electricity Co., of Buenos Ayres and other South American cities, proposes to pay a dividend at the rate of 8 per cent. for 1920 on the share capital of 120,000,000 pesetas. All the promotion expenses, costs of issue, taxes, and stamp taxes have been previously provided for, as well as the payment of 6 per cent. interest on the annuity bonds of nominally 180,000,000 pesetas.

Mirrlees, Bickerton & Day, Ltd.—The accounts for the year ended March, 1921, show, after providing for depreciation and directors' fees, a loss of £9,782. £7,510 was brought forward, so that the adverse balance is £2,272. Substantial sums have been paid in previous years in excess profits, and it is estimated that not less than £20,000 will be recovered by the company under this head, making a credit balance of £17,728. After paying the preference dividend £14,369 is carried forward, no dividend being paid on the ordinary shares.

Babcock & Wilcox, Ltd.—At the annual meeting, last week, Sir John Dewrance said that in spite of the exceedingly difficult times, they had been able to maintain their prosperity. The nation was passing through a very difficult and dangerous period. A large part of their works was closed down for want of coal, and they were unable to obtain steel and other raw materials. The company's organisation and staff was capable of facing any situation which might arise.

Great Northern Telegraph Co., Ltd., of Denmark.—The directors recommend for the year 1920 the distribution of a total dividend and bonus of 24 per cent., including the 5 per cent. already paid, and to transfer £50,000 to the reserve and renewal fund; £83,333 has been allotted to the pension fund. It is further proposed to set aside £416,667 for extraordinary taxes, and to carry forward £285,892 to the account for 1921.

La Plata Electric Tramways Co., Ltd.—After providing for debenture and other interest, the accounts for 1920 show a profit of £6,879, which, added to £10,652 brought in, and after allocating £3,000 to reserve fund, leaves £14,531 to be carried forward, subject to corporation profits tax, if any.—*Financial News.*

Brisbane Electric Tramways Investment Co., Ltd.—A dividend of 4s. per share, free of tax, for the half-year is to be paid on the ordinary shares, making 8 per cent. for the year. £20,000 to reserve, £8,000 to depreciation of investments, and £42,837 carried forward.

Stock Exchange Notice.—The Committee has ordered the undermentioned to be officially quoted:—

Calcutta Electric Supply Corporation.—£500,000 5 per cent. first mortgage convertible (registered) debentures, free of income tax, Nos. 1 to 4,000 (£100) and 4,001 to 6,000 (£50).

Hart Accumulator Co., Ltd.—A dividend of 8 per cent., less tax, on the ordinary shares for the year is recommended. £10,580 is put to income and corporation profits taxes, and £25,616 is to be carried forward.

Altrincham Electric Supply Co., Ltd.—A dividend of 7½ per cent. on the ordinary shares and one of 10s. per share on the deferred are announced.

STOCKS AND SHARES.

Tuesday Evening.

The feature of the Stock Exchange markets is undoubtedly the way in which new issues are being subscribed. Demand for underwriting is eager. There is not enough underwriting to go round. Those in charge of new issues find themselves inundated, in the words of one of them, with requests to be allowed to have a participation in the various offers. It is not that the public take the securities every time on the issue of the prospectuses, although within the past week there have been striking successes scored in this direction. The Metropolitan Electric Supply Company, for instance, which offered 7½ per cent. Extension debenture stock at 95, closed its list soon after midday on Monday, several days in advance of the time to which the prospectus referred as the last day for closing. The Norwegian Government, offering a 6 per cent. loan at 88, was equally successful. A good deal of the money is required by Norway for the development of electrical power. The General Electric Company is about to make an issue of 7 per cent. debenture stock, and in spite of the largeness of the amount required, namely 3½ million pounds, the underwriting was completed rapidly, and some of the people who would have liked a share were shut out altogether, or had to be content with a comparatively small amount.

Although business throughout the general markets is exceedingly quiet, there is no mistaking the appetite of the public for good investments. The depression caused by the continuance of the coal-strike prohibits any attempt at speculation, or any desire to take risks. Consequently, the markets concerned with speculative issues are in a lifeless state. Nevertheless, money accumulates which, in the ordinary way, would be going into trade, and it is this capital which flows so readily nowadays into the good investments either new or old.

The second reading of the Railways Bill will probably be taken this week, and, of course, no particular opposition is expected to be raised at this stage. When the Bill goes into Committee, however, the hostility will develop, and of the big companies, the Great Eastern and the Great Northern chairmen have both declared definitely against the Bill. Some of the other companies, however, are acquiescent in what they perhaps regard as the inevitable, and it remains to be seen whether the changes that are introduced into the Bill will be of sufficiently drastic character to alter its salient features.

Meanwhile the Underground group stands out as being the firmest of any of the railway departments. Underground Incomes have risen 4 to 78½. Anticipation looks for payment of the full £3 per cent. for the half-year ended next March, and some of the optimists hope that the £3 will be paid in September next. The £10 shares are 5s. up at 2⅝, and the 1s. shares, after touching 8s. 6d., went back a shade, leaving them 1s. higher on the week. Districts are 2½ up. With these, a further improvement has come in London United Tramways preference, the present price of 4s. 6d. comparing with half-a-crown only two or three weeks ago. The company's 4 per cent. debenture has risen from 30 to 35, though as there is scarcely any of it on offer, the latter must be regarded as more or less nominal. London and Suburban Traction preference at 6s. 6d. are another 2s. up, and the ordinary shares are quoted better at 2s. 6d.

Amongst home electricity shares, County of London preference are ⅛ better at 8⅛, and Metropolitan 4½ per cent. preference at 2 15/16 are an equal amount lower. The decline in the latter occurred, of course, owing to the offer of the Extension debenture stock. The new City of London second preference go quietly ahead, and the premium has advanced to 1s. 6d. It is said that several of the other lighting companies are contemplating new issues in this market, although nothing reliable has yet transpired in regard to such rumours.

The Great Northern Telegraph Company has raised its dividend 2 per cent. to 24 per cent., and the price is strong at 24. The cable list is better than it looks, owing to the fact that quotations are kept at about their previous levels, but that there is a further shrinkage in the amount of stock available. As an instance, Eastern Telegraph ordinary is called 163½ middle, but it can be sold at 165, while buyers might find it difficult to get any stock at 166. Direct United States have risen to 5⅞ and Anglo-American deferred is harder at 16⅛. Globe preference advanced to 9¼. Amongst the foreign issues, Brazilian Tractions have recovered 2 points to 36. Anglo-Argentine Tramways 5 per cent. debenture stock, mentioned here on several occasions as a sound speculative lock-up when the price was about 55, is 2 points higher this week at 63½. Mexican issues are on the dull side once more, owing to the scarcity of news as to improvement in the outlook for settlement of the companies' finances. Various dollar stocks are better, prices being marked up in accordance with the quotations cabled from New York, although in the matter of actual business, the market is doing next to nothing.

Electrical manufacturing shares are dull on the whole. General Electrics weakened to 22s., on the forthcoming issue of debenture stock. The first preference have fallen to 17s. 6d. and the B shares to 18s. English Electrics are lower at 12s. Siemens' price relaxed to 24s. 4½d. The Chairman, at Monday's meeting, reported that the total value of orders received in 1920 was just over four million pounds sterling, as against £2,835,000 in the previous year. He remarked that, although orders may fall off in some lines, they increase in others, and so the business is balanced. The new shares are quoted 22s. 6d. to 23s.

Armament shares remain under the influence of the coal-strike. Nobel Industries have decided not to pay any dividend on the ordinary shares for 1920, because, although the profits for that year are not less than those of the preceding year, it is considered necessary to conserve resources in every way, and not to make a distribution of profit as would, in normal circumstances, be justified. The shares eased off a trifle on the announcement. Vickers and Armstrongs keep tolerably steady. The rubber share market is no better. A golf ball manufacturer was telling us the other day that, although the price of rubber is under 9½d. per lb., he has to pay 5s. a lb. for his rubber in strips. Marconi shares came on offer at 50s., to rally later on. Canadian Marconi's enjoyed a spurt to 9s. 6d., though ninepence of this was lost on profit-taking by earlier buyers. Radio Common and preferred remain at 9s. 3d. and 11s. respectively.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend		Price		
	1919.	1920.	May 24, 1921.	Rise or fall.	Yield. p.c.
Home Electricity Companies.					
Brompton Ordinary..	12	12	8	—	£10 0 0
Charing Cross Ordinary	7	8	8⅞	—	10 8 8
do. do. do. 4½ Pref...	4½	4½	8	—	7 10 6
Chelsea..	4	6	8¼	—	9 4 8
City of London	18	14	1 3/16	—	11 18 0
do. do. 6 per cent. Pref...	6	8	17/-	—	7 1 2
County of London ..	8	8	7¾	—	10 6 6
do. do. 6 per cent. Pref. .	6	6	8⅛	+ ⅛	7 7 8
Kensington Ordinary	7	9	4⅛	—	10 18 2
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref ..	6	6	2¾	—	10 18 2
Metropolitan ..	6	7	8⅜	—	10 7 4
do. 4½ per cent. Pref.	4½	4½	2 15/16	— ⅛	7 18 2
St. James' and Pall Mall ..	12	12	6	—	10 0 0
South London	6	7	2½	—	9 2 10
South Metropolitan Pref. .	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	5⅛	—	9 15 2
Telegraphs and Telephones.					
	1918	1919			
Anglo-Am. Tel. Pref.	6	6	78½	—	7 12 10
do. Def...	83/6	1½	16⅛	+ ⅛	9 6 0
Chile Telephone	8	6	5¼	—	5 6 8
Cuba Sub. Ord.	7	7	7¼	—	9 6 8
Eastern Extension ..	10	10	16⅜	—	8 2 2
Eastern Tel. Ord.	8	10	163½	—	8 2 4
Globe Tel. and T. Ord.	8	10	16⅜	—	6 2 2
do. do. Pref.	6	6	9¼	+ ¼	6 9 9
Great Northern Tel.	22	22	24	—	10 0 0
Indo-European	18	10	82	—	7 16 4
Marconi	25	25	2⅝	—	—
Oriental Telephone Ord. ..	10	12	2 3/16	—	*5 13 0
United R. Plate Tel.	8	8	6⅛	—	6 10 8
West India and Panama ..	1/3	Nil	3/16	—	Nil.
Western Telegraph..	8	10	16¾	—	*5 19 5
Home Rails.					
	1919	1920			
Central London Ord. Assented ..	4	4	45½	—	8 15 10
Metropolitan ..	1½	1½	26½	+1	5 17 8
do. District	Nil	Nil	19	+2½	Nil
Underground Electric Ordinary ..	Nil	Nil	2⅝	+ ¼	Nil
do. do. "A"	Nil	Nil	8/-	+1/-	Nil
do. do. Income ..	4	2	78½	+4	2 11 0
Foreign Trams, &c.					
	1918	1919			
Anglo-Arg. Trams, First Pref. ..	Nil	5½	2⅝	—	10 9
do. do. 2nd Pref.	Nil	Nil	8	—	Nil
do. do. 5 % Deb.	5	5	63½	+2	7 17 6
Brazil Tractions	Nil	Nil	36	+2	Nil
British Columbia Elec. Rly Pfce.	5	5	55	—	9 1 10
do. do. Preferred	2½	5	58½	—1	*8 15 0
do. do. Deferred	Nil	8	51½	—	*11 17 6
do. do. Deb. ..	4½	4½	59½	—	7 2 10
Mexico Trams 5 per cent. Bonds..	Nil	Nil	42	—	Nil
do. 6 per cent. Bonds..	Nil	Nil	23½	—	Nil
Mexican Light Common ..	Nil	Nil	11½	—	Nil
do. Pref.	Nil	Nil	17½	— ½	Nil
do. 1st Bonds ..	Nil	Nil	69	— ½	Nil
Manufacturing Companies.					
Babcock & Wilcox ..	15	15	2 7/16	—	6 11 2
British Aluminium Ord.	10	10	16/3	—	12 8 2
British Insulated Ord.	12½	15	1 9/16	—	9 12 0
Callenders	25	15	1½	—	10 0 0
" 6½ Pref. ..	6½	6½	17/6	—	7 8 7
Crompton Ord.	10	10	16/3	—	12 6 2
Edison-Swan ..	10	10	11/3	—	—
do do. 5 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	16/3	—	12 6 2
English Electric	—	8	12/-	—1/-	13 6 8
Do. Pref.	—	6	14/6	—	8 5 6
Gen. Elec. Pref.	6½	6½	17/6	—1/6	7 8 7
do. Ord.	10	10	22/-	—1/9	*9 1 10
Henley	25	15	1⅞	—	10 8 8
do. 4½ Pref.	4½	4½	8¼	—	6 18 6
India-Rubber	10	10	⅞	—	—
Met.-Vickers Pref. ..	—	8	1 13/16	—	8 16 10
Siemens Ord.	10	10	1 7/32	— 1/32	*8 2 0
Telegraph Con.	20	20	20½	—	*5 18 4

* Dividends paid free of Income Tax.

THE ROYAL SOCIETY'S SOIRÉE.

(*Concluded from page* 641.)

Prof. K. Onnes, For.Mem.R.S., Sir R. A. Hadfield, F.R.S., and Dr. H. R. Woltjer showed apparatus and specimens used in research on the influence of low temperatures on the magnetic properties of alloys of iron with nickel and manganese. A series of iron-manganese and iron-nickel alloys were exposed to the temperatures of liquid air, liquid hydrogen, and liquid helium respectively, and the specific magnetism tested after the return to atmospheric temperatures. Tests were also made during immersion in liquid hydrogen (– 253 deg. C.), and it was shown that alloys with the higher percentages of manganese cannot be made magnetic even by immersion in liquid helium (– 269 deg. C.). The existence of one magnetic and one non-magnetic manganese-iron compound was shown to be probable.

The National Physical Laboratory had a number of exhibits made up of: (*a*) a relay for breaking moderately large electric currents (Dr. Guy Barr), in which the difficulties due to sparking at the contacts of ordinary relays are avoided by causing the make and break to occur between mercury electrodes in an atmosphere of hydrogen. An iron core floating in mercury carries at its upper end a silica cup, full of mercury, and connections are made to the mercury outside and inside the cup. A solenoid pulls the core and cup down, and thus makes the contact; the current is broken by the core floating up so that the surface of the mercury is cut by the silica, and the spark is sufficiently quenched to allow currents up to 20 amperes at 100 volts to be broken easily. The mercury remains clean.

(*b*) A standard optical pyrometer (Dr. Kay and Dr. Griffiths) designed with a view to facilitating the accurate measurement of high temperatures by the "disappearing filament" method. An image of the hot object is superimposed on the filament of the pyrometer lamp and the brightness matched by varying the current through the lamp. Monochromatic red light is obtained by means of a filter glass in the eyepiece, and to enable the observer to check the permanency of the calibration of the pyrometer, two lamps are fitted which can be interchanged exactly in the field by a simple transverse motion. Each lamp is provided with fine adjustment in three mutually perpendicular planes. The use of the pyrometer for measuring the "black body" temperature of lamp filaments was demonstrated.

(*c*) Various types of hygrometers (Dr. Griffiths and Mr. Schofield) adapted to the measurement of humidity in cold stores.

(*d*) Wireless-telegraphic direction-finding apparatus (Mr. R. L. Smith-Rose) of the type developed by Capt. Robinson, of the Royal Air Force. Instead of finding two positions of a receiving coil for which the signals have equal intensity, two coils at right angles are connected in series and rotated together until the signal strength is unaltered by reversing the connections of one of them. This gives the direction from which the signal is coming and, therefore, the apparent bearing of the transmitting station. Differences between the apparent and the true bearing are found to occur, especially at night; these differences raise many interesting questions in connection with the transmission of electromagnetic waves in wireless telegraphy, and the instruments have been installed at various universities by the Radio Research Board to assist in the elucidation of this problem.

(*e*) Resistance alloy "Omal" for electrical standards (Dr. W. Rosenhain, F.R.S., Mr. S. W. Melsom, and Mr. S. L. Archbutt), a material of the type usually known as "Manganin" which is an alloy of copper, manganese, and nickel. Prior to the war, the product was supplied almost exclusively by Germany, and great difficulty was experienced by makers of scientific and ordinary measuring instruments in obtaining material suitable for their purpose from any other sources. The question was investigated at the Laboratory and, as a result, alloys were made, and watched through the various processes, that meet the requirements as regards temperature co-efficient, constancy, resistivity, and secular change. The material is made in two types, one having a resistivity of 45 microhm-cm., and the other 35 microhm-cm. Samples of the product were shown in various stages of manufacture, in the form of cast ingots, rod, strip, and wire, together with micrographs and curves of the temperature co-efficient.

(*f*) A standard resistance, 0.01 ohm for 200 amperes, (Mr. S. W. Melsom and Mr. H. C. Booth) for the standardisation of current-measuring resistances to the highest degree of accuracy. The element is composed of a number of wires, a method which ensures ease of adjustment, large cooling surface, and uniformity of temperature.

The Western Electric Co., Ltd., exhibited telephone transmission measuring apparatus, including (1) a portable high-frequency bridge designed to give instantaneous readings of the capacity of the cables which are already installed. The cumbersome method of using a galvanometer and batteries, which has heretofore been used, is replaced by a method which gives direct readings of the capacity at any desired frequency. (2) A line impedance high-frequency bridge which enables one to obtain the resistance and reactance components of the line impedance by direct readings. It is an adaptation of the bridge method which is used for measuring effective resistance and effective inductance. (3) A transmission measuring set that gives direct readings of the loss in miles of standard cable of a telephone circuit. (4) A transmission gain measuring set specially developed to determine transmission gains and transmission losses of lines and apparatus used in the telephone art, and (5) a variable frequency oscillator consisting of a thermionic tube generator which is so arranged that the frequency delivered may be varied over the range normally considered essential for voice current. It is arranged to give a uniform output at all frequencies and has a very pure wave form.

The Radiological Branch of the Research Department of the Royal Arsenal at Woolwich had on view a selection of pinhole photographs illustrating the change in shape of the focal spot with current change, and also the various parts of the target of the tube which emit X-rays under varying conditions. The method of protection used when radiographing large metal objects, *i.e.*, complete enclosure in a lead box, was shown by means of photographs, and illustrations could also be seen of a portable set, which has already been described in the engineering Press, that was designed and made in the Research Department at Woolwich for the purpose of the visual examination of materials, and which affords complete protection of the operator.

Dr. Leonard Hill, F.R.S., exhibited his recording kata-thermometer, an instrument which gives a continuous record of the cooling power of the environment exerted on the surface of the bulb of the kata-thermometer which is automatically kept at skin temperature. Introduced into the bulb of the "kata," which is filled with alcohol, is a coil of wire with a large temperature co-efficient of resistance, which coil forms one arm of a Wheatstone bridge that is balanced when the coil is at a temperature of 36.5 deg. C. An automatic device is used by which the current sent through the coil varies according to atmospheric conditions so that the coil is kept at 36.5 deg. C., while an ammeter placed in series with the coil indicates the variations of current and so the cooling power.

Dr. E. E. Fournier d'Albe demonstrated his latest form of optophone, an instrument which enables totally blind people to read ordinary printed books and newspapers. It is based upon the reflection of beams of rapidly intermittent light from the type on to a selenium preparation, which produces sounds in a telephone varying according to the shapes of the letters. The instrument shown was lent by the National Institute for the Blind, London, where it is in daily use; it has been fully described in our pages.

The instruments and records exhibited by the Meteorological Office included Dr. J. S. Owens's remarkably simple apparatus for recording the degree of atmospheric pollution, and the present lack of coal was clearly indicated on the records. Other interesting records were those which showed the relation between the atmospheric pollution and the vertical potential gradient of atmospheric electricity, which subject is now being investigated at the Kew Observatory.

While the apparatus briefly described above only formed part of the whole shown by some 39 exhibitors, it was noticed that the latter figure had decreased by about one-eighth compared with last year, neither did the exhibition as a whole reach the standard one remembers in pre-war days.

THE PRESENT ECONOMIC POSITION OF THE ENGINEERING AND ALLIED INDUSTRIES.

(*Continued from page* 664.)

The following is a continuation of our extracts from the pamphlet issued by the Engineering Unions:—

The Ruin of Our Foreign Trade.

But although we need say no more about the foreign exchanges, there is an aspect of foreign trade on which we must insist. Why is it that, at a time when there is the most urgent demand for machinery of all kinds, for agricultural implements, for railway locomotives, and what not, the employers are getting so few orders from Germany? They say it is because of the depreciation of the currency, which our employers imagine is so advantageous to employers over there. Assuming this weird idea to be correct, *who is now depreciating still further the German mark?* We understand that an overwhelming majority of the British engineering employers have supported, and still support, Mr. Lloyd George's Government, with its policy of "making Germany pay," and its present proposals of high Customs duties calculated to prevent all German exports. Everything that hinders the German export trade necessarily still further depreciates the German mark; and, therefore (according to the statement of the British engineering employers), *still further strengthens the position of the German employers.* Now, the British employers contend that, because their German competitors enjoy the "advantage" of having a depreciated currency, the British engineering workman must accept lower wages! When the British Government, by its strangling of the German export trade, has caused a further depreciation of the German mark, presumably this extra "advantage" that the German employer will possess will be made the justification for a still further reduction of British wages. . . . Who is paying this so-called German indemnity? The British employers clearly intend that it shall be the British workman.

Of course, this is not what the employers call it. They call it a "consumers' strike."

The Consumers' Strike.

According to the engineering employers, the world was going along very well until "the critical month" of August, 1920—the employers had been, until then, admittedly making large profits, which we have seen reflected in their swollen dividends—but that, suddenly, there was "a consumers' strike," when all over the globe people decided to refuse to buy, because prices were too high. The argument insinuated is that the present depression of trade in engineering products can be remedied by a substantial lowering of price, which will bring the "consumers' strike" to an end, so that purchases will be resumed on the old scale, and employment will once more become brisk.

Unfortunately for this argument, the sequence is the other way. Prices began to fall precipitately long before the so-called "consumers' strike." According to the very figures given in the employers' pamphlet, wholesale prices were at their highest at the end of February, 1920, namely, 256 per cent. above those at the end of December, 1913. They then dropped almost continuously, month by month until, a year later, they stood at no more than 61 per cent. above the 1913 figures. Thus, the wholesale prices, on an average, were, at the end of February, 1921, *less than half* what they had been a year before. If, as it is suggested, a mere cut in prices is sufficient to restore demand, was not this drastic *cutting of prices in halves* enough to bring about a revival of trade? Yet, far from causing demand to increase, and leading to a regular boom, the fall in wholesale prices in the proportion from 356 to 161 was marked, so the employers tell us, not by an increase but by a continuous falling off of orders for commodities, and consequent reduction of work, so that the Trade Union percentage of members drawing unemployment benefit rose from 1.6 per cent. at the end of February, 1920, to 8.5 per cent. at the end of February, 1921.

Whatever was the cause of the slump, it has been demonstrated that a reduction of prices does not remedy it—not even a reduction of prices to the extent of more than half. *This reduction has taken place, and the slump, so the employers tell us, is worse than ever.* The employers, shutting their eyes to this fact, still go on repeating the shibboleth of "reduce prices in order to induce larger sales." Why do they persist in such mistaken political economy? It is because they wish the workmen to come to believe, in their hearts, that it is only by accepting a drastic reduction of wages that they can get rid of unemployment. But every economist knows (though the employers still cannot believe it) that a reduction of wages is no remedy for unemployment.

These countries will not, because they cannot, buy from abroad to a greater total amount than the total amount of their own purchasing power. To offer them British goods at lower prices is merely to give them more British goods for the same total sum—a course which will reduce, not increase, the national advantage from the trade. No general reduction of prices has any effect in increasing the total value of international trade. No general reduction of the cost of production in any country can increase its aggregate share of the trade of the world. British engineering employers may not think much of political economy, except when they want to quote it against the workmen, but it may interest them to remember that, in all their present argument, they are "flying in the face of political economy." For it is the confident teaching of political economy that *no general reduction of prices or wages can, in itself, increase the total value of a nation's exports.*

"General low wages never caused any country to undersell its rivals, nor did general high wages ever hinder it from doing so."

Why Destroy the Home Market?

Not a word is said, from beginning to end of the employers' pamphlet, about the home market. No one would imagine from its perusal that, great as is our interest in the export trade, *two-thirds of the nation's production is for the home consumer.* Even in engineering, which is, along with the cotton trade, exceptionally dependent on export sales, something like 50 per cent. of the whole industry is engaged in producing the locomotive and marine engines, the multifarious equipment of our railways and factories, the innumerable kinds of machines, the agricultural implements, the electrical plant, the scientific instruments, the motor cars, the sewing machines, even the bicycles and gramophones, and all the thousand and one engineering products, for sale and use in the United Kingdom. Large fortunes have been made in the past out of the home trade alone. Even to-day, as is common knowledge, there are engineering firms making quite substantial profits out of one or other kind of engineering for the home market. Why is this left entirely out of account in the employers' pamphlet?

The Conspiracy to Reduce Wages.

This is why the "conspiracy to reduce wages" is worse than a crime; it is an economic blunder. The employers' pamphlet states: "It is unfortunate that, in certain quarters, it should be alleged that employers have entered into a conspiracy having for its object the forcing down of wages. We need not quarrel over the word "conspiracy," or the words "forcing down," which the employers, perhaps, understand in a sense different from that in which they are used by the workmen. But quite a number of prominent employers, in quite a number of different industries, have publicly declared that wages must be reduced, and are to be reduced. At the present moment, to name only half a dozen great industries in which explicit intimations have been made that the associated employers intend and demand a reduction of wages, this is being simultaneously sought by (*a*) the shipbuilding and engineering establishments; (*b*) the cotton and woollen manufacturers; (*c*) the coalowners; (*d*) the farmers on the Agricultural Wage Boards in different parts of the country; (*e*) the mercantile marine; (*f*) as regards the wages of women in particular, the employers in a large proportion of all the Trade Boards. These represent, in the aggregate, at least one-third of the whole wage-earning population of the nation, and there are innumerable other cases in which wages have already been drastically reduced. . . .

Bad Economics.

There is much more false economics in the employers' pamphlet—all deliberately inserted, possibly in all sincerity, with a view to "create atmosphere," and persuade the engineering workman to acquiesce in reductions of wages—but we cannot deal with all the blunders. There is, however, one glaring fallacy directly affecting our own industry which should not be passed over. We are told with all the emphasis of capital letters, that "New capital is the engineer's source of employment. The engineer and the builder are fed and clothed out of the savings of those in other occupations; but those, *e.g.*, the farmers of Northern France and of Russia, have at the moment such a slender margin that they cannot achieve the task which, incidentally, would be enormously to their own advantage. This, to many, may be a new idea, but it is evident that *if people in other industries did not save there could never be an engineering industry at all.*"

This "new idea" is blank nonsense, unworthy even of an

Oxford undergraduate. The engineer and the builder are no more fed and clothed out of other people's savings, or out of savings at all, than any other workmen. They are fed and clothed, year by year, like everyone else, by the contemporary labours of those who produce food and clothing, which are exchanged, at each moment, for the labour of the engineer. . . .

Why Not Give the Facts as to Profits?

It is to be noted that the engineering employers support their argument for a drastic reduction of wages by no facts and no statistics as to the actual results of their enterprises. They imply that these are making no profit whatever now, and that their works are running at a loss. But they do not put the cards on the table. Even without revealing the profit and loss account of particular firms they might, at least, have produced a statement showing (as regards the membership, taken as a whole, of the Engineering Employers and the National Employers' Federations) the total cost of production and the total proceeds of sales, as the mineowners have done. Before the workmen can be expected to believe that the British engineering industry is working at a loss, such an authoritative statement must be published. It is not produced because it does not yet exist. *The employers do not themselves know what their fellow-employers are making.* Only the Inland Revenue officials at Somerset House have any approximation to knowledge on this point; and, to judge from what leaks out privately, supplemented by what is published now and again in joint stock company prospectuses and reports, *there is the greatest possible range of difference between firm and firm.* . . .

It is taken for granted that the employers are to pocket the exceptional profits of good years, but that, in bad years, the workmen are to make good the loss by a lowering of their standard of life. But the very justification for leaving to the employers the exceptional gains of good years is that the employers, in turn, should stand the racket of the bad years. The workman has no share in the gamble, and the wage-earners' standard of life ought to be at all times maintained intact.

The employers' present argument for wage reductions ignores all this; their case is that whatever may have been the state of things down to August, 1920, the flow of new orders has greatly fallen off, lessening of engineering work to be done has already led to extensive discharges, and there is every prospect of a continuance of the slump leading to losses which they have no means of meeting otherwise than by a cut at wages. . . .

No wonder the prices of the shares keep up! From one end of the country to the other engineering firms which find themselves this year making, not losses, but merely less abundant profits than in 1912-14, are sending in their claims for repayment of the Excess Profits Duty that they have parted with during 1915-20. This fact is known to every engineering employer.

Is it quite honest to publish a long pamphlet, insinuating on every page that the employers are making huge losses and have no prospect of avoiding still further losses, except by a drastic cut at wages, without mentioning the fact that practically every engineering firm in the kingdom, which has begun to make losses (or even to find its profits falling below the 1912-14 standard) is already sending its claim for repayment of its Excess Profits Duty? Many tens of thousands of pounds have already been issued by the Treasury to engineering employers during the last few months in such repayments.

In view of these circumstances, the first step must be to put all the cards on the table. Without any revelation of the business of particular firms, there can be no valid objection to the production of an accountant's certificate showing, for each of the past ten years, as regards all the firms associated in the Employers' Federations:—

(*a*) The aggregate cost of production and working;

(*b*) The total net proceeds of sales;

(*c*) The aggregate amount paid to Government as Excess Profits Duty, and the portion of that amount that has already been repaid.

(*d*) The aggregate amount distributed to partners and stockholders of all kinds.

Specific Instances of Foreign Competition.

Although the employers carefully conceal the facts and statistics of their enterprises, on which alone any valid claim for a reduction of wages could be based, their pamphlet abounds in alarmist "hearsay" statements—unauthenticated, obviously unverified by the writer of the pamphlet, and unverifiable by its readers—as to foreign competition. We are presented with as many as six and a-half pages of statements (unsupported by details or statistical proof) as to alleged undercutting by foreign manufacturers and "orders lost to this country." Trade Unionists, whilst fully aware that manufacturers in other countries exist, and that they naturally secure some of the orders that British firms would like (at their own prices) to execute, will not be impressed by these instances. *They have heard them all before.* At every conflict with the employers over wage-rates and conditions, from 1851 down to last year, the same bugbear of foreign competition has been, at every recurring period of "bad trade," trotted out. Exactly similar cases have been cited of British tenders being rejected in favour of those of foreign firms. Almost identical instances have been adduced of orders cancelled, withdrawn, or transferred, and just the same insinuation is made that the only remedy is for the British workman to submit to a reduction of his wages. *Each time, during the past 70 years, subsequent events have shown the scare to have been an illusion.* Within a very few years on each occasion the amount of engineering products exported to other countries has not only gone back to its former height, but has actually greatly increased, and the profits of the successful employers (as revealed in the last few decades by the published prospectuses and balance sheets of their joint stock companies) have grown by leaps and bounds. And now, when those exports have risen to a height surpassing the wildest dreams of the engineering employers of 1851, with an aggregation of profits during the past decade that would have made them gasp and stare, the same old bogey of foreign competition is trotted out, almost in the same words as in the preceding generations!

Such denseness of comprehension and failure to learn from experience is surely somewhat remarkable. It is strange that the employers and their scribes do not realise that, in bewailing the frequency with which, in bad times, they tender in vain, only to find orders going elsewhere, they are merely suffering from an illusion. What is real is the universal but temporary falling off of demand. What is illusion is the impression that our rivals are doing better than ourselves. When trade is good and firms are "booked up" with orders, they do not put in tenders for every job that is advertised. They may, indeed, refuse to tender at all. When, on the contrary, work is slack, they tender on every opportunity for every job they can hear of. If, because business is bad, every engineering firms puts in, this year, four times as many tenders as last year, there must necessarily be four times as many tenders rejected as there were last year, leading every firm, quite sincerely, to believe in four times as many instances of "losing trade by foreign competition," four times as many cases of the "shortsightedness of the workmen in demanding such high wages," four times as many opportunities for demonstrating the "ruin of the British engineering industry"! Yet it would be all illusion due merely to the increased frequency of tendering by all the firms.

As a matter of fact, there is no more "foreign competition" when trade is bad than when it is good. At all times foreign engineering firms exist, and do business in competition with others in their own and foreign countries. Extraordinary as it may seem to simple-minded British employers, we do not find these foreign engineering firms exceptionally busy and prosperous just when British engineering firms are slack and "losing money." On the contrary, experience shows that it is just in the years that British engineering is flourishing, working overtime, and making large profits that our foreign competitors are having the same experience. Equally is it the case that years of slump affect all countries. And there is a reason for this universality. Each country gains by the prosperity of its rivals; and, on the other hand, when bad times come it suffers along with its rivals. Nevertheless, the delusion is, among engineering employers, almost universal. At this very moment, when British engineering firms are telling their workmen that only by a reduction of wages can they cope with the Belgian, German, or American competition, as the case may be, we have information that Belgian, German, and American engineering firms are enforcing on their own workmen reductions of wages and increases of working hours, on the plea that without these they cannot compete with their British competitors and rivals (or Belgian, or German, or American, as the case may be), and in each case the employers are quite honest in their arguments. They are going on, generation after generation, making, through sheer ignorance, the same economic blunders. The answer to their tale of woe is simply, "It is not true."

(*To be continued.*)

Decline of Italian Industry.—The *Economic Review*, quoting from *Economista d'Italia*, states that during the war the Italian engineering industry made such progress that it was able to export even the class of machinery for which Italy had previously been dependent on the foreigner. At present it is passing through a crisis. Several firms are still engaged in the execution of outstanding orders, but as few new ones have come in their activity will be appreciably reduced. Many orders have been lost owing to the successful competition of Germany, Hungary, and Czecho-Slovakia. In a recent tender for electrical plant the prices offered by German firms were a third lower than the Italian offers. The construction of a complete set of paper-making machinery was adjudged to a German firm at M. 2 mill., equivalent to L. 800,000, whereas the lowest Italian tender was L. 1,250,000. The same results have occurred with regard to aviation plant and railway rolling stock.

Patents: Licences of Right.—The *Board of Trade Journal* states that, by virtue of the provisions of Sec. 24 of the Patents and Designs Acts, 1907 and 1919, the undermentioned patents were amongst those endorsed "Licences of Right." on May 11th, 1921:—No. 974, of 1913 (J. G. Johnson, Badische Anilin and Soda Fabrik), "Improvements in and relating to chemical reactions in gases by means of electric arcs." No. 113,523 (3,213, of 1918). (N. V. Fab. van Instrumenten en Electrische Apparaten "Inventum,") "Improvements in electric heating apparatus."

ELECTRICITY SUPPLY TARIFFS.

At an ordinary general meeting of the Institution of Electrical Engineers, held on April 26th, a discussion on "Tariffs" was opened by Messrs. J. R. Blaikie and J. W. Beauchamp, each of whom read a paper. Abstracts of the papers follow :—

Electric Supply: Present Conditions and the Hopkinson Principles.

By J. R. BLAIKIE (*Abstract*).

The paper draws attention to the changes that have come about since the late Dr. John Hopkinson devised the well-known system of dividing the costs of electric supply under two headings, viz., fixed and running charges. At that time electricity was used almost entirely for lighting, and he showed how it might be sold at low rates to compete with gas and still make a profit.

Dr. Hopkinson's concluding sentences were : "It is hopeless to compete with gas in this country all along the line if price is the only consideration. But with selected consumers electricity is cheaper than gas. Surely it is to the interest of those who supply electricity to secure such consumers by charging them a rate having some sort of relation to the cost of supplying them."

It is important to notice the scope and limitations of the problem as thus set forth. There are certain assumptions which have been proved to be thoroughly justified so long as the bulk of the output was for the purpose of lighting, but which do not appear to be applicable, as they stand, to the large undertakings that have since grown up, where lighting constitutes only 10 or 20 per cent. of the output, for example : That the central supply is always ready to supply the maximum demand, which means machines actually running; that all consumers cost the same in wages per kilowatt of demand, and that all consumers cost the same in capital charges per kilowatt of actual demand.

If we divide consumers broadly into two groups, viz., those who require a supply for seven days a week, and those who require a supply for six days a week, we find in the seven-day group : Public lighting, domestic lighting, some heating, a small amount of power and, in certain cases, traction supply; and in the six-day group : Practically all factory power and lighting supply, shop lighting, and some heating.

If we assume that the heating demand in the seven-day group is balanced by the shop lighting in the six-day group and exchanged, the percentage error in the whole group is probably quite trifling in the majority of cases, and the problem is much simplified.

With reference to the Hopkinson assumptions it will be admitted that : In the matter of coal consumption there must be a very considerable difference between the two groups, as the seven-day group not only demands service for more days a week, but also for more hours per day. The factory group is usually limited to, say, 60 hours a week, at definite times; the wages of the seven-day group are much in excess of those for the six-day group, and capital charges are much less per kilowatt in the six-day group for many reasons. The expenditure in mains and services is undoubtedly less, as in the majority of cases low-pressure distributors are entirely eliminated, sub-station space and sometimes buildings are provided by the consumer, and there is an opportunity at the generating station of installing large sets at a lower initial cost per kilowatt.

With these points in mind we can now consider the need of reviewing the whole situation and the possibility of measuring the various differences indicated, with the object of arriving at a satisfactory system of analysis and finally framing tariffs to suit. Since the price of coal has risen so enormously and rates of wages, &c., have increased, we find a remarkable change in the relative values of the components of the fixed charge.

In a comparative study of fixed charges as given for Hopkinson's hypothetical station, for an actual case 1914-15 and for an actual case 1919-20, we get the following percentages: Coal, 21, 23, and 32; other charges, 22, 37, and 42; and capital charges, 57, 40, and 26.

So long as the capital charges were the dominating component of the fixed charge, the assumption that all consumers called for an equal readiness on the part of the undertakers to supply did not make an important difference. Now that coal and wages predominate, the differences between classes of consumers with reference to readiness to supply becomes very important, and it is this feature that we have to watch carefully in trying to hold our own against the possibility of private plants in large factories. The fear of gas competition in lighting disappeared with the introduction of the metal filament lamp.

If the central supply does not take full credit for the saving due to limited hours of demand, the margin of profit will become very narrow indeed at competitive rates. In coal consumption, the superior running economy of the central supply suffers a discount in mains and transformer losses. In other charges a factory can often claim as good figures as the central supply, particularly where a fair number of engineering hands are employed. In capital charges it is doubtful if the factory cannot do as well, and it must not be forgotten that the central supply is always handicapped with the cost of mains and transformers.

Taking all these points into account the factory load is a serious problem and justifies careful consideration in order that the supply department may feel sure of its ground in offering sufficiently low rates to consolidate the business, and work profitably at the same time.

To go a step further, there are, I believe, many engineers who find it very difficult to decide how the inevitable increases are to be applied. There is a general feeling that they should be applied to the lighting, one of the most effective reasons being that power contracts are very difficult to alter. On the other hand, municipal bodies are apt to favour the taxation of the power consumer.

From conditions as they are to-day it is possible to retrace our steps and start again, following Dr. Hopkinson's methods, with new facts, new observations, and changed conditions. We have before us still the brilliant idea of grouping and selecting consumers, and dividing the costs between them in such a manner that we may safely quote low rates to certain classes.

Having stated the need and indicated the advantages of regarding consumers under the two headings of six and seven days, the problem arises as to how the costs can be segregated.

Beginning with coal we can follow Dr. Hopkinson and take a hypothetical station running under average conditions. Let us assume that the plant consists of four sets of turbo-generators, each of 1,000 kW, three being in service at a time to meet demands as follows: For lighting, 800 kW, and for power 1,600 kW; total, 2,400 kW. If the lighting load factor is 12½ per cent. the output per annum is 876,000 units, and if the power load factor is 23.7 per cent., 3,324,000 units, a total of 4,200,000 units; the whole station load factor will thus be 20 per cent.

If the total observed coal consumption is 6 lb. per unit sold, and the running coal 2.5 lb. per unit sold, then the total coal consumed will be 11,200 tons, which we will now apportion to the two supplies: Running coal units × 2.5 lb :—Power 3,700, lighting 980; total 4,680 tons. Fixed coal : kW × 2.72 tons per annum :—Power 4,350, lighting 2,170; total 6,520 tons. This gives the following totals :—Power 8,050, lighting, 3,150; grand total 11,200 tons, or expressed as lb. per unit sold 5.43, 8.05, and 6 respectively.

The total capacity of the system in kilowatt-hours may be :—One 1,000-kW for 8,760 hours, 8,760,000; one 1,000-kW for 51 weeks of 60 hours, 3,060,000, and one 1,000-kW for 25 weeks of 6 hours, 150,000; total, 11,970,000 kWh. For running this number of plant kWh without generating any current we have already allocated 6,520 tons as fixed coal, or 1.22 lb. per plant kWh run.

For comparative purposes between one station and another or between one year and another of the same plant, it is the percentage of units output to the plant kWh run that is needed. In this case it is about 35 per cent., though the ordinary load-factor scale shows 20 per cent.

To continue with our hypothetical station. If power alone were required two sets would run 51 weeks of 60 hours. Lighting alone would require one set for 8,760 hours, a total of 14,880,000 kWh.

But by the co-operation of the two supplies we have seen that only 11,970,000 plant kWh run are necessary, or about 19.6 per cent. less. We can therefore reduce each of the above items by 19.6 per cent.

In the probable working of the hypothetical station the percentages of output to plant kWh run in the two groups are :—Lighting 12½ per cent. and usual load factor 12½ per cent.; power 67½ per cent. and usual load factor 23.7 per cent.

It follows, therefore, in the six-day group that beyond a load factor of about 35 per cent. on the usual scale we cannot expect a further reduction in coal consumption for power, as at this load factor the plant would be running at 100 per cent. activity on the plant kWh scale.

Any further increase in output could only be obtained by increasing the number of plant kWh. The coal per unit could only be decreased beyond this point by employing more efficient plant.

Through the courtesy of the several engineers concerned, the author has been able to examine and experiment with the figures of several undertakings, and the results obtained confirm his figures for the plant kWh scale of the hypothetical case.

It was suggested by Dr. Hopkinson that the running charge should contain, besides the running coal, certain proportions of wages and stores. Mr. Arthur Wright and others have shown this method to be very satisfactory for a number of years, but, incidentally, always on a rising load factor. If for some reason, such as "summer time" or shorter factory hours, the load factor drops, it is difficult to believe that there will be any reduction in expenditure except on account of coal. It is suggested, therefore, that the safest policy is to limit the running charge to coal only.

A method of finding the fixed coal has already been described. The two other components of the fixed charges, viz., capital charges and all other charges, can be divided and allocated to the two groups by simultaneous equations, as in the case of the coal. In these cases, of course, "kilowatts demanded" are substituted for "units," and values are found for each group per kilowatt demanded.

Examples from the actual figures are given in the paper.

From these figures it is seen that the cost of private lighting is about 4½ times the cost of power, and the cost of public lighting about twice the cost of power, with low-priced coal.

There are two views of charging held: The value-of-service theory, and the cost-of-service theory.

The first simply means getting as much as possible having regard to the possibility of competition. The second is a rate which includes a comfortable return on capital, and is found to be very palatable to public utility commissioners.

An extreme case of the value-of-service theory is found in a scheme which is in successful operation in a few undertakings, known as the "Point Five" system. It is a compound charge which has no sort of relation to the cost of supply; the fixed charge is based upon the rateable value of the property, and current is supplied at ½d. per unit.

For those who feel constrained to supply on the cost-of-service theory, as public policy, the following methods can be applied: The Hopkinson compound rate and variations; the Wright maximum demand system; the Doherty system (American) which is a three-charge rate similar to the Hopkinson, the third rate being a consumer's charge to cover book-keeping, meter reading, and such charges that are common to every consumer, large or small; and various time-controlled two-rate meters.

None of these systems, however, defines what the cost really is.

Dr. Hopkinson's discovery that the costs of preparation were very high and that the costs of continuing to supply were very low, naturally suggests that the first charge should be high and the second low. This form of tariff may encourage waste at the high rate in order to attain the low one, and at the low rate because it is not worth the trouble of economising. Proposals to dispense with meters altogether are an encouragement to waste, and are against national interests. In the opinion of the author, the value-of-service theory is the only one of practical value, and the aim of the management should be substantial profits, with an eye to future competition. In the case of public authorities these profits can be applied to various reserve funds or to the relief of the rates.

Returning to the form of analysis proposed, it remains to show the practical application of one form of tariff dealing with the points that arise.

Having divided the supply into suitable groups, there is no reason why the usual load-factor differentiation should not apply to each group, as far as is legally and commercially practicable.

In addition, a coal clause should be devised to adjust automatically the rates of charge with the price of coal.

For the coal in the fixed charges an opportunity occurs to compensate also for rises in wages and the increasing price of plant and capital. It will be generally admitted that these costs must follow, more or less, the price of coal.

It is, therefore, possible to arrange what may be called a fixed-charge clause as well as a coal clause, both varying automatically with the price of coal.

Power.—In order to compete successfully with private plant, and to meet the changing conditions of hours of labour, it seems essential that all power consumers (six-day group) should be strictly on a load-factor tariff. At the same time, in the author's opinion, a suitable maximum charge should be fixed in order to keep the operation within the limits of fair trading.

As a first approximation the cooking and heating section has so far been included with the six-day group, and in justification it may be pointed out that it possesses in a marked degree many of the characteristics of the large six-day consumers.

There are mains problems to be taken into account, but actual practice may show that in many cases the cooking load will not overlap the heavy lighting load.

Promiscuous heating naturally occurs during the winter months, and is also confined to definite periods. The same arguments apply as in the case of cooking, the only difference being that, whereas cooking loads occur at definite times during each day throughout the year, heating occurs at more irregular times, but only for about half the year.

The lighting of factories where the supply is high-pressure only and limited to factory hours, may be treated as power load. It tends to lower the load factor of the factory and draws extra payment in this way.

As regards the seven-day group, if power is used on Sundays it will probably have a very good load factor on the usual scale, and therefore the price will not be unreasonably high. If there is a considerable Sunday load the analysis will show no very marked difference between the fixed charges of the two groups.

Frequent reference has been made to the relation between units output and what has been called plant kilowatt-hours. It might be expressed as a percentage and is in need of a name. Until a better one is forthcoming the author suggests "work factor." For all statistics connecting coal and units it is essential to know this factor. Comparisons between different undertakings on thermal efficiency are useless without this factor for correction, and, very possibly, a few more factors. We have seen that the consumption of the same plant with the same load factor can vary from about 12 lb. to 8 lb. or less, for no other reason than the development of power load, which has a high "work factor" and therefore improves the average.

On the whole supply the effect of improved plant can be measured by correcting the work factor, and gives a useful indication when it is necessary to balance capital expenditure with improved fuel consumption.

Load factor, as we have seen, is by no means the whole case. Comparatively small stations situated in districts with a load factor of about 30 per cent., but with a high "work factor," might easily be more efficient than a super-power station. With the large amount of data collected day by day in the larger undertakings, there should be as much scope for special and continuous research as there is for a chemist in a steelworks. Continuous checking and testing of the tariffs are as important as watching the cost of generation. Occasions arise when the timely correction of properly measured amounts may easily be worth ten times the saving due to the best engine-room and boiler-house supervision. It should never be forgotten that practically all tariffs are based on certain assumptions, liable to vary with every new development. It may be the expansion of some particular service, the price of coal, factory hours of labour, or a gradual change of power factor.

(*To be continued.*)

JOINT ELECTRICITY AUTHORITIES.

The West Riding Inquiry.

An inquiry on which hinges the future of electricity supply and distribution in the greater part of the West Riding of Yorkshire was opened in the Leeds Town Hall on Wednesday last week by the Electricity Commissioners.

The local authorities concerned have been unable to agree on a joint scheme, the main item of discord being the inclusion or exclusion in its present state and capacity of the Yorkshire Electric Power Co., which already supplies a large area in the West Riding. The result is the projection of three separate schemes, one by the Leeds Corporation, providing for the co-operation of the Power Co. for 42 years, and its purchase at any time after the expiration of that period; the second by a conference of local authorities in which Bradford is the central figure, providing for the immediate absorption of the Power Co.; and the third by the Power Co. itself, which suggests the company as the future Joint Electricity Authority in embryo, the municipalities to become joint controllers by the purchase of shares.

The Commission was composed of Sir John Snell (chairman), Sir Harry Haward, Mr. H. Booth, and Mr. A. Page, with Mr. E. W. Hudson as legal adviser and Mr. D. S. Cumberlege as clerk. Mr. E. Wooll, of Liverpool, represented the Leeds Corporation; Mr. A. T. Miller, K.C., and Mr. F. R. D. Wright, the conference of local authorities; Mr. J. Hunter Gray, K.C., and Mr. R. A. Shepherd, the Yorkshire Electric Power Co.; Mr. J. C. McGrath, the West Riding County Council; and Mr. J. A. Greene, the West Riding District Councils' Association. Affected railways and other bodies were also represented.

In an explanatory address occupying nearly two hours, Mr. Wooll put forward the Leeds scheme. He emphasised the care taken in the compilation of it, and deplored the lack of outside support accorded to it. For the latter, he said, there were various reasons, but the primary ones were undoubtedly the questions of principle of representation and the unsatisfactory and almost chaotic condition of legislation at the present time with reference to those matters. His clients had been much impressed by the cogency of the various representations of the committees instituted by the Government in recent years, both with regard to the conservation of coal and the improvement of electricity supply. But with the imperfections of the Statute of 1919 they found themselves left with the necessity for the development of electrical re-organisation and without any powers of compulsion with reference to the acquisition of electrical undertakings, and without any genuine or satisfactory financial endowment. This had induced two results—the attitude of those who said that the Act was so imperfect and the situation so chaotic that one must do nothing, but must acquiesce in what was virtually stereotyping, if not paralysing, electrical development, and the other the category of those who said that these statutory defects and inadequacies would be supplemented at an early date, and schemes could be put forward in the confidence that powers for coercion and financial endowment would be available.

Leeds did not desire to be identified with either of those categories, neither sharing the apathy of those who believed that the present position involved essential futility, nor the precipitancy of those who were anxious to run before they had the power to walk. Its attitude had not been one of selfish exclusiveness. Counsel traced the local developments in the matter before the Act of 1919, the conferences between the local authorities after the passing of the Act, and the reasons for the retirement of Leeds from the deliberations of the conference. Since then, he said, the residue of the local authorities had gone on with their scheme, and Leeds had been compelled reluctantly to plough a lonely furrow, but a furrow which they hoped even yet might produce a useful electrical harvest. The scheme was put forward as one which must supply invaluable data and material, and which might well, after the defects and impossibilities of the Bradford scheme had been more thoroughly exposed and more genuinely appreciated, even evoke the support of those who at present were behind and in apparent sympathy with other schemes.

In the drafting of the scheme they had carefully limited themselves, apart from finance.[*] They had not invoked the assistance of any powers with which the legislature did not provide them. They did not wish to talk of compulsion or coercion when they had no powers of compulsion. They wanted to see how far their scheme, which was well within the four corners of the Statute, could be seriously regarded as a contribution to electrical economy and efficiency. Its general objects might be summarised conveniently under four heads:—

1. To encourage efficient autonomy. Under their scheme the heads of great undertakings had the same impulse and the same incentive to develop their own electricity supply, and to surpass their own past records in efficiency.

2. What might be called the main object, to enlist the co-operation of the Yorkshire Electric Power Co. They regarded the Power Co. as not only an inevitable but an invaluable factor in the electrical life of the area.

3. They wanted to avoid large and impossible capital commitments.

4. They most particularly desired to avoid the generation of friction, and to concentrate on the generation of electricity.

As for the area of the scheme, Leeds, like Bradford, had adopted that prescribed by the Commissioners, as suitable, and of convenient size. In that area there was a population of 2,114,000, of which Leeds accommodated 445,550, say, one-fifth. Leeds was also responsible for the generation of about 30 per cent. of the total electricity generated in the area in 1920. One peculiar feature of the electrical position in the area, which was almost unique, was that by 1935 there would be remarkably little difference in the situation, financial or electrical, either under any of the schemes or under independent evolution. It was not a practical electrical proposition to erect one super-station owing to the difficulty of finding adequate cooling resources within reasonable distance. That being so—and it was conceded in other schemes—whatever the scheme adopted there would only be moderate-sized stations, and, again, under any scheme, these would probably be three in number.

The scheme of representation on the controlling board provided for five members for Leeds, four for the Yorkshire Electrical Power Co., three for Bradford, and one each for Halifax and Huddersfield, with five for other authorities, and two for the West Riding County Council. The clause providing for the purchase of the Power Co. after 42 years indicated a minimum period during which it would not be absorbed, and gave ample opportunity for legislative changes. He admitted that the whole of that clause was *ultra vires* at present, but it served to show the attitude of Leeds towards the company. No negotiations had taken place between Leeds and the company on that clause so far.

Counsel also dwelt on some of the more important technical clauses, and on the suggested sites in the following suggested order of erection: Leeds, Wakefield, and Knottingley; and, in conclusion, said he did not propose to indulge in any criticism of the Bradford scheme. They had tried, but failed, to co-operate loyally. The Bradford scheme would have to stand—if it ever became a scheme—on support which did not include that of the dominant electrical factor in the area. To his mind, that was a fatal criticism, and when the consequences of it were appreciated by Bradford, and the bodies supporting it, some of them might wish to rally to a scheme which held within it a larger promise of co-operation and success.

The first witness called was Mr. C. N. Hefford, chief engineer and manager of the electricity supply department of the Leeds Corporation, who explained his working basis in arriving at the estimates of cost and output up to 1935.

On Thursday, Mr. Hefford again went into the witness-box. He had been under cross-examination since about noon on the previous day, and before he was released, completed a full day of the ordeal.

Mr. A. T. Miller, for the Conference of Local Authorities, opened the day's session, and elicited the information from Mr. Hefford that it was proposed in the Leeds scheme to erect a central distributing station at Morley, from which transmission cables would run, untapped, to sub-stations. In his opinion, the danger of failure of supply from tapping *en route* was so great as to justify further expense in laying a double set of cables. He admitted that this would lay them open to the possibility of the control engineer at Morley working the sub-stations unfavourably in relation to each other, but said the same thing might happen in any single generating station.

The witness agreed with Mr. J. Hunter Gray, K.C. (for the Yorkshire Electric Power Co.), that the company could supply the requirements of the area as efficiently as the new scheme, and that the cost of providing such a scheme by the company would be borne by the company itself.

Under the Leeds scheme, until you have legislation to enable the authority to get the finances, the scheme is impossible?—Yes.

The witness, answering further questions, admitted that the whole scheme was dependent on the agreement of the Power Co.

The Chairman (Sir John Snell): Do you not think the double system of transmission lines you contemplate will mean an unnecessary expenditure on the transmission system?—I don't.

You are of opinion that there will be no unnecessary expenditure of capital involved by the creation of a system of high-pressure transmission lines by the joint authority and of a secondary system of lower pressure, but still high pressure, transmission lines by the Power Co. or someone else?—That is so.

Is it your opinion that whatever the scheme adopted for this particular area the extra-high-pressure transmission lines will be necessary in addition to the secondary high-pressure transmission lines of the Power Co. or someone else?—It is.

Your point is that the protection of these important arteries is better carried out if they remain untapped from source to point of supply?—Most certainly.

Mr. Page: Is not that point dealt with by retaining one or possibly two untapped lines between such stations and using the others for the ordinary purposes of distribution *en route*?—I admit that is quite possible.

Would you advise it in your scheme?—I should not advise it. I don't like it at all.

Mr. Hunter Gray: I think you said earlier that you don't intend to supply and distribute. You would only supply to the secondary stations, which would themselves distribute?—That is so.

Yet in Section 29 of the scheme you have the power to distribute yourselves?—That is in districts where there is no supply.

It is put to me that there is no district without a supply?—That I cannot say.

Mr. Hefford, in answer to further questions, conceded that there was no engineering reason why the Power Co. should not do the work suggested, that the company's policy had never been an obstructive one, business negotiations had been amicable, and that it had expressed willingness to enter into working agreements with the Leeds Corporation.

Mr. J. A. Greene, for neighbouring small bodies, concerned himself particularly with the finance of the scheme. Did it not provide, he asked, that Leeds would get a capital station without paying any of the expense of creating it?

The Witness: It provides first for assistance by grant.

And it is quite clear to the Corporation that there will be no contribution from the ratepayers of Leeds at all?—Unless there is a deficit.

But surely a deficit would be met from the Exchequer? The capital expenditure on your Leeds station would be met by the Joint Electricity Authority, and not by the Leeds Corporation, although it would in effect supply the consumers within the city of Leeds?—Certainly.

Suppose there was no Joint Authority, in the interests of the city of Leeds would you have to have that capital station?—Yes.

And in that case who would pay for it? It would be met by loan in the ordinary way?—Certainly.

That might lead to an increase of rates?—It might.

But under this system there could be no increase in the rates, could there?—No.

The witness further agreed that there might be friction between the Joint Authority and Leeds itself, but thought Leeds would adopt any policy which was for the good of the area.

The Chairman: Your proposal does not in any way interfere with the distribution in any local government area?—That is so.

Mr. Greene: Do you expect as a result of this scheme that the price of electricity will be decreased?—I do.

Mr. J. C. McGrath, for the West Riding County Council, took up Mr. Hefford on that point, and both entered into much detail as to bases of calculations and estimates applying to future years, the estimates showing a saving on the scheme that would not be effected in the ordinary course of independent evolution of existing stations.

Mr. McGrath: At any rate, your scheme is entirely dependent on State aid? If that is not forthcoming the scheme falls to the ground?—If the money is not forthcoming, yes.

I suggest that it is a particularly bad time to enter upon any public scheme involving the outlay of large capital sums. Do you agree?—Yes, I do.

Will you agree that the economic conditions are extremely unfavourable?—Quite.

The Chairman pointed out that on the estimates the scheme would expend less money than would go in individual development of existing stations, for some years, at any rate.

Mr. McGrath: I suggest to you that the proposal is a very serious mistake, and that the proper thing to do would be to have trunk inter-connecting mains running from the capital power stations to the towns proposed to be served. I suggest that to centralise the whole thing at this point is not advisable?—I don't agree.

Mr. Hefford was also cross-examined for the Yorkshire Woollen District Electrical Tramways, Ltd., and was then re-examined by Mr. Wooll.

Sir Robert Fox, town clerk of Leeds, followed Mr. Hefford.

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[*] See Electrical Review, June 25th, 1921, p. 815.

On the question of the constitution of the controlling authority, he said it was not thought desirable to have a large governing body. Cross-examined by Mr. Mitler, he said the Leeds Corporation had come to the conclusion that so far as Leeds was concerned they could arrive at the same ultimate position without any Joint Authority.

But that would involve expense for Leeds?—Quite so.

Leeds will take no financial responsibility?—That is so.

I suggest that that is not a very fair position for Leeds to take up. They will want electricity just as much as anyone else in the future, will they not?—Certainly they will. They will take their fair share. At present, the witness added, Leeds could supply itself with electricity without any danger of its falling on the rates. They had been asked to take part in combating national waste, and they considered that if they were to do that and to help other places to do it, they were quite justified in saying there ought to be no call upon the rates of Leeds in doing so.

On the resumption of the inquiry, on May 20th, Sir ROBERT FOX denied that Leeds Corporation contemplated any preferential advantage to the city by its scheme; any advantage which might accrue from successful application for State subsidy would be enjoyed equally by all concerned, and any disadvantage which might result from the extinction, by gradual atrophy, of existing undertakings was not confined to the undertaking of the Yorkshire Electric Power Co.

Sir HARRY HAWARD questioned the witness as to whether he considered reasonable the fact—which he had admitted—that there was a certain element of double representation given in the settlement of the amount of electricity supplied in districts which were served by companies; under the Leeds scheme the companies would have representation and also the local authorities of the districts in which the companies operated.

The WITNESS agreed that there might be a little objection to that, but fancied that any remedy might prove worse than the disease. He agreed that it did not follow that the local authorities of the districts were entitled to equal representation with the local authorities which were authorised to undertake; but it had been a convenient way of constituting a sufficiently small board to be workable.

Sir HARRY HAWARD: Is it not rather an unusual method of constituting a Joint Authority, where you are providing for representation of different interests, to pool the voting? By a combination of certain of the voting parties those parties might elect the whole of the members of the authority.—I must arrive at some basis on which to constitute representation. The basis really applicable is that of consumption of electricity and the statutory requirement of representation of those who would provide the electricity. I suggest they should all have equal voting power because the one common and leading factor is consumption of energy.

Sir HARRY HAWARD: It seems to me that by pooling the votes and providing no definite representation of the two classes of local authorities and companies, you stand a chance of a particular combination getting entire control of the Joint Authority.—It opens the possibility, but I am prepared to take the risk. I cannot think a public-minded body would be open to a resort of that kind. Further, you would be open to that risk on any kind of constituted Joint Authority, and I don't think anything can debar the possibility of such methods of election. Sir Robert added that he would be prepared to amend the Leeds scheme in the direction of providing for definite representation until further order, giving Leeds five representatives, the Power Co. four, Bradford three, and the other authorities voting as a class.

Counsel for a railway company suggested that the amendment proposed would involve abandonment of the Leeds general principles.—Witness said it would obviously follow that there ought to be a provision that in any future revision of the scheme relative consumption would be the main factor.

The CHAIRMAN (Sir John Snell), commenting on the essential differences of attitude towards the Power Co.'s continuance or otherwise, as between the Leeds and Conference schemes, asked Sir Robert if he had had any negotiations with the company which he was at liberty to divulge, with regard to subsequent acquisition.—Witness said he had only had negotiations with the company with regard to a suggested working agreement. Asked whether he had any definite objection to the continuance of private enterprise, provided that it could be done efficiently in conjunction with existing plant and without involving local authorities in the heavy expense contemplated, the witness said he could not say that the view of Leeds Corporation had been expressed in that precise form, but its general attitude raised no objection whatever to private enterprise; it very much appreciated what private enterprise was doing, but in arriving at its conclusions it had had in mind the fact that whatever its point of view might be it had no power to do otherwise except with the consent of the Power Co. to be merged, which had never been anticipated as being likely to be obtained. It understood that there could not be public control unless the company was prepared to give up private enterprise on terms satisfactory to itself.

Is it the opinion of your Council that the object would be gained in the promotion of the best scheme, whether public or private?—Undoubtedly; it is purely a matter of business, and not of sentiment or politics.

Mr. ARTHUR COLLINS, city treasurer of Birmingham, gave evidence as a financial expert, on behalf of the Leeds scheme. In answer to Mr. Wooll, he said he had been consulted in connection with the financial side of joint electricity and other schemes up and down the country, and he wished it to be understood that his views related entirely to the West Riding situation, with its own peculiarities, and were not of general application. Leeds held a predominating position in this matter, not merely from the standpoint of responsibility for capital provision, but the actual incidence of expenditure, whether it should be borne by ratepayers or by consumers generally. The figures of connections in 1914 showed 36,000 kW for Leeds, as against 25,000 for Bradford, the next biggest, and the Leeds dominance was maintained throughout the years up to and including 1920 (as near the present as was ascertainable), when the Leeds connections were 81,000 and Bradford 55,000 kW. He had no definite statistics of the Yorkshire Power Co., but he understood the 1920 figure was about 29,000 kW.

Mr. HUNTER GRAY, for the Power Co., said the figures for that authority were: 1914, 30,100, increasing to 62,600 in 1920, so that the company came second and Bradford third.—Witness accepted the figures, though he expressed surprise to learn that Bradford, apparently, as leader of the Conference, was proposing to buy out an undertaking bigger than itself. The figures given meant that since 1914 there had been approximate increases of 125 per cent. for Leeds, 111½ per cent. for Bradford, and 110 per cent. for the company, despite the retarding influences of wartime. There certainly had been a striking electrical development in the area. For the future Leeds was estimating a demand for 79,000 kW in 1931 and Bradford one for 62,000 kW. As measured by energy sent out Leeds, as amended by the engineer, anticipated in 1931 a supply of 190 million kWh, and Bradford 140 million. He was sorry he had no corresponding estimates of the Power Co. The witness emphasised the fact that Leeds alone was doing practically as well as anybody on the present conditions as measured by cost. During the year ended March, 1920, Leeds was able to deliver coal into the generating station at an average price of 25s. 8d. per ton, which was cheaper than any other station whose figures had been given, and the cost of generation was only 0.733d. per unit, the lowest cost figures of any given; Bradford's, the next lowest, was 0.867d. The coal cost in Leeds had been 0.509d., considerably lower than most others, and Bradford's was 0.529d. Those facts, witness suggested, lent strong support to the Leeds view that it was going a long way for the general good, and should not be called upon to pledge its rates. It had been said in evidence that Leeds was in about the same position whether acting alone or in the scheme, but as a matter of fact, it was slightly worse off financially under the scheme than if it carried on alone.

(*To be continued.*)

A Heart-breaking Appeal.—The supply manager who received, and has sent us, the following piteous appeal must be truly hard-hearted if he turns a blind eye to it. Even if he be so callous as to ignore the moral suasion, he must give way before the dire threat contained in the third paragraph of this extremely cogent letter:—

MOST IMPORTANT.

"Confectioner's Shop," 19, —— Street.
The Manager, March 31st, 1921.
Electric Works.

DEAR SIR, I Happen to live at the above address, and have A place of Business for which I find Rent and Rates are very heavy *and* I open my Shop all day on A Wednesday Every Week. There is no Half Holiday in my Business. And last night I was Without Light or Fire for A very Long Time, I have no Fire for any purpose Except Electric Light.

How Would you feel if you had been in my place Last Night. The pressure has been very poor for Heating purposes for A good While *and* Seeing how things are *Even now* Do you propose to Extend and Try to supply Electric Light and Heat for the new Houses on The Estate before you have Some means of giving A Better Supply to your present Customers. Just Think these matters over please. *and* I hope you will endeavour to let us have A Better Supply of Electricity and A Reliable Continuity, before you *attempt* to Supply a New lot of houses. If the Supply is So Feeble Now and Apt to Fail entirely What Would happen if you had more Customers to Supply. Please Try to prevent us being in the Dark in the Shop in Business Hours *and* Please Do Not Let us Freeze for Want of Electricity.

I Hope you Can Manage at all times to let us have enough Electricity To Boil The Kettle. If *not* You may expect us to Come to Your house to Warm our Selves, See A Light *and* have A Cup of Warm Tea. There are Five of us here, and So your Family would be A Little Larger if we all come. And So For your Own Comfort Sake Perhaps you will Try Your Best To Comfort us with A good *and Constant* Supply of Electricity and oblige

Yours Respy.,
Mrs. L.

P.S.—There is plenty of Electricity in the Atmosphere. Get it and Send us plenty please *and* As Soon as you can Let us have it Cheaper Than it is. God will *not* Charge you anything at all for the Supply.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

13,091. "Electric arc welding." C. Hardy. May 9th.

13,117. "Electro-magnetic apparatus for recording sound." A. F. Sykes. May 9th.

13,173. "Braking direct-current series motors with recuperation of energy." G. Meyfarth and Soc. Anon. des Ateliers de Secheron. May 9th. (Switzerland, August 18th, 1920.)

13,181. "Flux for welding or depositing metals electrically." J. R. Booer and District Chemical Co., Ltd May 9th.

13,182. "Generation of continuous waves for wireless telegraphy and telephony." A. Blondel and M. Touly. May 9th.

13,192. "Apparatus for production of electrolytic compounds and their employment." J. T. Niblett. May 10th.

13,202. "Electric lighting or illumination." A Bell. May 10th.

13,224. "Means for adjustably fixing and retaining magnetos, &c., on bracket." J. B. Brown. May 10th.

13,231. "Trolley-guiding device for electric tramcars, &c." G. A. Lister. May 10th.

13,232. "Electric switches for motor-vehicles, &c." G. A Lister. May 10th.

13,245. "Windings of alternating current machinery." British Thomson-Houston Co., Ltd., and H. W. Taylor. May 10th.

13,255. "Electric locomotives." E. C. R. Marks (Soc. Anon. Constructions Electriques de Belgique). May 10th.

13,266. "High-frequency multiplex signalling system." Western Electric Co., Ltd. (Western Electric Co., Inc.). May 10th.

13,270. "Apparatus for cancelling electrical signals." J J. V. Connaughton and M. J. Railing. May 10th.

13,279. "Cut-out devices for magneto-electric machines." A. M. Allen and R. B. North. May 10th.

13,280. "Magneto-electric machines." A. M. Allen and R. B. North. May 10th.

13,288. "Thermionic devices." W. Fitze, Ges. fur Drahtlose Telegraphie, and A. Meissner. May 10th.

13,294. "Electro-magnetic radiation or induction." W. E. Hitch. May 11th.

13,304. "Electrically-propelled ships." R. MacGregor. May 11th.

13,335. "Electrical apparatus for remagnetising magnets." S. H. Best. May 11th.

13,336. "Sparking plug." R. Bosch Akt.-Ges. May 11th. (Germany, June 17th, 1920.)

13,348. "Interlinking electric power stations." A. M. Taylor. February 2nd.

13,349. "Electrical distribution in alternating-current systems." A. M. Taylor. February 7th.

13,350. "Electrical distribution in alternating-current systems." A. M. Taylor. February 9th.

13,351. "Electric combined lock and bolt." E J. Francis and W. Francis. May 11th.

13,355. "Electric resistances." J. J. J M. Kluijtmans May 11th.

13,369. "Spring couplings for electric locomotives, &c." F. Krupp Akt.-Ges. May 11th. (Germany, May 28th, 1920.)

13,381. "Thermal relays." Metropolitan-Vickers Electrical Co., Ltd. May 11th. (Germany, June 3rd, 1920.)

13,391. "Current-distributors of electric ignition systems." J. H Ronbaken. May 11th.

13,398 13,399. "Electric accumulators." W. O. Garbutt. May 11th.

13,405. "Incandescent electric lamps." K Kambayashi. May 11th.

13,406. "Thermo-couple manometers." K. Kambayashi. May 11th.

13,425. "Systems for producing electrical oscillations." British Thomson-Houston Co., Ltd. (General Electric Co.). May 11th.

13,426. "Electric discharge devices." British Thomson-Houston Co., Ltd. (General Electric Co.). May 11th.

13,427. "Regulating systems for dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). May 11th.

13,441. "Commutators for electric ignition systems." F. W. Baker. May 12th.

13,467. "Device for recording and checking telephone calls." C W. Cooke, J E. Copeland, W Rogers, J. G. Sutherland and W. C. Sutherland. May 12th.

13,487. "Apparatus for protecting electric supply circuits comprising aerial lines." Akt.-Ges Brown, Boveri et Cie. May 12th. (Germany, May 15th, 1920.)

13,488. "Commutation of a commutating electric machine." K. Nobuhara. May 12th.

13,492. "Transforming an alternating electric supply to a supply having a larger number of phases." S A. Stigant. May 12th.

13,495. "Method of distributing electrical power." R. W. Cowin. May 12th.

13,497. "Electric furnaces." L. J. Hancock and T R. Hancock. May 12th.

13,513. "Automatic telephony." L. Turcat. May 12th. (France, May 12th, 1920.)

13,516. "Attachment for electric lamps, lamp-holders, &c." F. W Salway. May 12th.

13,521. "Relays." S. M. Day. May 12th.

13,557. "Device for explanation of construction, &c., of electric armatures." C. B. Brook. May 13th.

13,559. "Resistance element for electric heating, &c., apparatus." J. K. Catterson-Smith and C. W. Stopford. May 13th.

13,561. "Earphone." V. A. Foot. May 13th.

13,566. "Methods for controlling relative phases of alternating current." W. H. Eccles. May 13th.

13,572. "Wiring systems for electric light and power installations." L. J. Lepine. May 13th.

13,596. "Electric switches." A Reyrolle & Co., Ltd., and J Schuil. May 13th.

13,601. "Lapping strips of paper, &c., on electric conductors, &c." C. J. Beaver and E. A Claremont. May 13th.

13,604. "Universal relays." General Railway Signal Co. May 13th. (United States, July 19th, 1920.)

13,619. "Cooling arrangements for dynamo-electric machines." Metropolitan-Vickers Electrical Co., Ltd. May 13th. (United States, May 17th, 1920.)

13,621. "Process for obtaining deposits of iron by electrolysis." Soc. d'Electro-Chimie et d'Electro-Metallurgie. May 13th. (France, June 9th, 1920.)

13,622. "Process for obtaining metallic electrolytic deposits easily detachable from the cathode." Soc. d'Electro-Chimie et d'Electro-Metallurgie. May 13th. (France, June 18th, 1920.)

13,630. "Electric signalling." B. Davies, Eastern Telegraph Co., Ltd., and F. Ryan. May 13th.

13,642. "Electric railway trains with refrigerator cars." Akt.-Ges. der Maschinenfabriken Escher, Wyss, et Cie. May 13th. (Switzerland, May 25th, 1920.)

13,657. "Device for automatic synchronisation of electric clocks, &c." C. W. Hirst. May 13th.

13,665. "Magnetic clutches, &c." J. W Hall. May 13th.

13,666. "Electrically heated vulcanisers." H. Frost & Co., Ltd., and W H. Welch. May 13th.

13,668. "Current-collecting shoes." H. F. Gaze and J. D Twinberrow. May 13th.

13,671. "Automatic reversing switch, &c., for dynamo-electric machines." A H Darker and J Stone & Co., Ltd. May 13th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

20,368. "Combined electric bell and battery." S. R. Brown. August 19th, 1919. (162,310.)

21,585. "Electrodes for electrical accumulators." M. Kreber. November 3rd, 1917. (132,259.)

28,796. "Contacts for electrical switches, switch fuses, plug connectors, and the like." H. F. Shanahan. November 20th, 1919. (162,320.)

32,244. "Thermionic valves." H. St. J. De A. Donisthorpe. December 23rd, 1919. (162,338.)

32,576. "Magnetos." American Bosch Magneto Corporation. February 20th, 1919. (139,152.)

32,597. "Magnetos for multicylinder engines." American Bosch Magneto Corporation. March 27th, 1919. (Addition to 139,152.) (140,748.)

1920.

1,810. "Rotary apparatus for converting electric currents." British Thomson-Houston Co., Ltd. (General Electric Co.). January 20th, 1920. (162,353.)

2,029. "Mouthpieces for telephone transmitters." G. A. Lanes. January 22nd, 1920. (162,356.)

2,338. "Electric valves or tubes for use in wireless telegraphy and telephony." A. K. Macrorie, C. L. Fortescue, G. B. Bryan and H. M Airey. January 23rd, 1920. (162,367.)

2,501. "Burglar and like alarms." A. V. I. Bond. January 27th, 1920. (162,379.)

2,710. "Electro-deposition of metals upon iron and alloys of iron." R. J. Fletcher. January 28th, 1920. (162,391.)

2,822. "Electric transformer arrangement." F. E. Berry. January 29th, 1920. (162,394.)

3,313. "Electro-magnetically-operated valve-mechanism for internal-combustion engines." W. C. Harrigan and R. A. Lye. February 3rd, 1920. (162,412.)

3,446. "Alternating current induction motors." Aktieselskabet Jydsk Elektro. February 4th, 1920. (Addition to 141,671.) (162,415.)

4,103. "Apparatus for use in testing electric lamps, fuses, sparking plugs, and induction coils." W. S. Wolff. February 10th, 1920. (162,428.)

5,025. "Electrical distribution fuse boards, fuse boxes, and the like." Midland Electric Manufacturing Co., Ltd., and H. E. Sutherland. February 19th, 1920. (162,449.)

5,442. "Carbon-brushes for dynamo-electric machines." W. W. Jarvis and Morgan Crucible Co., Ltd. February 23rd, 1920. (162,461.)

5,644. "Mine signalling apparatus." T. H. Hill. February 25th, 1920. (162,465.)

5,816. "Vapour arc lamps." Siemens & Halske Akt.-Ges. July 26th, 1918. (139,506.)

5,904. "Fuse boxes, switch gear, and other electrical gear contained in boxes or cases." F. W. Abbott. February 27th, 1920. (162,470.)

5,949. "Alternating current electric instruments for indicating synchronism power factor, phase difference, or the like." Nalder Bros. & Thompson, Ltd., and C. L. Lipman. February 27th, 1920. (162,471.)

6,543. "Code-signalling arrangements for party-line telephone systems." Automatic Telephone Manufacturing Co., Ltd. June 30th, 1919. (146,079.)

7,046. "Electro-magnetic device for re-magnetising permanent magnets." G. A. Foehl. March 20th, 1918. (140,074.)

7,699. "Electric fuse holders." F. Shergold and A. H. Maxwell. March 15th, 1920. (162,487.)

10,748. "Method of preventing injurious earthing currents in electrical nets." Akt.-Ges. Brown, Boveri et Cie. April 17th, 1919. (141,756.)

11,894. "Machine switching telephone exchange systems." Western Electric Co., Ltd. September 14th, 1917. (142,488.)

12,835. "Incandescent cathode rectifiers for alternating currents." Naamlooze Vennootschap Philip's Gloeilampenfabrieken. December 2nd, 1919. (154,872.)

13,216. "Electric switches." S. E. Hall and W. Hall. May 13th, 1920. (162,546.)

13,969. "Dynamo-electric machines." Siemens Bros Dynamo Works, Ltd., and P. H. H. Jantzen. May 20th, 1920. (Addition to 146,624.) (162,552.)

14,105. "Electrical apparatus for railway signalling." Tyer & Co., Ltd., and F Downes. May 21st, 1920. (162,553.)

16,726. "Process for electrical gas purification." Metallbank und Metallurgische Ges. Akt.-Ges. & J. E. Lilienfeld August 8th, 1918 (145,477.)

18,373. "Joint-covering sections of electric cable conduits." T. Wragg & Sons, Ltd., and F. J. Aubrey. July 2nd, 1920. (162,579.)

19,802. "Building commutators for dynamo-electric machines." V. G. Apple. January 22nd, 1917. (147,774.)

19,862. "Enclosed electric arc devices." British Thomson-Houston Co., Ltd. October 30th, 1915. (147,817.)

23,090. "Electric emergency lighting installations." P. Das August 5th, 1920. (162,587.)

25,046. "Receiving apparatus for electrical oscillation." Ges. fur Drahtlose Telegraphie. September 6th, 1919 (150,701.)

26,820. "Cut-outs for electrical circuits." M. Grob & Co. September 20th, 1919. (151,285.)

27,561. "Thermal relays for use in electrical circuits." Metropolitan-Vickers Electrical Co., Ltd. October 6th, 1919 (152,024.)

28,861. "Motor controllers." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). October 12th, 1920. (162,596.)

31,331. "Transmission dynamometers." F. Krupp Akt.-Ges. November 27th, 1919. (Addition to 147,137.) (154,581.)

33,684. "Spring contacts for electric fuse-carriers and like electric fittings." W. T. Henley's Telegraph Works Co., Ltd., and W. S. Wakefield November 29th, 1920. (162,602.)

35,340. "Electric coupling devices." S. F Smith. December 15th, 1920. (162,606.)

Railway Construction in Japan.—In the course of an authoritative survey of the railway construction and extensions in progress or projected in Japan appearing in the *Far East Commercial Supplement*, it is stated that the boring of the Tan-na-Yama tunnel has been commenced, headings having been made 4,007 feet long at the eastern end, and 4,315 feet at the western end. For excavating, pneumatic excavators are used, with an air-compressor placed at each end of the tunnel. For carrying building materials and transporting excavated earth, a light railway of 2 ft. 6 in. gauge is to be laid, electric locomotives hauling the trains. An electric generating station is to be built to supply the power at the western entrance of the tunnel. Till the completion of this generating station, the compressed air required by the pneumatic excavators is to be supplied by steam engines placed at both sides of the tunnel. Further details of the railway construction work contained in the article may be inspected by United Kingdom firms interested on application to the Enquiry Room, Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W.1.

THE
ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE ELECTRICITY SUPPLY BILL.

In our last issue we printed a rejoinder, from the pen of a well-known authority, to our leaderette on this subject; it reached our hands too late to admit of comment in the same issue. Needless to say, we welcome any sincere expression of opinion, no matter whether it supports our views or controverts them; what we are all seeking is the truth, and the subject under discussion is so exceedingly complex that to arrive at the truth is even more difficult than usual. A false step now may delay the progress of electricity supply for years to come.

With much of our critic's article we are in general agreement; his fundamental aim is "a cheap and abundant supply of electricity"—with the proviso that it really shall be at least as cheap as the existing undertakings can make it. Clearly, however, he holds that the proposals now before the Electricity Commissioners offer no real prospect of producing a cheap supply—that they will, in fact, involve an increase in the cost of energy at the consumer's terminals. That is a question which can only be decided by detailed study of the conditions obtaining in each case, which is one of the main objects of the inquiries that are being held by the Commissioners.

But it is of the first importance to make it clear that our critic's remarks are almost wholly directed to the question of electricity supply in the Metropolitan area, whereas our article, with the exception of a single short paragraph, applied to the whole of the 13 districts delimited provisionally or otherwise by the Commissioners, and this fact should be borne in mind in considering the pros and cons. We have not yet seen "the report of the financial expert on the scheme for the London area," referred to by the author, and therefore must confine our remarks to matter which has been made public in this connection. We have in the first place Mr. Leslie Gordon, hon. secretary of the Conference of Local Authorities, making the following statement to the Executive Committee:—

"Neither from a company point of view nor a local authority point of view is it practicable to call into existence a Joint Electricity Authority as contemplated by the Act of 1919, and as suggested not only by the Conference of Local Authorities, but also by the London County Council, and further by a powerful group of companies supplying electricity within the area in question, without the necessary financial powers. . . . . The practical effect of the scheme, with the powers of the present Bill, will be to stop the wasteful system of producing an inefficient and costly supply in many parts of the area by excessive capital expenditure on existing unsuitable generating stations. The capital cost incurred in carrying out the Conference scheme will be considerably less than the inevitable capital expenditure upon existing stations under the present system to meet the growing demand, while the saving in working costs of administration will be enormous. The risk of any charge falling upon the rates in any part of the area is a very remote contingency."

Mr. Gordon naturally speaks for the local authorities; the engineering scheme put forward by them, however, is identical with that supported by the London companies, and it is *the only scheme* which applies to the whole of the Metropolitan area. It essentially involves the establishment of a Joint Electricity Authority for the district, and that Authority cannot act without the financial powers embodied in the Bill.

It is clear, therefore, that the Bill is, as we stated, essential to the reform of London's electricity supply; and by reform we by no means refer only to the provision of a "cheap and abundant supply," but also to the unification and standardisation of systems and voltages, and all the other improvements which can only be effected by centralising control. To complete that process will admittedly be the work of many years; but is that a reason why we should delay its commencement? Surely the sooner we start, the better.

Failing the Bill, what is the alternative?—To perpetuate the existing chaos, and to make the best of the situation by linking-up the present generating stations and installing new plant in them, where possible. But how far can that process be carried, and how long will it meet the needs of London? From the evidence given at the inquiry regarding the Barking station, and other data, it is clear that the limit will soon be reached—and the steps necessary to meet the future needs of the area should not be delayed. An examination of the reports of London undertakers for the past year shows that the demand is increasing very rapidly; that the heating and cooking loads are developing at a great pace; and that already the difficulty of coping with the position is being increasingly felt. In isolated cases it is true that plant can be installed amply adequate for the local requirements; but that does not solve the main problem. Moreover, all such plant will have to be bought at the same prices as plant for super-stations—and more of it will be required.

Hence, while we await the publication of the report of the financial expert with keen interest, we are not convinced that the Joint Electricity Authority, and therefore the Bill, is not necessary to the welfare of London's electricity supply.

With regard to the two amendments suggested, the first would appear to wreck the whole scheme; to the second, however, we have no objection to offer, and we may remark that the Commissioners, at the Chester and North Wales Inquiry (Elec. Rev., March 4th, 1921, p. 269) definitely and explicitly declared that if after the establishment of a Joint Electricity Authority there was a particular undertaker in the district whose undertaking could be extended at a cheaper rate, and with a greater benefit to the people in the area than the alternative course of taking electricity from some distant supply, they would not refuse to sanction the extension of that station. Hence it is certain that the Commissioners agree in principle with the amendment suggested as, indeed, they are bound to do if they carry out the main purpose of the Act of 1919, to provide a "cheap and abundant supply" of electricity.

The Economic Position of the Engineering Industry.

We conclude in this issue our summary of the pamphlet issued by the Amalgamated Engineering Union in reply to the statement published by the Engineering and the National Employers' Federations, dealing with the present economic position of the engineering and allied industries.

We are publishing fairly lengthy extracts from the reply, feeling that both statements should have a fair share of publicity among the very varied classes of men on both sides who are our regular weekly readers. The parts that we have omitted from the reply are mostly political and polemical.

We found some fault with the employers for not being political enough, and for omitting to lay at the door of the Government a very large share of blame for our present economic position. Their pamphlet was too restrained in its references to Government finance, and almost too severe in its avoidance of anything like political invective.

With the reply under consideration no such fault can be found. It is almost entirely political. The commencing paragraphs are rich in the current phraseology of the politician, sneering a little at the "artist" engaged by the employers to create an atmosphere of artificial gloom. They speak of poison gas and fresh air—hyperbole and analogy of the "mists and mountain tops" type, and quite worthless in considering facts. One may remark that if the employers engaged an artist, the unions employed a poet.

But to come to the subject matter, the first real instalment of reply gives a table comparing engineering exports in 1913 and 1920, and showing a very large increase approaching one hundred per cent. in values in the latter year. The pamphlet omits to point out that the increase is only apparent, owing to the enormously enhanced prices, the actual quantity of goods being lower.

With regard to one of the main causes, certainly the most important, of the present position, viz., the foreign exchanges, the clear and scientific handling of the subject by the employers is treated with contempt. The pamphlet says "The treatise may be disregarded. It is an impudent attempt to create a bogey by mystification." This is no reply, but a deplorable exhibition of carelessness or ignorance with regard to the matter.

The statement that our exchange in the United States being adverse ought, according to the employers, to have produced an opposite result, and to have caused our engineering productions to flow into the United States and elsewhere, is, we fear, a measure of the extent to which the trade unions have grasped the position. It does not seem to have occurred to them that the States do not import machinery at all (except in very special unimportant cases), but produce all they require and much more, the balance being exported.

The pamphlet blames the employers chiefly for supporting a Government which is seeking to impose import duties and to exclude German goods. Now, whatever may be one's views upon Free Trade, it is hardly fair to blame engineering employers for the present policy. The Labour Party, by constantly splitting the opposition vote, at three-cornered by-elections, has probably done much more than all the engineers put together to keep the present Government in power. But this is a deviation into politics pure and simple.

There are further arguments maintaining the importance of a home market supported by high wages, and speaking of a conspiracy to reduce wages, but no attempt is made to show how a reduction of wages is to be avoided. The one obvious remedy which might have been tried, viz., an abandonment of "Ca' Canny" and an increase of output, is not referred to.

An attempt is made to show that the position of the engineering trade is not bad, and a short list of dividend-paying concerns is put forward in proof of prosperity. This, of course, will mislead no one, as the facts are notorious. The reclaiming of Excess Profits Duty is also mentioned, but as this comes to an end before the close of the year, it obviously cannot be relied upon to maintain wages for long.

Without following the authors in their excursions into foreign policy, we venture to ask whether they will now apply themselves to the economic situation, and put forward some definite practicable plan for avoiding the imminent losses with which wage-earners, investors, and employers alike are threatened.

The Lower Severn Deadlock.

The fact that the Organising Committee of the Lower Severn Electricity District has decided that it is not justified in taking further action at present towards the formation of a Joint Electricity Authority opens an interesting question. As this Committee was the only body that was proposing any scheme, it is obvious that nothing further can be looked for in the way of a voluntary proposal. Under Section 5, Clause 2 of the Act of 1919, where it appears to the Electricity Commissioners that the existing organisation of the supply of electricity in a district provisionally delimited can be improved, the Commissioners are required to hold a local inquiry, and under Clause 3 it is provided that if no scheme submitted is approved by the Commissioners, the latter may themselves formulate a scheme. Now that the contingency anticipated by this last clause has arrived, it will be interesting to see whether the Commissioners propose to put forward a scheme, or whether the matter will drop. In this case the initiative came from the district itself, since, as will be remembered, there was a proposal locally to form a Joint Electricity Authority within a few weeks of the passing of the Act. Hence the holding of an inquiry did not imply that the Commissioners had decided that the existing organisation stood in need of improvement. However, it is obvious that, under the Act, the next move lies with the Electricity Commissioners. They have no power to impose a scheme of their own upon the district, and we suspect that they will pursue a policy of "masterly inactivity" in that quarter.

The I.E.E. at Home.

The meeting at the Institution of Electrical Engineers last week was worthy of the occasion—the first to be held in the Institution's own building for four years; there was a crowded attendance, and the subject of the lecture was of exceptional interest. Mr. Alfred Johnsen explained the nature of the phenomenon that he, jointly with Mr. Knud Rahbek, discovered in 1917, and the numerous applications which had already been found for it, in the most lucid manner, and the interesting experiments were entirely successful.

We congratulate the Institution upon securing this remarkable demonstration, through the instrumentality of Mr. Ll. B. Atkinson, aided by Mr. Frank Gill, as well as the Danish inventors who gave it. Our "Correspondence" columns to-day show that the phenomenon had been observed in this country as long ago as 1880; but, as Mr. Campbell-Swinton points out, it was discovered and utilised by Mr. Elisha Gray, of Chicago, and in an article by the late Sir W. H. Preece, published in The Telegraphic Journal of September 1st, 1877, it is recorded that Gray's invention was made in 1873. We quote the passage in our "Notes" columns. However, full credit is undoubtedly due to Messrs. Johnsen and Rahbek for, first, rediscovering the phenomenon; secondly, perceiving its importance; and thirdly, turning it to practical use so thoroughly and so quickly.

Penny-Wise.

We cannot imagine that the British Government will permit the Postmaster-General's proposals relating to the increase in charges for overseas circulation of printed matter to be put into force. With a desire to be polite, we might allude to the proposition as short-sighted or mistaken, but if we express our real feelings without restraint, we must describe the plan to put difficulties in the way of the foreign distribution of British trade and technical journals, catalogues, price lists and technical books, as a piece of crass stupidity on the part of somebody, and as one of the biggest blunders committed by the Post Office. What is more important for the well-being of the millions of industrial and commercial workers and their families, than the fullest possible circulation of printed matter prepared in the interest of the foreign trade of the United Kingdom? We have been often warned from Government and other circles that British propaganda abroad is weak and inefficient in comparison with that of rival peoples, and now, when the trade of the nation needs every ounce of help and energy that can be contributed to that end, so that the British Foreign Trade Flag may be kept flying high everywhere, a most unbusinesslike, short-sighted—nay, absolutely stupid—policy is introduced by a Government Department which has no concern with the fact that its penny-wisdom is in effect certain to be a hundred-pound-foolishness. Not only will the Post Office lose in revenue by making the prices of trade literature appear to be prohibitive to the reader abroad, but he will compel firms who dispatch publicity literature thence in pursuit of trade, to cut down their schemes, with a corresponding decrease in resultant business, greater unemployment at home, and less profit to be taxed. We add our voice to the general protest of the industrial community against a proposal which ought on no account to be allowed to go any farther. The bread and butter of the community are at stake. We may make a present of millions sterling to the miners, but we will charge the uttermost farthing to everybody who is so unwise as to try to secure export trade! Tut! Tut!!

Currency.

On May 27th, Mr. E. J. Graves, of Sheffield, gave a lecture at the Institution of Mechanical Engineers on the world's currency system. It was announced by the president that the lecture would be reported in the *Proceedings* of the Institution, and we heartily recommend our readers to look out for it.

The lecturer dealt with the subject exhaustively, and showed how currency systems had grown up and superseded barter, and how, after trials of other standards, we had, to our great advantage, finally selected gold of a standard purity as our standard of currency.

It might be expected that such a subject as currency and the exchanges might be dry and difficult to follow, but Mr. Graves delighted his audience with a most interesting and eloquent discourse. He ended with a moving appreciation of the currency and exchange systems which we have now in existence, and prophesied nothing but evil for any attempt to tamper with them.

While he was thus praising what exists it was impossible to exclude the thought that there is another side to the picture. He did not say that at the present time our gold standard is practically non-existent, and that the foreign exchanges have absolutely broken down, thereby making international trade almost impossible, and reducing whole nations to beggary.

We are inclined to think that something has got to be tampered with soon, if a world catastrophe is to be avoided. The very fact that the value of our currency is gradually rising makes it more and more difficult to sell our goods abroad.

If we may be permitted one more criticism, it is that enough stress was not laid on inflation of credit as distinguished from inflation of currency. The two things are not exactly the same. But the need for public economy was insisted upon most strongly.

A Second Dutch Electricity Commission.

Apparently the final word has yet to be uttered in connection with the question of Government intervention in the electricity supply industry in Holland, for it is announced that a new Government Electricity Supply Commission is to be appointed to give effect to a resolution adopted recently by the Second Chamber of the States General—the so-called Van-Beresteyn-Marchant motion. It was the passing of this resolution which induced the Government to withdraw the Bill creating a semi-public authority to control the generation and transmission of energy throughout the country. In Dutch industrial circles the composition of the new Commission is looked forward to with interest, and the hope is expressed that the Government, in making the nominations, will not repeat the mistake which was made in connection with the former Commission, which was constituted in April, 1919. Although very largely interested in the supply of electricity, the industrial consumers were not even represented on the first Commission; they had no opportunity of expressing their opinions on the proposals made by the Minister of Public Works, and their advice was not officially sought. Not only so, but even the views of the Council of Industry were not heard on the scheme. If these vast interests had been invited to co-operate in reaching a satisfactory solution of the problem, it is considered that the defunct Bill would not have experienced the check to which it was subjected through the resolution adopted by the Second Chamber, and if the new Commission is to be successful in its work, it is submitted that the assistance of the industrial and other large consumers will have to be obtained.

THE UNITED ALKALI CO.'S POWER STATION.

A New Mersey-side Station at Widnes.

At the recent general meeting of the shareholders of the United Alkali Co., Ltd., at Liverpool [whose activities cover a wide field, and which owns works at Glasgow, Newcastle-on-Tyne, Widnes, St. Helens, Fleetwood, Bristol, London, in Spain, and America] Mr. Max Muspratt, chairman of the company, recalled the difficulties through which the company had passed, mentioning that during the last six years it had been taxed to no less a sum than £1,759,233, as against a net dividend distribution of £1,847,905, or 9s. 2d. in the £ of the gross amount divided. In addition, on the instructions of the Ministry of Munitions, it had expended just under 2½ millions on new plant. The termination of the war left the company with many arrears of repairs to overtake, and new plant only partly completed, and to have failed to make good the dilapidation and to complete the valuable, but costly, plant would have placed it in a hopelessly inferior position, as compared with its competitors. The gradual development and transference from the old to the newer processes which had been hoped for have not been possible, and as a result of alterations in processes, certain works have had to be permanently closed, while large parts of the Hardshaw Brook, McKechnie, and Hebburn undertakings will not be restarted. Other works, which are at the moment idle, are being kept in commission for the present in case of an early recovery.

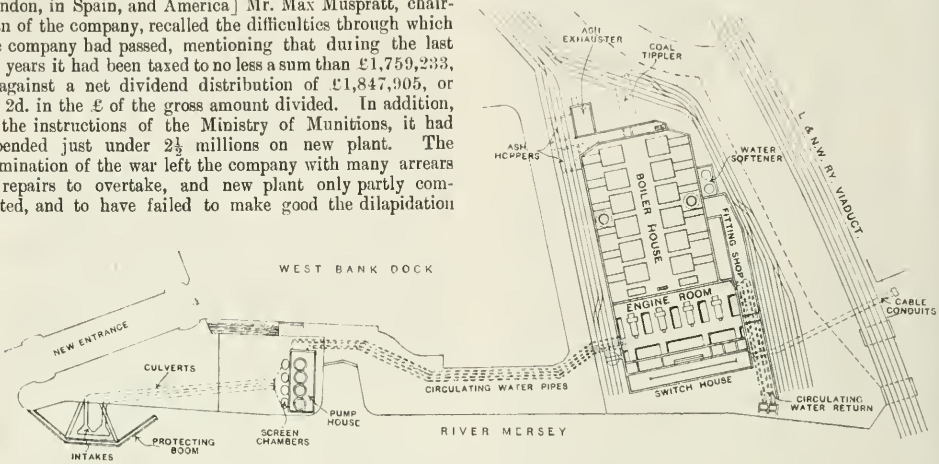


Fig. 1.—Plan of Station and Circulating-Water Arrangements.

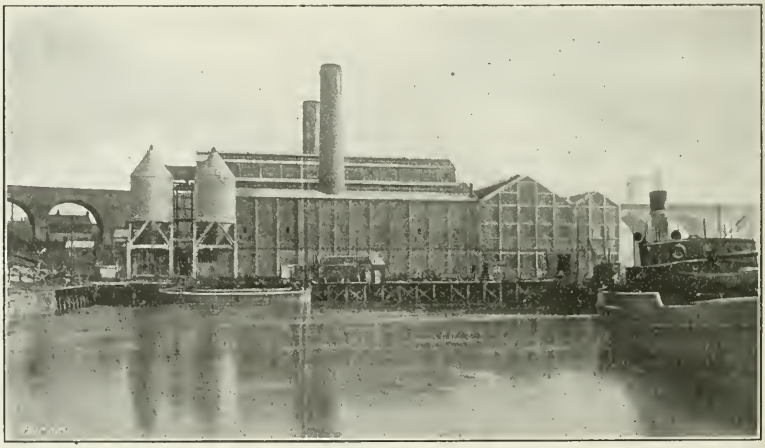


Fig. 2.—West Bank Dock Power Station.

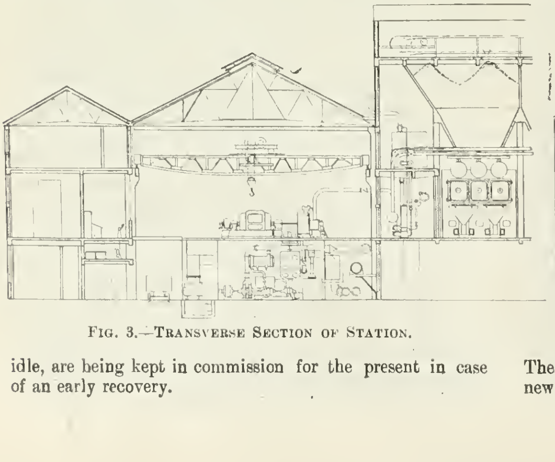


Fig. 3.—Transverse Section of Station.

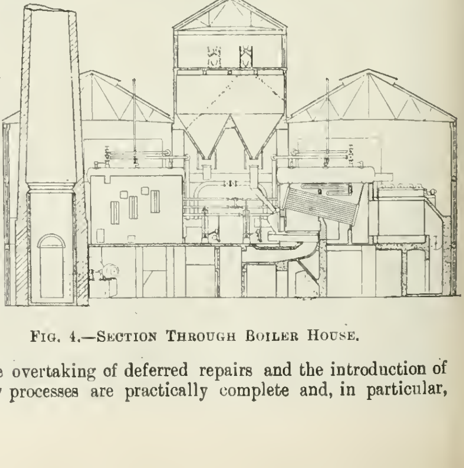


Fig. 4.—Section Through Boiler House.

That is the dark side, but it must not be assumed that the outlook is all gloomy. The company is optimistic with regard to its prospects and, notwithstanding the present discouraging depression, looks to the future with confidence. The overtaking of deferred repairs and the introduction of new processes are practically complete and, in particular, the electrolytic plant is in perfect order, as is also the new electricity generating station at Widnes. For a century the Leblanc process served the heavy chemical industry of the world, and sentimental regret is felt at the necessary changes; nevertheless, the training that process gave is no small asset. The most important improvement in the company's position during the year was the discovery of brine at Widnes, not of standard quality, but happily well suited for the process the company has installed. Property has been acquired, and borings made, with the result that since the beginning of 1921 the electrolytic plant has been worked practically entirely on brine obtained locally. By the middle of last year the disorganisation due to the war had been overcome, and the efficiency and the work done are showing gratifying improvement. Dr. G. C. Clayton, however, is not yet completely satisfied with the results obtained, and for that reason the works are being equipped with many additional improvements.

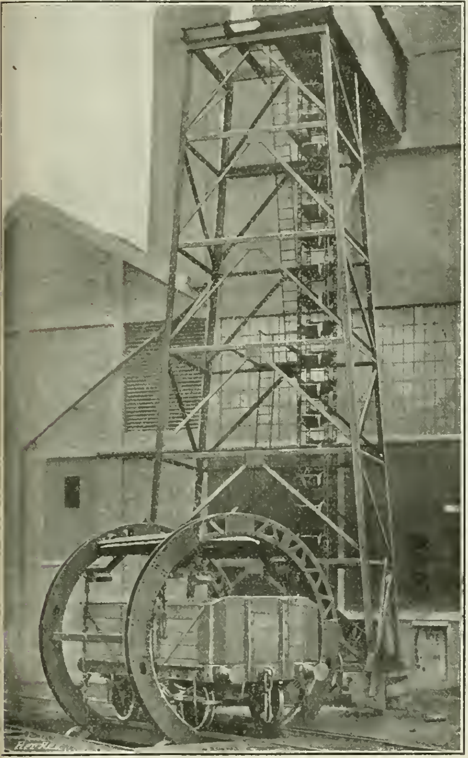


Fig. 5.—Coal Tippler and Elevator.

One of these is the up-to-date power station, fig. 2, which has been erected on the bank of the river Mersey, between the West Bank Dock and the L. & N.-W. Railway Co.'s bridge which spans the river from Widnes to Runcorn, in order to supply the company's numerous works in and around Widnes with electricity. Although somewhat restricted, the site chosen is a convenient one from the point of view of fuel and ample condensing water supplies, and for the disposal of ashes. The station, which is unique inasmuch as under normal conditions it operates at a load factor of over 90 per cent., at present contains only two 5,000-kW turbo-generator sets and eight boilers, but it is interesting because the existing buildings contain foundations, &c., complete and ready to accommodate additional plant of a larger capacity than that mentioned above, and it would, therefore, be possible for it to augment the existing supply of the district without any serious delay, a fact that should be borne in mind now that the Electricity Commissioners have practically settled the destiny of the Mersey and West Lancashire Electricity District. The station could not, of course, supply Widnes itself on account of the rights of the Mersey Power Co., Ltd., but there should be no difficulty in laying cables to furnish a bulk supply to the Joint Authority when constituted, to the Mersey Power Co., or to other authorised undertakers in the surrounding districts.

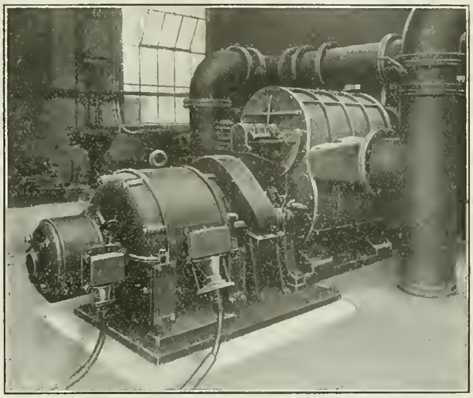


Fig. 6.—Motor-driven Ash Exhauster.

The general lay-out of the station is clearly shown by the plan and sectional elevations, figs. 1, 3 and 4; the station buildings include offices, staff and workmen's mess and dressing rooms, stores, and a fitting shop; an electric lift, controlled by push-buttons, and supplied by Messrs. Smith, Major & Stevens, Ltd., serves the various floors, while a 20-ton electric crane spans the turbine room and, as will be seen from fig. 3, a railway line is laid from end to end of the turbine house.

Rock was found near the surface on one side of the station, but on the other it was necessary to pile, and the 16-in. diameter reinforced-concrete piles were cast *in situ* in the following manner:—

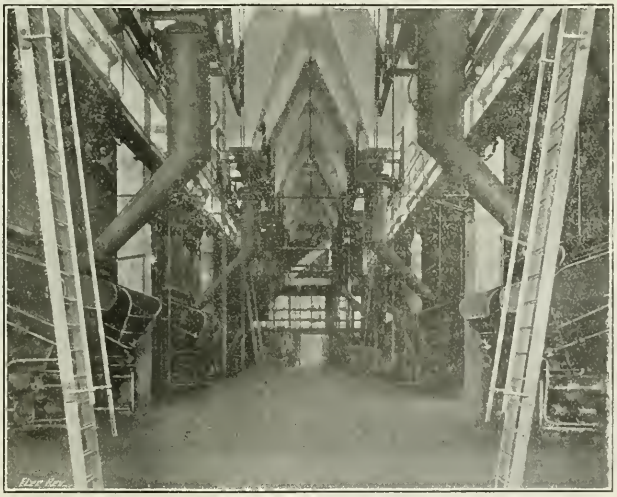


Fig. 7.—Boiler House.

A steel tube was placed on top of a loose cast-iron point, and driven into the ground until the required final set was obtained. Reinforcement was then placed inside the tube where necessary, and the tube was next filled with concrete to a height of several feet (depending on the length of the pile) above the level at which it was desired to finish the head of the pile. The tube was then slowly pulled out of the ground, leaving the loose cast-iron point at the base of the pile, and as the tube was withdrawn the concrete sank and expanded, thus filling up the hole formed by the tube. Some of the piles, reinforced with 1-in. bar down the centre, are 11 ft., and others nearly 30 ft. long, their average length being 20 ft., and the approximate total length of piling 15,000 ft.; 741 piles were driven under the station, or an average of 35 per week. The superstructure, fig. 2, consists of reinforced-concrete columns and beams, and large mass concrete piers, the framework being filled in with brick panels.

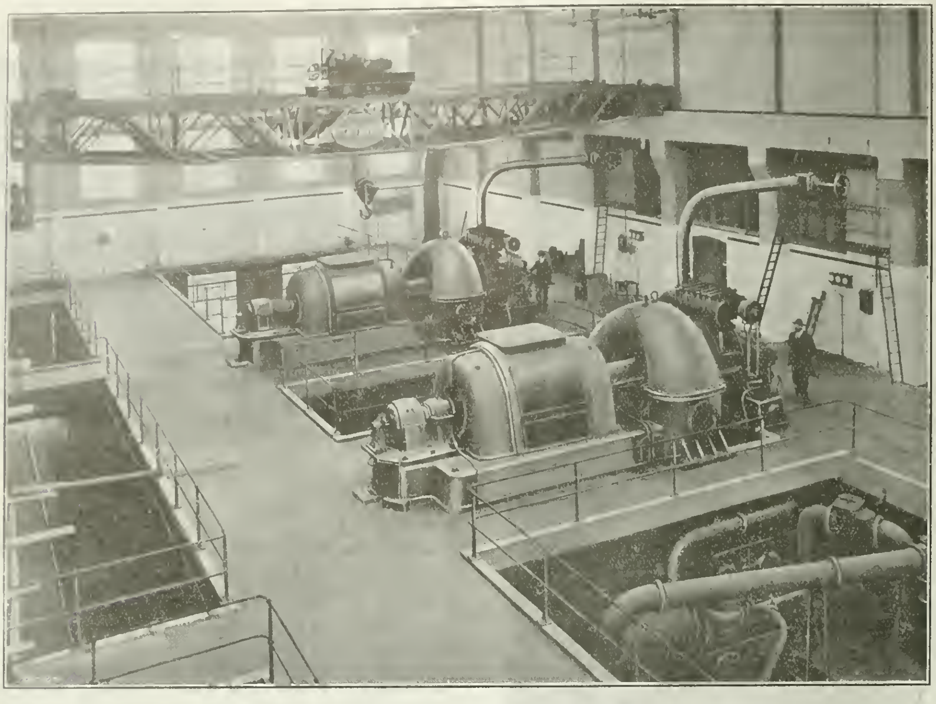


Fig. 8.—Turbo-generator Room.

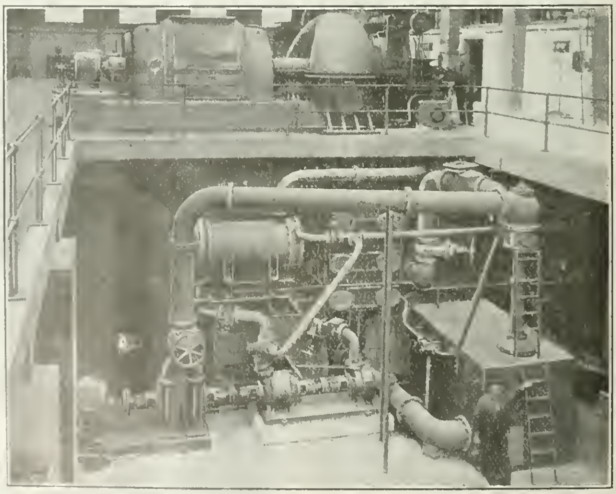


Fig. 9.—Turbo-generator and Condenser Auxiliaries.

The storage and handling of coal is provided for by means of railway sidings. The contents of each wagon is discharged by an automatic tippler, fig. 5, into a hopper feeding an automatic bucket elevator, the latter in turn feeding a conveyor which distributes the coal to overhead reinforced concrete bunkers extending the full length of the boiler house along its centre. The bunkers have a total capacity of 900 tons of fuel, and are covered by the conveyor floor and housing. As will be seen from fig. 7, travelling stokers convey the coal from the bunkers to the furnace hoppers, and in so doing measure the amount of fuel consumed. Incidentally, it may be mentioned that a laboratory is being fitted up, and one boiler set off for the purpose of testing the fuel used. A recent fuel analysis, i.e., January, 1921, gave the following figures:—Calorific value of coal burnt = 8,840 B.th.u.; fixed carbon = 35·25 per cent.; volatile matter = 27·15 per cent.; ash content = 30·18 per cent.; and moisture content = 7·42 per cent.: and the best result obtained under normal conditions of operation, but at an output of only about 3,000 kW, was 2·5 lb. of coal per kWh generated, the fuel consisting chiefly of Lancashire rough slack.

The boiler house is set at right angles to the turbine room, the firing floor being 14 ft. above the basement level, and it will ultimately contain 12 boilers which will involve the duplication of the existing coal-handling plant. At present, the building houses eight Babcock & Wilcox water-tube boilers, arranged four on each side; each boiler has a heating surface of 6,591 sq. ft., and is capable of evaporating 25,000 lb. of water per hour at 220 lb. per sq. in. pressure. An integral superheater having a heating surface of 1,590 sq. ft. adds 200° F. superheat to the steam, and two Underfeed "E" type stokers, with a grate area of 137 sq. ft., are fitted to each boiler, as is also a 200-pipe Green economiser.

An unusual feature of the boiler house is the provision of a warm-air duct extending the full length of the building, which is constructed entirely of reinforced concrete, and through which the air for combustion is forced into the boiler furnaces by means of three (eventually there will be four) sets of fans after it has been drawn through the windings of the main generators in the engine room. Each 35-in. Sirocco fan is driven by means of a 45-h.p. B.T.H. motor, running at 410 r.p.m., and is capable of supplying 44,000 cb. ft. of air per minute at a pressure of 2·75 in. water gauge, or a sufficiency for three boilers burning 12,000 lb. of coal per hour, with a calorific value of 10,500 B.th.u.

Each of the four sets (two to each stack) of 68-h.p. induced-draught fans runs at 360 r.p.m., and is capable of dealing with the products of combustion from three boilers, or a capacity of 94,000 cu. ft. of gas per minute, at a suction of 2 in. water gauge, which is estimated to give a draught of 0·35 in. over the furnace grates, and can be regulated to $\frac{3}{16}$ in. by means of dampers. The waste gases, after passing through the economisers are discharged up two brick chimneys, each 125 ft. high, and having a diameter at the top of 10 ft. Three Weir steam-turbine pumps, each capable of delivering 7,500 gallons of water per hour, or sufficient for three boilers, deal with the feed-water, which is heated (as explained later) and stored in tanks, out of which it is pumped through a second heater, which derives its steam supply from the feed-pump exhaust. The make-up water from the town supply is treated in a softening plant placed outside the boiler house.

For dealing with the furnace ash and the soot from the economisers, Babcock & Wilcox suction equipment is installed in duplicate, each being capable of dealing with 110 tons. Each boiler is fitted with two (one per furnace) concrete ash hoppers, which discharge their contents into a motor-driven crusher that runs on rails from end to end of the basement. The crushed ash is next drawn through pipes (each of the exhausters, fig. 6, is driven by a 74-b.h.p. motor, and maintains a vacuum of from 3 to 6 in. of mercury) into two receivers, shown in fig. 2, and subjected to a spray of cooling water before being emptied into railway wagons. By the use of concrete ash receivers, it is hoped to avoid corrosion troubles which metal receivers are subject to, owing to the presence of moisture and sulphur in the ash.

In the turbine room, two interior views of which are shown in figs. 8 and 9, the generators are placed on a floor 16 ft. above the basement level, and, as previously mentioned, railway trucks can be run right into the basement under the travelling crane. It has been built to ultimately accommodate four generating sets, but the plant at present installed consists of two of the British Thomson-Houston Co.'s 11-stage turbo-alternators, running at a speed of 3,000 r.p.m. Each of the three-phase, 50-cycle generators has an output of 5,000 kW at 0·8 power factor, the generated pressure being 6,600 volts, and the speed of the machines is controlled from the control room by the aid of servo motors. The alternators are totally enclosed and ventilated by fans fitted to the rotors. The cooling air to each is filtered through an "Invincible" wet-air filter made by Messrs. Wm. Grice & Sons, Ltd., in which the air is brought into contact with a large area of static water, on to which the impurities in the air are deposited. At the same time the temperature of the air is reduced to within a few degrees of the prevailing reading of the wet-bulb thermometer.

The turbine steam consumption guarantees when operating with a steam pressure of 200 lb. per sq. in. superheated 200° F., and at a vacuum of 28·5 in. are: 11·8 lb. per kWh at $1\frac{1}{4}$ load, 11·75 lb. at full load, 12·15 lb. at $\frac{3}{4}$ load, and 12·85 lb. at $\frac{1}{2}$ load. The machines exhaust into Worthington-Simpson three-flow surface condensers, each having a cooling surface of 7,500 sq. ft. Hydraulic vacuum and motor-driven extraction and lift pumps are provided, while the water from the troughs is drained into a tank and conveyed to the feed tanks. The condensate pumps discharge into a Lee recorder which, in turn, delivers the water to a B.T.H. heater that is fed with steam "bled" from the turbines at a pressure of 10 lb. absolute. The heated water is then collected in the boiler feed tanks, as before mentioned. All the condenser and air filter auxiliaries are placed in the basement, as shown in fig. 9, and are readily accessible.

The station is in the fortunate position of having available an ample supply of condensing water from the River Mersey, to deal with which a pump house has been built on a site 200 ft. from the water intake, and 330 ft. from the turbine room, fig. 1. The position of the intake was chosen, so as to ensure an ample supply of water at any state of the river, and at the lowest tide yet experienced the river level remained 18 in. above the intakes. Any difficulties due to silting have been obviated by providing that the rate of flow of water at the intakes shall not exceed the rate of one foot per second, at which velocity there is very little, if any, tendency to pick up sand from the river bed. In the settling chambers the velocity had to be slightly increased so as to prevent the size and consequently the expense of the conduits becoming too great, but the actual rate of flow was kept under 3 ft. per second, so as to ensure that any sand that was carried in suspension would be deposited in the settling chambers, which can be easily flushed, rather than in the remainder of the pipe line and the condensers wherein the velocity reaches a figure of from 6 to 7·5 feet per second. The two intakes, which are protected by a heavy timber boom, each have an area of 26 sq. ft., and are fitted with vertical 6-in. mesh screens; two reinforced concrete 3-ft. diameter culverts terminate in penstocks at the pump house, where the water passes through $\frac{1}{4}$-in. mesh 30-ft. deep stationary screens, which so far have proved very effective. After being lifted, the water is delivered to the condensers through two 21-in. cast-iron pipes which function by means of siphonic action. On leaving the condensers, the water is returned to the river through two 21-in. cast-iron pipes about 150 ft. long, the ends of which are sealed in wells sunk below the low-water level of the river. A tank, with a capacity of 18,000 gallons of water, is provided for the purpose of flushing the delivery culverts; one culvert is flushed back each day at low tide, and by timing the operation it is possible to keep a check on the rate of silting up.

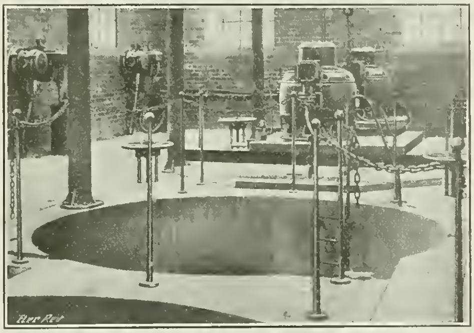


Fig. 10.—Circulating-water Pump House.

Four screens and pump chambers have been constructed, but only two pumps are at present installed, fig. 10; they are Rees-Roturbo vertical-spindle centrifugal machines, and are placed 34 ft. down the well. Each pump is capable of lifting 5,800 gallons of water per minute, and is driven by a vertical-shaft, 440-V, 130-b.h.p., three-phase motor, running at 580 r.p.m., supplied by the B.T.H. Co. Two bus-bars and duplicate switchgear are provided, so that the machines can be changed over at will, and the pipe connections are so arranged that either pump can supply either condenser.

(To be concluded.)

REPORT ON THE FUTURE OF BRITISH INDUSTRIES FAIRS.

Last July a Committee was appointed by the Board of Trade to consider the best policy to be adopted in future as regards British Industries Fairs, particularly in respect of the centres at which they should be held, the trades which should be included, and the classes of exhibitors who should be allowed to participate. The Committee, which was presided over by Sir Frank Warner, has submitted its report to the President, but we understand that no decision has yet been taken on its recommendations. The conclusions and recommendations are as follows:—

We are of opinion that, other things being equal, the ideal arrangement would be for the Fair to be concentrated in one centre, and that centre London. We recognise, however, that this expression of opinion may require some qualification in particular cases, and we have given very careful consideration to the question whether the Glasgow and Birmingham Fairs should be continued as part of the British Industries Fair. It appears to us that, in deciding whether either or both of these Fairs should be continued on this basis, the criterion should be whether or not they receive the support of the trades concerned to a degree which would justify their being regarded as national Fairs.

We are of opinion that upon the evidence submitted to us we are not justified in recommending the continuance of the Glasgow Fair as part of the British Industries Fair. The Glasgow Fair has hitherto failed to secure adequate support in the principal industries which it comprises, namely, textiles, boots and shoes and chemicals, and Glasgow is not well situated as a centre for these groups of trades. We therefore recommend that the trades which have hitherto been included in the schedule of the Glasgow Fair should be transferred to London or to Birmingham, whichever may be most appropriate as regards each particular trade.

Birmingham occupies a more favourable position than Glasgow, since it is the geographical centre for many of the trades included in its schedule, and it has received a measure of support which would fairly justify its being considered as a national fair. We therefore recommend that it should be continued, unless and until it should cease to receive such support. There are also certain practical considerations which point in the same direction. There is considerable scope for expansion at Birmingham, while there would clearly for some time to come be great difficulty in providing the necessary accommodation in London in addition to that required for the expansion of the London Fair on its present lines. The overseas buyer can also visit Birmingham from London at little trouble and expense within the day, and having regard to the bulk and heavy character of many of the Birmingham exhibits there are obvious advantages in exhibiting them at a local centre.

We are not in favour of any new Fairs being initiated in provincial centres as part of the British Industries Fair.

With regard to the question of the trades to be admitted to the British Industries Fair, we are of opinion that the Fair should be open to all branches of British industry desiring to participate. Even in cases where the actual exhibition of the products is impracticable, *e.g.*, heavy machinery, engineering work, &c., the manufacturer may wish to avail himself of the opportunity afforded by the Fair of bringing his products to the notice of overseas visitors, by means of plans, photographs, models, catalogues, &c., and it does not appear proper that in a Fair of this character, organised under Government auspices, any section of British industry should be excluded. The question of the allocation of trades as between the different centres at which the Fair is held is one that we feel can be left to the discretion of the Department to determine in consultation with the respective Fair Committees.

The Fair should continue to be held, as hitherto, at such a time as will enable buyers from overseas to visit it *en route* to Leipzig and Lyons.

We do not consider that, at any rate for the present, sufficient support would be forthcoming to justify the holding of a second Fair in the year.

The Fair should continue in the main to be restricted, as hitherto, to *bona-fide* manufacturers, and to wholesale firms taking the whole output of a factory or holding the sole selling rights of patented or proprietary articles manufactured in the British Empire.

The reasons which have been submitted, in the course of our inquiry, in justification of this policy appear to us heavily to outweigh those urged on the other side. In the first place, we think that special weight should be given in this matter to the views of the manufacturing firms, for whose sake the Fair was originally established, and who have supported it from the beginning. The immense majority of these firms are opposed to the admission of the factor. We believe, too, that the overseas buyer doing business on a large scale prefers dealing with the manufacturer direct, and the success of the Fair in attracting the overseas buyer is probably due in no small measure to the facilities which it affords him in this respect. It is further an advantage to him to know that the product of any particular manufacturer is shown in the Fair on one stand only, and at one price, and that the manufacturer's price. The general admission of the factor would also make it more difficult to ensure that only goods of British origin were included in the Fair. There is also the question of space, which is inadequate to meet existing requirements.

We therefore recommend that as a general rule the Fair should continue as hitherto to be open only to manufacturers and to wholesale firms taking the whole output of a factory or holding the sole selling rights of patented or proprietary articles manufactured in the British Empire.

We consider that this principle should be relaxed as regards textiles, in view of the special conditions existing in that trade, and possibly in the case of other groups of products, if similar conditions can be shown to exist, but we would recommend that exhibits coming under such categories should be shown, if possible, in separate buildings.

A further question to which our attention has been drawn, and which we would venture to emphasise here, is the importance of systematic propaganda. We are aware that the Department of Overseas Trade is fully alive to this aspect of the question, and that an overseas publicity campaign is conducted on an extensive scale in connection with the British Industries Fairs. We consider, however, that the logical development of this policy should involve its extension to all trade fairs and exhibitions held in this country which might afford opportunities for the promotion of export trade, and particularly of course to any which it might be decided to run concurrently with the British Industries Fairs.

LEGAL.

Sentence on Charge of Fraud.

At the Surrey Sessions, held at Kingston recently, two young men from Manchester, who were engaged in business at Surbiton Road, Kingston, named G. E. L. Wynne (22), merchant, and Albert E. Wynne (20), packer, were charged with obtaining credit by means of fraud from the Notable Electric Co., Ltd., of Merton, the Electrical Supplies Co., of London, and others; also for conspiring with G. W. Lester (26), engineer, of the same address, to obtain credit from the Notable Electric Co. by means of fraud. Local reports of the hearing, published in the *Surrey Comet* for May 21st, show that 46 firms were victimised. The matter was gone into in great detail, as there were many transactions. A verdict of guilty was returned against George Wynne and one of not guilty against Albert Wynne. The chairman said the prisoner G. Wynne had been guilty of a series of deliberate frauds, and would be sentenced to 12 months' hard labour on each count, the sentences to run concurrently. Lester failed to surrender to his bail at the last Sessions, and his absence was also reported on this occasion. A warrant for his arrest had been issued, but it had not been possible to execute it. The bail of himself and of his surety was accordingly estreated.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Charging for Idle Current.

In response to the request, contained in Mr. E. W. Dorey's letter of May 23rd, I give below an example of my method of finding the average power factor, and making a charge for idle current based on it, and on the total units used; the latter bringing in the length of time the low power factor was in operation.

I made a slip in my letter of May 8th in saying "the running charge only should be altered." As will be seen from the example the units are increased in the proportion .8/power factor, so that not the running charge but the amount of units on that charge is altered.

Example.—A 5-ampere meter (one element reversed) in series with a meter of 800/5 amperes, gives the following integration over a certain period:—

800-A meter, 27,980 **units.**

5-A meter, $108{\cdot}1 \times 800/5 = 17{,}296,$

$$\tan\phi = \sqrt{3}\,\frac{w_1 - w_2}{w_1 + w_2} = \sqrt{3}\,\frac{17\,296}{27{,}980} = 1{\cdot}07,$$

$$\phi = 47^\circ \therefore \cos\phi = {\cdot}682.$$

$$27{,}980 \times {\cdot}8/{\cdot}682 = 32{,}821,$$

or an addition of 4,841 units to the running-charge portion of the account.

Mr. Dorey's method for integrating the kVAh of the reactive and capacity components along with their respective kVA demands is interesting, but I would not care to make out a consumer's account from them, especially if the consumer were fed through several meters when summation dials for all these would become necessary.

J. D. Watson.

Aberdeen.
May 30th, 1921.

The Cost of Living in Burma.

I have pleasure in forwarding herewith particulars of the cost of living in Burma, together with a table showing the estimated average cost under eight different headings.

The cost of living in a boarding house and in a hotel has been included, and it is necessary to consider these costs because free quarters are not always provided, and houses are scarce.

The figures given in the table are below the average for Rangoon and above the average for Burma generally; of course only averages can be given, as the actual cost of living depends so much on the taste of the individual, but these figures may serve as a guide to engineers who may be considering an appointment in this country.

Before accepting any appointment in Burma, I would strongly emphasise the importance of finding out the conditions of living and the social status of the appointment as, unlike conditions at home, there are few, if any, similar electrical appointments in the whole country.

Most companies provide free quarters or a free house partly furnished, and allow one or two other extras, but particulars should also be obtained regarding provident fund, salary, or passage money during leave periods, &c.

By taking all these points into consideration, engineers who may be thinking of coming to the "Silken East" should be able to work out from the accompanying table what their expenses are likely to be.

Item.	Young Bachelor. (a) Sharing free furnished chummery with two others.	(b) Sharing rented chummery with two others.	(c) Boarding house.	(d) Hotel.	Young Married Couple. (e) Free house partly furnished, &c.	(f) Rented house.	(g) Boarding house.	(h) Hotel.
1. House rent	Nil.	75	250	300	Nil.	250	450	575
2. Food	120	120			240	240		
3. Sodas, wines, &c.	15	15	20	25	20	20	23	28
4. Tobacco, Papers, &c.	10	10	10	10	12	12	12	12
5. Lighting	Nil.	10	Nil.	Nil.	Nil.	25	Nil.	Nil.
6. Guests	20	20	25	30	40	40	50	60
7. Amusements	10	10	10	10	15	15	15	15
8. Club bills	25	25	25	25	30	30	30	30
9. Clothes	60	60	60	60	185	185	185	185
10. Laundry	10	10	10	10	25	25	25	25
11. Furniture, &c.	Nil.	20	Nil.	Nil.	30	60	Nil.	Nil.
12. Car and chauffeur	Nil.	Nil.	Nil.	Nil.	110	110	110	110
13. Gary or motor cycle	30	30	30	30	Nil.	Nil.	Nil.	Nil.
14. Insurance	Nil.	Nil.	Nil.	Nil.	40	40	40	40
15. Servants	50	60	30	35	140	175	40	45
Total in rupees	350	465	470	535	887	1,227	980	1,125
Totals in sterling at present rate of exchange. One rupee = 1s. 3⅝d....	£22 15 8¾	£30 5 5⅝	£30 11 11¾	£34 16 7⅜	£57 14 11⅜	£79 17 7⅞	£63 16 0½	£73 4 10⅛

In the table I have not included "savings" (a very necessary item), and would point out that unless the salary offered is such that from 20 per cent. to 25 per cent. can be saved, the glamour of the East will soon wear off.

With regard to salary, I would recommend that:—

1. No young bachelor should accept a commencing salary of less than Rs. 500 per mensem, with free furnished quarters, &c., or Rs. 650 per mensem, without free quarters.

2. No married man should accept a commencing salary of less than Rs. 1,000 per mensem, with a free (partly) furnished house, &c., or Rs. 1,275 per mensem, without free house.

3. The agreement should provide for annual increases of Rs. 50 per mensem, with liberal leave allowances.

Before accepting a salary of less than Rs. 1,000 per mensem a young bachelor, hoping to get married, would do well to consult the accompanying table, from which he will understand why some companies when advertising appointments state "Single man preferred."

M.I.E.E., A.M.I.Mech.E., M.Amer.I.E.E.,
M.I.E. (India).

Rangoon.
May 2nd, 1921.

[By furnishing this valuable and detailed information our correspondent has laid many of our readers under a very real obligation, and on their behalf we offer him our best thanks.—Eds. Elec. Rev.]

Wear of Rotary-Converter Slip Rings.

In your issue of the 20th inst., a correspondent, "Koocaf," reports a bad case of uneven wearing of the collector rings of his 500-kW, 40-cycle, 800-r.p.m., 240-volt, d.c. rotaries. His surmise regarding the transference of metal between the rings and the brushes, while not strictly true, is certainly a shot in the right direction. I shall refer to what is, in my opinion, the real cause later; first, I would hazard the guess that the trouble is greatly accentuated by a too high current density in the a.c. brushes. The amperes per ring, at about 100 per cent. power factor, will approach 1,000; the space available for a.c. brush-gear on a machine of the type considered will usually be quite restricted, and the designer probably was forced to rely on brushes for which satisfactory operation at abnormally high current densities was claimed. Your correspondent, unfortunately, forgot to state how many brushes per ring were employed; he should also have told us the cross-sectional area of a brush.

I would recommend him, however, to satisfy himself that there are sufficient brushes, allowing a current density of about 100 amperes per sq. in. of cross-sectional area. He should also see that they are properly spaced around the rings.

The explanation of the action going on, I hope, will be gathered from the subsequent remarks.

It has been generally recognised for many years that current passing from a brush to a ring in motion will tend to "eat," or burn, away the brush surface, but not affect the ring to any extent; while in passing from the ring to the brush, the former would burn, but not the latter. To form an idea of the action, let us assume the case of a single brush on a ring. The current would then be from the ring to the brush in one part of the ring, representing one pole arc, and would be in the opposite direction in the part representing the next pole arc. Therefore, within a given segment, or part, the current is always in a given direction with respect to the brush and ring. It follows that, in one segment, the ring would tend to burn away, while in the next segment it would not, with the result that there would be as many low spots as there are pairs of poles. Large-section (therefore heavy) brushes would aggravate the trouble, as owing to their high inertia they would not readily follow the slight irregularities first set up, and consequently burning would occur, with rapidly increasing deterioration of the rings. Your correspondent should, therefore, endeavour so to space the brushes that each segment (*i.e.*, the one-sixth part of the circumference of a ring) has at least one brush on it. Owing to mechanical difficulties, this will, no doubt, be impossible, but the idea should be followed as far as possible. For instance, if half the periphery is covered with brushes, care should be taken to have as many brushes on segments corresponding to north, as on those corresponding to south polar arcs.

If it appears hopeless to readjust the present brush gear successfully, "Koocaf" might fit copper-leaf brushes; by working these at 200-250 amperes each, four would be required per ring, two on a north polar arc, and two on a south. The lubrication of the rings would be the same as at present. These brushes, being very flexible, can easily follow slight variations out of true; they have a low contact drop, and probably the rings will operate at a lower temperature.

Undoubtedly, the copper-leaf causes more dust around the rings, and so more attention is necessary to keep them clean; this is their only bad feature, and I know of rotaries fitted as above operating for years with only an occasional "true up."

W. G. Stuart.

Trethomas.
May 23rd, 1921.

Fire Prevention and the Insurance Companies.

Your issue of April 15th contained a communicated article under the heading "Fire Prevention and the Insurance Companies," together with an editorial comment thereon, the theme in both instances being an attack on the attitude of the fire offices committee towards the question of premium rebates to be granted in the case of "protected risks."

It is difficult to believe that the writer of the communicated article has much experience of insurance business from the actuarial point of view, when he makes the statement that the interests of an insurance company and the interests of the public are in direct conflict. The interests of an insurance company are, first and foremost, to reduce the fire loss ratio, and any sound-principled company prefers to turn its attention to improving the risks under its policies, rather than merely to increasing its annual premium total, regardless of the nature of the risks insured. Are not the public interests equally directed towards improving risks and thereby preventing fires? Although he may be fully insured, the property owner has little comfort as he watches his factory or his warehouse burn down, when he thinks of the interruption which will be caused to his turnover and the loss of business connections which must inevitably ensue.

Under these circumstances the introduction of automatic apparatus for the detection and extinction of fire has received the closest attention from insurance companies, resulting in the granting of a rebate from the insurance premium in accordance with the nature of the automatic device installed, and in this connection your comments are certainly open to criticism when it comes to comparing electric alarm devices with automatic sprinklers.

The writer can speak with more authority than most insurance men on the technical aspect of such devices, having served for a year and a half as a fireman in a large city, and having had actual experience of fires in a large variety of risks. He well knows the value of an early alarm of fire being given, and he also knows what it is to reach the scene of the outbreak and find the *fire already extinguished* in its infancy by the action of the sprinklers. With regard to water damage, it is well known that a fireman entering a burning room which is full of smoke does inevitably cause unnecessary water damage with his fire stream in his endeavours to locate the exact position of the fire, whereas a sprinkler, being operated by heat alone, and not by smoke, confines its water shower to the vicinity of the actual outbreak, and goods stored a few yards distant are untouched by water.

Good as they are, electric alarm devices only make a start in the matter of fire detection, and it is not to be wondered at that insurance companies place on a higher level the apparatus which not only detects but also extinguishes the outbreak. Incidentally, it may not be generally known that in America and Australia sprinkler installations have electrical connections to the fire brigade stations, by means of which an alarm is rung in to the brigade simultaneously with the opening of the first sprinkler by the heat of a fire.

The Royal Commission will, of course, have every opportunity to probe the whole question of fire prevention to its depths, and it will be indeed surprising if the result of these investigations shows the Fire Offices Committee to be as blind as your contributor would have us believe to the pertinent factors in this all-important and national problem.

E. W. Hubbard.

London.
May 27th, 1921 .

The Johnsen-Rahbek Electrostatic Loud-speaking Telephone and Relay.

While listening to the brilliant lecture on this subject yesterday at the Institution of Electrical Engineers, and while witnessing the very remarkable and beautiful demonstration with the authors' talking violin, I experienced some dim feeling that I had, in the distant past, read of similar apparatus working on the same principle. I remembered Edison's loud-speaking telephone with its rotating cylinder of moistened chalk, but I also recollected that in that instrument the passage of the electric current had the effect of reducing the friction between the cylinder and the metallic slider rubbing thereon owing to electrolytic decomposition.

This morning, from the perusal of a collection of technical Press cuttings nearly forty years old, I have confirmed my vague impression that Messrs. Johnsen and Rahbek's method, in which electrostatic attraction is employed to increase the friction between sliding surfaces, one of which is of metal and the other of imperfectly conducting material, is not entirely new, as I find that in the late seventies a speaking telephone receiver based on this principle was invented, patented, and constructed by Mr. Elisha Gray, the well-known electrician of Chicago. I have a complete printed account of this instrument, taken, I fancy, from a long-extinct journal of those days called "Design and Work," and find that the instrument is also mentioned in a lecture on telephony given by my old friend Mr. Conrad Cooke before the Royal Society of Arts on May 23rd, 1879. For his badly conducting substance Mr. Elisha Gray used animal tissue, such as bacon rind, pork skin, kid-glove skin, and even the living human hand. A portion of one of these was lightly pressed against a rotating disk of polished metal, and produced sounds and speech from a resonating box owing to the amount of the friction varying with the electrical potential applied through a step-up transformer from a microphone, the effect being due, according to Mr. Gray's own explanation, to electrostatic attraction and repulsion between the sliding surfaces.

Verily "there is nothing new under the sun"; but this revival in an improved and modified form of what would seem to be an old idea appears likely to have several useful present-day applications, while Messrs. Johnsen and Rahbek's experimental demonstration of the surprisingly considerable amounts of force that can in this way be controlled was certainly most convincing.

London. **A. A. Campbell Swinton.**
May 27th, 1921.

[In a letter to *The Times* of Monday last, Mr. Rollo Appleyard points out that in a paper on "Contact with Dielectrics" read before the Physical Society of London in 1905, the phenomenon was described, under the name of "retentive force." The value of the force was measured by a balance at voltages from 0 to 750 volts. Particulars of these and other tests were published in the *Phil. Mag.* in 1894, 1896, 1897, and 1905.

Prof. W. F. Barrett, in a letter to *The Times* of May 31st, went still further back—to January 19th, 1880—on which date he read a paper before the Royal Dublin Society in which he showed that the Edison chalk-cylinder telephone really depended upon the principle which Mr. Appleyard discovered 25 years later—namely, the "stiction" induced when a current passed from a metal spring to a rotating cylinder of chalk or other material. Prof. Barrett described further experiments (showing that an e.m.f. was generated between the metal and the chalk cylinder) in a paper read before the Physical Society of London on March 14th, 1880, which was reported in THE TELEGRAPHIC JOURNAL (now ELECTRICAL REVIEW) of April 1st, 1880, p. 126. A paragraph from this journal of 1877 bearing on Mr. Swinton's letter appears in our "Notes" columns.—EDS. ELEC. REV.]

Coal Shortage and Oil Fuel.

In almost every engineering and daily paper that is read to-day one continually reads of the conversion of some works' boilers from coal to oil burning, because we have placed all our eggs in one basket, and continue to do so.

When are we going to give the internal-combustion engine a real start in life and get some good work and experience from the Diesel engine?

I quite agree that the changes which are taking place to-day are emergency changes to keep works running, but on the other hand, we have had several stations running on Diesel engines for ten years or more, and many are quite satisfactory; surely we should now be in a position to place some reliance in them. I am afraid that people who have not had Diesel experience are allowing them to fall into the same category as the gas engine has had to be content with for many years—simply because of neglect or misunderstanding.

My experience has been that the design, material, and workmanship of gas and Diesel engines are such that, given normal care and attention, you have quite a happy time with them; I have spent many happy years with both types.

In your notes for May 13th the following appears in connection with one installation: "Apart from the advantage that oil fuel is available, while coal supplies are likely to be short for some time, it is claimed that the conversion will result in considerable economies, because:—

1. Consumption is 50 per cent. less than coal.
2. One man can do work requiring six men in the case of coal fuel.
3. Storage is simpler and handling easier.
4. Supplies can be obtained without fear of interruption.

The above four items which have taken seven weeks of strike to bring forward, are well worth considering and comparing individually with what might have been the case had 20 or 30 per cent. of the plant in our medium and small stations been Diesel engines or gas engines, working on a new type of producer where coke can be used efficiently and the tar burnt off at the furnace top.

Take case (1); this seems to point to the fact that we are at last going to be compelled to realise and acknowledge that the days of 3.5 lb. of coal per kWh must be looked on as a wastage of our fuel resources.

If we go a little deeper into the matter, we find that most Diesel engine makers guarantee to produce one kWh for 0.5 lb. crude oil. Now take to-day's figures. One works gives 70 tons of oil to do the work of 100 tons of coal, and the respective prices are £490 and £300. So that oil is at £7 per ton and coal at £3 per ton, while one recent contract in your columns for May 13th showed that the contract had been closed at the average price of 43s. 4d. per ton for all grades of coal.

In your issue of May 27th, Glasgow Corporation quote the coal consumption of their older stations (that is, those which are running to-day with the new Dalmarnock station) to be 3.42 lb. per kWh generated, so that for stations up to 2,000 to 5,000 kW capacity we can safely double this figure and say 7 lb. per kWh generated.

If we take the case of coal at £3 per ton and at 3.42 lb. per kWh generated, we get a fuel cost of 1.097d. per kWh.

Now take oil at £7 per ton and at 0.5 lb. per kWh generated, we get 0.375d. per kWh, or just about one-third the cost.

If we base the price of oil on the coal figure we find we can for the same fuel cost afford to pay a tremendous price for oil. Take the price as above of 43s. 4d. per ton of coal; at the very low figure of 3 lb. per kWh, this gives a fuel cost of 0.69d., and with oil at 0.5 lb. per kWh, we could for the same fuel cost per kWh pay £12.9 per ton of oil. This oil in pre-war days was purchased at £2 per ton when coal was

14s.; the fuel costs then were as follows: Coal 0.225d. and oil 0.105d. per kWh.

There is every reason to believe that these figures will soon return to a pre-war balance. For several years I have plotted the curves for oil prices, and it is known that well over 80 per cent. of the increase is due to freightage charges.

Now, if we take the smaller stations at 7 lb. of coal per kWh generated, and coal at £3 per ton and oil at £7, we get a fuel cost of: Coal=2.247d. and oil at 0.375d., which shows what could be saved by the smaller stations in addition to labour saving and a conservation of our coal; many of our smaller stations would be free from coal strikes, and so leave a bigger margin of good coal for the larger stations where it can be burnt and one kWh produced, as at Dalmarnock, for 1.71 lb., which, after all, is not much to be proud of.

If our medium and smaller stations had installed, say, 30 per cent. of their plant of Diesel or gas engines, they would to-day be carrying on, and giving most of their consumers an adequate supply.

Case (2). One man can attend to several Diesel engines, and so continue the great labour saving that can be shown when we are forced by circumstances to accept something different to the beaten track.

Case (3) follows in each case, and is very noticeable compared with the large floor space occupied by our coal storages.

Case (4) is no less glaring than 1, 2, or 3, and after the many strikes that have occurred of late years, should be well marked.

I consider that many of our to-day extensions to the medium and smaller stations should be in the field of gas and Diesel engines. The electrical industry would then reap a great benefit by putting a cheap supply within the reach of every householder and manufacturer. Where any gas is available it should certainly be used at its maximum efficiency, and then the case of Diesel engines should be very carefully considered for any extensions to run in parallel with the existing plant.

There are many stations in this country where Diesels are installed, and I feel sure that the experience of the engineers of these plants would be very useful.

S. H. Fowles, A.M.I.E.E., A.M.I.Mech.E.

Jarrow-on-Tyne.
May 30th, 1921.

The Grading of Mains Engineers.

I have read with some amusement the letter of "P. S." deriding mains engineers; it is just the same old story over again, each man thinks he has the worst job, but "P. S." will certainly not improve his by trying to belittle others. Personally, I am always glad to see the next man get a substantial increase, because if he can get it, then there is some hope for me. Each post has its own advantages and otherwise. I often envy the "inside" man, because he can walk round the whole of his work in an hour, and when his eight-hour shift is finished, he is free.

Not so the mains man; he must make two or three journeys per day to different sets of men, perhaps miles apart, in all weathers, and when he reaches home he is still at the call of the telephone, and often has to turn out at all hours of the night. I have gone to bed and got up again three times the same night. I have had 25 years of both shift and mains work, so I know a little of each.

Thanks to the E.P.E.A., together with the valued support of the Review, things are improving, and it is up to "P. S." to support the Association, attend the meetings, and ventilate his grievance there, and always remember that criticism, to be of any value, should be helpful, and not destructive.

A. B.

May 28th, 1921.

C.T.S. in Iron Pipes.

I should be glad to learn whether any reader has had any failures of small C.T.S. wires or cables when enclosed in an ungalvanised iron pipe in any situation underground or otherwise, due to the action of rust, and if so, after how many years?

I think the question is of some interest, particularly to wiring contractors, as it is often required to place wires in pipes underground, say, to a garage, and in this position it is well known how rapidly ordinary braided or lead-covered V.I.R. wires fail.

B. W. Gothard.
Electrical Engineer.

Aldershot Electricity Works.
May 26th, 1921.

Submarine Cable Telegraphy.

Regarding the article under above heading in the Electrical Review of May 6th, 13th, and 20th, and with special reference to footnote †, concerning paragraph 13 on page 576 (May 6th), may I point out that my surmise as to constant 4 c.h.p.l. having been adopted to cover cable *Morse*, is mistaken?

Constant 4 applies to recorder equal time dot-dash code *only*.

Corresponding constant in Morse work is 5.28 c.h.p.l.

A simple way to utilise, for *Morse*, all formulæ, graphs, tables, and scales included in the above article, is to multiply by 0.57392 all final results obtained therefrom whether for K or for L.

New matter relating to Morse code for cable purposes will soon be submitted for publication.

Edward Raymond-Barker.

London.
May 27th, 1921.

A Peculiar Phenomenon.

We regret that in the interesting letter by Mr. C. R. C. Hadfield in our issue of May 27th, an error occurred in paragraph 6, line 1, "the bluish fluorescence is characteristic of bad and lithium glasses." This should, of course read: "Lead and lithium glasses."—Eds. Elec. Rev.

BUSINESS NOTES.

Bankruptcy Proceedings.—George William Lester, electrical engineer, lately carrying on business at 44-6, Surbiton Road, Kingston-on-Thames, in the name of Lester & Browne.—Under this failure accounts have been lodged at the London Bankruptcy Court showing liabilities £1,904 (unsecured, £1,824) and assets "nil." According to the observations of Mr. F. T. Garton, Official Receiver, a previous failure is recorded against the debtor in May, 1919, when a dividend of 2s. 5d. in the £ was paid under a deed of assignment on liabilities of about £1,000. He further states that, having been previously employed as an electrical engineer, he, with another, entered into partnership, and traded as electrical engineers under the style of Herrtage, Lester & Co., at 4, Queen Street Place, E.C., each finding capital of £25; in or about September, 1917, differences arose, and the partnership was dissolved; the debtor then continued to carry on the business alone, and assumed all the liabilities; in May, 1919, he called a meeting of his creditors and executed a deed of assignment in favour of a trustee, who decided to sell his business as a going concern; the purchaser eventually sold the business to a limited company, the debtor being appointed managing director, at a salary of about £4 per week; he continued in this capacity until about February, 1920, when he resigned. He then, with £25 borrowed capital, resumed business on his own account at 44-46, Surbiton Road, Kingston-on-Thames, as a wholesale electrical engineer, under the style of Lester & Browne; after a few months' trading, owing to lack of capital he transferred his business to a limited company, which only took over the assets, he remaining responsible for the liabilities, the consideration being the payment of £70 in cash and the allotment of 2,505 shares as fully paid, and was appointed managing director, at a salary of £750 per annum. About March, 1920, he opened a branch business at Nottingham, and carried on until about June, 1920, when, owing to its not being successful, he closed it. He had since October, 1920, been without regular occupation. The debtor attributes his present failure to bad trade, extravagance, and losses by betting. The deficiency account showed a net loss of £1,333 on the trading since October 30th, 1919, in spite of which his household, personal, and medical expenditure during the same period amounted to £693, and he lost £117 by betting.

A sitting of the Court was appointed to be held before Mr. Registrar Francke for the public examination of the debtor. The Official Receiver reported that on February 4th the debtor was ordered to file cash and goods accounts, and to attend at the department to give particulars. He had not attempted to comply with that order. Criminal proceedings were pending against the debtor, and it appeared from a newspaper report that he had failed to surrender to his bail under those proceedings. In the absence of the debtor the sitting for his public examination was adjourned *sine die*.

J. F. Lyons, electrical engineer, 27, Palmerston Street, and Front Street, Consett, Durham.—Receiving order made May 20th, on debtor's own petition. First meeting, June 8th; public examination, June 9th; both at Newcastle-on-Tyne.

P. Downie, electrical engineer and factor, 355a, Westborough Road, and 88, Ronald Park Avenue, Southend-on-Sea.—First meeting, June 7th, at 14, Bedford Row, W.C.; public examination, July 6th, at the Shire Hall, Chelmsford.

S. H. Dougherty (Mersey Electric Co.), electrical engineer, Liverpool.—First meeting, June 3rd; public examination, June 27th; both at Liverpool.

R. P. Baker & F. C. Stubbs (Sheffield Electric Construction Co.), electrical engineers, 124, Pond Street, Sheffield.—Receiving order made May 27th, on debtors' own petition.

Company Liquidations.—Ampere Electrical Engineering and Plating Co., Ltd.—Particulars of claims, &c., must be sent to the liquidator, Mr. T. L. Hammond, North-Eastern Bank Chambers, Fowler Street, South Shields, by July 1st.

Sun Fuel Co., Ltd.—A petition for winding up has been presented by Mr. P. J. Mitchell, a creditor, and it is to be heard on June 7th.

Lacy-Hulbert & Co., Ltd.—Winding-up voluntarily for reconstruction. Liquidator, Mr. G. H. Hill, 91, Victoria Street, S.W., who is authorised to consent to the registration and to enter into an agreement with a new company, to be called Lacy-Hulbert and Co. (1921), Ltd. Meeting of creditors called for June 6th, at Boreas Works, Beddington.

Electro-Chemical Developments, Ltd. — A meeting of members is called for July 4th, at Waye, near Ashburton, Devon. Liquidator, Mr. E. A. Ashcroft.

Dissolution of Partnership.—Warwick & Walker, electrical engineers, 107, Church Road, Birkenhead.—Messrs. N. Warwick & A. Walker have dissolved partnership. Debts will be attended to by Mr. A. Walker.

Trade Announcements.—Owing to a recent fire, Messrs. Ames & Co. have temporarily transferred their offices from Market Place to 6, York Chambers, Long Eaton, where all correspondence should be addressed.

The Midland Supply Co. has removed from Paradise Street to larger premises at 53, Summer Row, Birmingham.

Messrs. Marshall & Plumtree, Ltd., of 20, High Holborn, W.C. 1, announce that their telephone number has been altered to "Chancery 7144."

Messrs. Electrical Utilities, Ltd., have appointed Messrs. F. W. Parkes & Co., of 65, Dame Street, Dublin, to represent them in the South of Ireland.

Mr. Dougall, electrical engineer, of 22, South End, Croydon, announces that he is retiring from business.

Mr. F. H. Dennis, electrical engineer, of Chelmsford, has removed his business to the Chelmer Works, 21c, High Street.

Mr. William Raine, who was for 20 years with Sykes & Co., has commenced business as an electrical engineer with his son, trading as William Raine & Co., at 9, Coniscliffe Road, Darlington.

The Mackenzie Holland, and Westinghouse Power Signal Co., Ltd.—This company has removed to 82, York Road, King's Cross, N. 1.

The London Shafting and Pulley Co. has removed to Northdown Works, Northdown Street, King's Cross, N. 1. New Telephone number: "North 196."

Catalogues and Lists.—British Central Electric Co., Ltd., 6 and 8, Rosebery Avenue, E.C. 1.—Monthly List of electrical machinery, including steam turbines, alternators, d.c. generators, and a.c. and d.c. motors.

The British Aluminium Co., Ltd., 109, Queen Victoria Street, E.C. 4.—Publication, No. 173, dealing with numerous examples of the application and working of sheet aluminium. The list is well illustrated, and shows reflectors, distilling apparatus, aeroplane parts, and other articles.

Economic Electric, Ltd., 10, Fitzroy Square, W. 1.—A comprehensive general catalogue of small electrical appliances and apparatus. The list, which is fully illustrated and priced, includes small motors and dynamos, telephone instruments, electric bells, pocket lamps, dry cells and accumulators, spark coils, X-ray tubes, &c.

Messrs. Parmiter, Hope & Sugden, Hulme Electrical Works, Manchester.—A splendidly produced catalogue of "Fluvent" and "Ajax" electrical switchgear. Full prices and illustrations are given of magnetic blowouts, ironclad three-phase and double-pole fuse boxes, coupled boards, crane control panels, inspection troughs and sealing boxes, switch fuses, unit type switchboards of many types, mining type switchgear, and the "Rotaloc" fuse system.

The General Electric Co., Ltd., Magnet House, Kingsway, W.C. 2.—Booklet No. V 2,532, giving illustrations and prices of a wide variety of "Freezor" fans for a.c. or d.c., wall, ceiling or table. Also automatic shutters and regulators for fans.

The Lawton Machine Tool Co., Burgess Street, Sheffield.—An illustrated leaflet, giving details and prices of "Lawton" simplex oil burners.

X-Rays, Ltd., 11, Torrington Place, Gower Street, W.C. 1.—An illustrated pamphlet describing the "Ped-o-Scope," a device for use in shoe-fitting.

Langham Engineering Co., Park Street, Slough, Bucks.—A list giving details and illustrations of "Langham" d.c. motors and dynamos. Fully priced.

Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Leaflet No. 881, a pamphlet illustrating a number of interchangeable lighting fittings for building up into various styles.

The Cambridge and Paul Instrument Co., Ltd., 45, Grosvenor Place, S.W. 1.—A postcard advertising List No. 191, dealing with "Cambridge" potentiometers, &c.

Messrs. Studebaker, Ltd., 117-123, Great Portland Street, W. 1.—A priced booklet, illustrated in colour, describing the "Lalley Light" house-lighting plant and its advantages.

Messrs. E. P. Allam & Co., 107-109, Gray's Inn Road, W.C. 1.—Monthly Stock List of d.c. motors for sale and hire—June, 1921.

Messrs. Henry Wallwork & Co. (1920), Ltd., Roger Street, Manchester.—Two well-produced booklets, illustrated and fully detailed dealing respectively with gear generators and worm gear devices (including several applications to electrical machinery). Also a number of leaflets giving further details and prices.

Mr. E. W. Dobey, Norwich House, Southampton Street, High Holborn, W.C. 1.—An illustrated pamphlet dealing with the improvement of power factor by means of static condensers.

Messrs. Leopard Bros., 81, Micheldever Road, Lee, S.E. 2.—An illustrated and priced leaflet dealing with a new bonding and earthing clip for wiring systems.

Messrs. Higgs Bros., Sand Pits, Birmingham.—"Monthly Magazine," June. Prices and particulars of a.c. motors and d.c. dynamos and motors, hints on power required for machine tools, and the usual features are included in this issue.

The Electric Heating Co., George Street, Croydon.—An illustrated and priced pamphlet advertising electric kettles and the "Elect" electrical irons for domestic and tailors' use.

Catalogues Wanted.—Messrs. Aldrich & Butland, who have commenced business as electrical and mechanical engineers at Castle Street, Ruthin, desire to receive catalogues from manufacturers, &c.

Safeguarding our Industries.—The House of Commons, on Tuesday, renewed its discussion of the financial resolutions relating to the Safeguarding of Industries Bill. An amendment was moved reducing from five to three years the period of the import duty of 33⅓ per cent. on certain imported articles, but it was lost by 203 to 81 votes. An amendment to substitute 10 per cent. for 33⅓ per cent. was defeated by 244 to 79. A further amendment to omit optical glass, &c., because the industry did not require assistance, was lost by 209 to 70, and one to omit arc-lamp carbons from the resolution was rejected by 168 to 75. Other amendments met similar fates, and ultimately the first resolution was put as a whole and carried by 194 to 74. The discussion was then turned on to the second resolution, which imposes the Customs Duty of 33⅓ per cent. to prevent dumping, and an amendment was moved to limit the operation of the resolution to one year.

The Coal Dispute.—Neither side having given way in matters of principle affecting the future conduct of the coal-mining industry, the dispute continues.

The bulk of public service undertakings are carrying on with surprising vigour after eight weeks of stoppage, and oil fuel is gradually being introduced to more and more power stations.

Further developments in connection with the staff of the L.C.C.'s Greenwich station are foreshadowed by the *Daily Herald*. The trouble arose from the dismissal of members of Trade Unions for carrying out the instructions of the Transport Workers' Federation with regard to the handling of imported coal. The withdrawal of the "embargo," it having proved ineffective, led to a request for the re-instatement of the men whose position was not to be prejudiced by their action. This has apparently been refused, and a meeting of representatives of the Unions involved was to be held on Wednesday night, when further action was to be discussed.

The official unemployment figures for the week ended May 30th, quoted by the *Morning Post*, showed a further increase, bringing the total up to 2,070,100, in addition to those working shorter hours.

Norwegian General Strike.—The *Morning Post* correspondent at Christiania reported on May 27th that owing to the general strike, Christiania was without tramcars and gas, although the electricity supply was being maintained. The railways and hospitals were not affected by the strike.

A later message stated that the principal electric cable in the centre of the city had been cut, depriving this district of light.

Additional G.E.R. Trains.—The Great Eastern Railway Co. has for some time past been using liquid fuel for locomotives, the apparatus used being what is known as the Holden injector, and with recent additions it now has a total of about 50 engines so fitted. These engines can without further alteration consume either solid or liquid fuel, as may be necessitated by circumstances. This, in conjunction with the use of wood and coke, will enable the company to extend its present limited services.—*Financial Times.*

Electrical Trade in Italy.—Our attention has been called to the fact that the figures in the Italian article, page 651 (May 20th) are incorrect. The cwt. there referred to are to be understood as quintals—*metric* quintals—and not the common quintals, which only are equivalent to cwt. The Italian paper from which the article was extracted did not specify that the quintals in question were metric ones. Hence, from a lapse of attention, the mistake of the translator.

Visit of American Trade Delegates.—The American and Canadian Trade Delegation at present touring this country visited Preston, on May 26th, and inspected various large works, including those of the English Electric Co. (Messrs. Dick, Kerr's) and the Leyland Motor Co.

Outing.—The ladies of the Ediswan Ponders End staff went for a very successful outing on Saturday, 21st ult. A party of nearly 100 left the works in three large charabancs for Ruislip Common, where various games, sports, &c., were engaged in until tea-time. After tea the journey was continued to Uxbridge, where a dinner was held at the Chequers Hotel, under the chairmanship of Mr. J. W. Elliott. After dinner there was a short concert, organised by Mr. A. P. Ambler. A hearty vote of thanks was given to the Ladies' Organising Committee.

The Cost of Living in Constantinople.—In the *Journal* of the British Chamber of Commerce, p. 164, is given a detailed table from official sources showing the cost of living in Constantinople during the past six months, as compared with July, 1914. Since November last there has been a downward tendency, but the cost in April was still 1,230 per cent. above the cost in July, 1914. The rate of exchange (piastres) was 568.

The Belgian Thomson-Houston & Carels Co.—The directors of the Société d'Electricité et de Mécanique (Procédés Thomson-Houston & Carels), reporting on the year 1920, state that the period was one of transformation and preparation, particularly with regard to the production of electrical plant. As was mentioned in the report for 1919, the company had just begun the delivery of electric motors made in their own shops, and in July, 1920, the production of these motors in bulk reached the figures which had been decided upon previously. To this branch was subsequently added the construction of rheostats, and towards the close of the year that of large motors and transformers. These productions had now become normal, and the construction of large alternators and of certain apparatus has recently been commenced. As to the output of Diesel engines and of steam engines, it had been possible during the year to give these departments the same importance as they had in pre-war times, and the company had resumed the position which the Usines Carels had been able to obtain in foreign markets, where most of the production was disposed of; and it is added that 92 per cent. of the orders yet to be invoiced in 1921 are for foreign account. After recalling the advantages accruing to the company from the agreement concluded with the International General Electric Co., of Schenectady, the report mentions that one of the results of the arrangements made was that the company had obtained control over the patents for the manufacture of incandescent electric lamps in Belgium, and was now engaged in establishing this branch of manufacture. For this purpose the company had acquired an interest in the Manufacture Belge de Lampes Electriques, which was to be assisted in improving and developing its production. While waiting until the company's own works at Ghent was able economically to undertake the construction of new classes of electrical plant, the company's sale organisations were using the plant made by associated companies, and were thus securing customers for the company's own products. On the other hand, the company had already supplied to allied companies some electrical plant made at Ghent, and several thousands of motors were being built for the account of the International General Electric Co., which the latter would subsequently distribute throughout the world. The financial results were very satisfactory, the net profits having been 2,722,000 fr., and permitting of the payment of a dividend at the rate of 8 per cent.

British Handicapped in Dutch Market.—Critical times have been passing in Holland since the attention of electrical engineers in the United Kingdom was attracted some time after the armistice to the ambitious schemes for the electrification of that country.

Dutch industries, which at the beginning of last year were flourishing, owing to the world's demand for goods, have naturally felt the sudden and general decrease in trade. Complaints of competition of goods produced with cheaper labour in Germany have called a movement into existence in Holland, as in several other countries, to legislate against dumping. Stocks of raw material have had to be sold at a loss, and difficulty has been experienced in disposing of manufactured goods. Banks have discouraged credit operations.

Probably for these and similar reasons the far-reaching plans for supplying electricity to farm, factory, and railway throughout Holland have faded somewhat into the background. Apparently they have been postponed or are likely only to be carried into effect in a less elaborate form.

The report on Netherlands industries by H.M. Commercial Secretary at The Hague, which has recently been issued by the Department of Overseas Trade, states that in the opinion of some leading Dutch financiers, it is expected that the present depression, both in industrial and financial circles, can be tided over without serious failures. This view is confirmed by the present general trend of the money market. Bankruptcies, although more numerous than this time last year, have not been spectacular either in number or in importance.

Readers of the Electrical Review will recall that a Bill—based on the report brought out by the Advisory Committee formed in April, 1919—regarding the supply of electricity in the Netherlands was introduced in July, 1920.

Whether the electrification plans are executed wholly or only in part, British electrical manufacturers, particularly of cables, should keep in touch with the business, though unfortunately every month's delay is likely to intensify the strength of German competition. H.M. Commercial Secretary takes the view that unless there is a modification in the present disparity in prices, no British competition in Holland will be possible.

Rough percentages are given below of the share of the more important importing countries in the Dutch electrical trade for the first eleven months of 1920:—

Insulated cable and wires, Germany, 60 per cent.
Insulated cable and wires, United Kingdom, 30 per cent.
Electric motors and transformers, Germany, 50 per cent.
Electric motors and transformers, Switzerland, 17½ per cent.
Electrical instruments, Germany, 70 per cent.
Internal combustion engines, Germany, 50 per cent.
Internal combustion engines, Sweden, 20 per cent.
Boilers, Germany, 60 per cent.
Machinery (exclusive of textile machinery), Germany, 70 per cent.

Yet the fact cannot be sufficiently emphasised that neutral ground like the Dutch market should be treated with great consideration if British industries are to prove themselves willing to compete abroad, and not remain conservatively engaged in production for overseas Dominions and Colonies only.

How German trade is helped by the depressed value of the mark is well known, and H.M. Commercial Secretary reports the ingenious manner in which German exports to Holland are stimulated by the artificial maintenance of this condition of affairs. It appears that whenever signs of an improvement in the exchange are evident, an influx of marks is arranged. With the florins thereby obtained, dollars are purchased. This results in a two-fold benefit to Germany, viz., the continued depression in the mark exchange in the Netherlands and a supply of dollars for the purchase of raw material. Where all quotations for export to the Netherlands are in florins, the depression of the mark abroad is of no interest to the exporter, as its purchasing value will always remain much higher in Germany than abroad.

Repeated evidence has been obtained that purchasers in the Netherlands are interested in British goods, and this interest, he says, should not be damped at the outset by the impossibility of comparing prices when these prices differ, not by small percentages, but by nearly one-half, as was the case in a certain contract for the supply of locomotives for the Dutch East Indies. The soundness of the Commercial Secretary's advice is unquestionable, but it is difficult to see how in present circumstances it can be acted upon.

Forthcoming Exhibitions.—The following exhibitions are being organised:—

London.—July 4th to 15th, London Fair and Market; September 7th to 28th, Shipping, Engineering and Machinery Exhibition; September and October, Textile Industries Exhibition; October 14th to 22nd, Commercial Motor Exhibition; November 4th to 12th, Passenger Motor Exhibition; November 17th to 25th, Public Works, Roads and Transport Exhibition; 1923, British Empire Exhibition.

Cardiff.—1922, Welsh National Exhibition.

Derby.—June 28th to July 3rd, Royal Agricultural Show.

Folkestone.—June 20th to 29th, Health Exhibition.

Glasgow.—November 1st to 19th, Shipbuilding, Engineering and Electrical Exhibition.

Leeds.—July 21st, Yorkshire Agricultural Show.

Canada (*Toronto*).—August 27th to September 10th, Canadian National Exhibition.

Austria.—(*Vienna*), September 11th to 17th, International Fair.

Czecho-Slovakia.—(*Pressburg*), August 6th to 15th, Czecho-Slovak Industrial Fair; (*Reichenberg*), August 13th to 21st, International Fair.

France.—(*Bordeaux*), June 15th to 30th, International Samples Exhibition.

Holland.—(*Utrecht*), September 6th to 16th, International Industrial Fair.

Latvia.—(*Riga*), August 1st to 28th, International Agricultural and Industrial Exhibition.

Norway.—(*Christiania*), September 4th to 11th, Norwegian Industries Fair.

Spain.—(*Barcelona*), September 1st to 10th, International Samples Fair.

Sweden.—(*Gothenburg*), July 4th to 10th, Fair.

Argentina.—(*Buenos Ayres*), 1922, International Exhibition.

Brazil.—(*Rio de Janeiro*), 1922, International Centenary Exhibition.

Java.—(*Bandoeng*), September 9th to October 19th, Netherlands East Indies Fair.

Mexico.—September, Commercial and Industrial Fair.

Work and Wages.—The dominant note in the June issue of *The Electron: the Electrical Workers' Journal* is disappointment at the failure of the "Triple Alliance" to bring about a general strike, and dissatisfaction with the policy of trade union leaders in general. A full account is given of the negotiations with the N.F.E.A. with regard to wages, and it is stated that at the meeting with the employers both sides agreed to recommend a reduction of 10 per cent. in two instalments of 5 per cent. on May 9th and July 9th respectively, "in accordance with the wages agreement." The representatives of the E.T.U. informed the N.F.E.A. that nothing further could be done till the members had voted on the recommendation, the earliest date for the result to be known being May 7th. Without waiting for the announcement of the voting, however, on May 4th notices were issued by the N.F.E.A. putting in force the first reduction, and in accordance with the instructions of the Executive Council of the E.T.U., members affected at once ceased work. On May 9th the result of the ballot was announced to be against the reduction, and strike orders were issued. Since then, as our readers are aware, the strike has been called off.

Reviewing the articles on "The Labour Situation," by Mr. T. W. Cole, which appeared in our pages recently, *The Electron* congratulates the author on having "studied the subject and attained a grasp of the elementary facts of the Labour movements," but is surprised at his omission of "Sovietism"—unless, indeed, he includes it "under his fourth category of Anarchism." The reviewer has little fault to find with Mr. Cole's treatment of the subject, being especially impressed with his clear understanding of the various forms of Socialism; but he makes it clear that his own policy is "The good old rule, the simple plan—that they shall take who have the power, and they shall keep who can," when he says: "Under the present system, the stockholders are the legal owners of the undertakings, while the workers, though in actual possession, have no rights beyond their claim to wages. But that system is doomed." "As surely as feudalism followed barbarism, and industrialism displaced feudalism—as surely as plutocracy superseded aristocracy—so surely will workers' control come, and be followed by workers' ownership of the means of production and distribution."

New French Companies.—There has been constituted as a company at Paris (103, Rue du Cherche-Midi) the Etablissements Desgouttes et Cie, with a capital of 1,300,000 fr., for the prosecution of the electro-mechanical industry.

Under the style of Lustre-Lumière has been formed a Société Anonyme with a capital of 300,000 fr., for the manufacture and sale of electric lighting apparatus, and more particularly the Lustre-Lumière products. The offices are at 20, Rue Malher, Paris.

For the purchase, sale, and manufacture of Edison accumulators the Agence Française de la Société Continentale de l'Accumulateur Edison has been formed at Paris (6, Rue de Sèze) with a capital of 550,000 fr.

With a capital of 250,000 fr. has been formed at Paris (24, Rue Vavin) a company for the manufacture of electric lamps and other small electrical accessories.

The Entreprise Généracl de Travaux Publics et d'Electricité has been embodied with a capital of 2,000,000 fr. in 500 fr. shares for the carrying out of public and private installations in all countries. Its offices are at 2, Rue de la Pépinière, Paris.

With a capital of 400,000 fr. in 500 fr. shares, has been launched the Triphasé Standard C.G.M., whose objects are the construction, purchase, and sale of electric motors and their accessories. The offices are at 42, Rue de Lagny, Paris.

Electric Vehicles in Germany.—*Elektrische Kraftbetriebe und Bahnen*, quoted by the *Technical Review*, states that in 1906, the North German Automobile-Motor Co., of Bremen, manufactured electric wagons of a pattern in accordance with a French patent. These did well in practice, and some are still in use after 14 years on the road. During and since the war a new type of wagon has been brought out capable of taking 4 to 5 tons as freight load, and also a wagon-trailer. The battery is accommodated on the frame and can easily be exposed by taking off the cover and turning down the side piece. The driving switch has been carefully considered and is placed in front of the driver under a hood, and is thus very easily accessible. The current consumption with 4-ton freight load and a speed of 13.35 km. per hour is 38.5 amp. at 154-volt pressure on the level, 48.6 Wh per ton-km., or 112 Wh per freight ton-km. Taking an average for the year it is calculated that for one km. traversed per wagon there is one kWh charge current including the unavoidable current losses at charging and tending the battery. A smaller and lighter type of vehicle has recently been made by the Hansa-Lloyd Works.

Book Notices.—"Coal Mines Act, 1911: General Regulations as to the Installation and Use of Electricity, with Explanatory Memoranda." (73 pp.) London: H.M. Stationery Office. Price 1s net. The first 18 pages reproduce the regulations, the remainder of the publication being taken up by the Memorandum. The latter is divided into two parts devoted respectively to the consideration of the effects of the Regulations upon the use of electricity both below and above ground, and with apparatus used above ground only. Methods of procedure in notifying the inspector of a division of the intention to install electrical apparatus are given.

"Testing of Continuous-Current Machines." By C. F. Smith. Pp. x + 102; figs. 20. London: Sir I. Pitman & Sons. Price 2s. 6d. net.

A Swedish Telephone Manufacturing Monopoly.—According to the *Svensk Handelstidning* an important consolidation of the telephone apparatus industry is impending. The newspaper states that it has long been an open question as to how the Allmaenna Telefon Aktiebolag L. M. Ericsson would proceed with regard to its foreign engagements which were thought to have involved serious losses, owing to the war and the subsequent crisis. The prospects for the subsidiary undertakings in Russia are such that the parent company cannot include the resulting obligations at the values at which they have hitherto stood in the balance-sheet, while the American subsidiary has recently had to work under very unfavourable conditions, so that losses in this case also will have to be reckoned with. The factories in Sweden are well occupied under the present state of trade, and most of the foreign subsidiary companies are also in a favourable situation. It would certainly be possible to devote the profits earned by the parent company and the foreign companies so as gradually to write off the losses on the Russian engagements, but this would imply a very tedious procedure and bring about for the shareholders a deprival of dividends for a number of years. Under these circumstances, the question has been discussed within the management as to the advisability of writing down very considerably for depreciation and of eliminating all the doubtful matters at one time, and a decision in this respect, the newspaper asserts, may be expected in the near future in connection with the presentation of the financial results for 1920.

The shares held by the company in the Swedish-Danish-Russian Telephone Co. were entered in the balance-sheet for 1919 at 6,130,000 kr., those in the Russian L. M. Ericsson Co. at 2,480,000 kr., and those in the Telephone Construction Co., of Moscow, at 500,000 kr., making a total of 9,110 000 kr. In initiated circles, the newspaper remarks, it has been suggested that the consolidation should be carried out so thoroughly that not only the year's profits and all the reserves, but also one half of the share capital should be written off. The share capital amounts to 73,260,000 kr., the reserve funds to 9,820,000 kr., and other funds to 50,000 kr. If, then, this statement should be confirmed, the total amount to be written off would be about 50,000,000 kr.

Apart from the scheme of financial consolidation, proposals are said to be under consideration for increasing the competitive capability of Swedish telephone apparatus by the merging of the H. T. Cedergren General Telephone Co. into the Ericsson Co. Such an amalgamation would imply that practically the whole of the manufacturing of telephone apparatus would be vested in one company, and the fusion would be simplified by the fact that the Ericsson company already holds the majority of the shares in the other company.

Belgian Contracts and Foreign Competition.—The principal reasons for the lack of success of United Kingdom firms in obtaining the numerous important Belgian contracts which have been notified are, states His Majesty's Commercial Secretary to His Majesty's Embassy at Brussels (Mr. R. F. H. Duke, M.B.E.), the present adverse rate of exchange and the activity of Belgian firms to supply the materials required. The majority of contracts which have come to the Commercial Secretary's notice have been obtained by Belgian firms, simply because British contractors have had to quote prices in a currency which has depreciated by 100 per cent. It must be remembered that industry in Belgium has, with few exceptions, almost completely recovered since the armistice, and also that the present trade depression makes firms willing to quote their lowest rates in the hope of obtaining an order and employment for their operatives.

In this connection the *Chronique des Travaux Publics* of April 24th, published an article according to which the Belgian Railway Department has examined the question of the participation of German firms in public tendering. That Department considers that no general rule can be laid down on the principle of permitting foreign competition, but that certain restrictions should be imposed favouring Belgian industry. Where Belgium is not necessarily dependent on foreign supplies it is proposed to give preference to tenders quoting unconditional prices in Belgian francs. It is also proposed to exclude foreign firms from contracting for public works of national importance from the point of view of defence. It is further stated that the Department considers that in present circumstances German and other foreign firms shall not be excluded in general from Belgian adjudications, but that a considerable right of preference ought to be accorded to Belgian firms in view of the difficult trade situation in that country.

E.D.A. Activities.—The latest departure of the British Electrical Development Association, Hampden House, Kingsway, W.C. 2, is an effort to educate the ordinary user of electricity; at least, that is what the title suggests, but we think the booklet (E.D.A. 162 "What the User of Electricity ought to Know") should also be addressed to the *non*-user. It is a description of the numerous advantages of electricity, the "silent servant," and is designed to cause the consumer to realise that lighting is by no means the only service rendered by electricity. The back cover illustrates methods of treating lamps, shades and connections and is really necessary to prevent common abuses. These illustrations might, with advantage, be extended to cover other appliances and fixtures.

Rathenan's Industrial Trust Scheme.—The London correspondent of the *Birmingham Post* writes as follows, under the title, "A Mammoth German Trust":—"I find myself rightly taken to task for not having been more explicit the other day when saying, touching a reascent up the sides of the pit in which Germany now lies, that Germans were facing the facts of their poverty squarely, and were thinking out new forms of industrial and social organisation. What I had in mind was Herr Walther Râthenau's scheme for the co-ordination of all German industries and commerce in one *kartel* or trust, operating under a charter granted by the State. It is an integral part of his plan that there shall be a systematic and continuous application of science to industry, with the object of getting cheaper and better production all along the line. The idea may be good or bad; there must be something in it, for Herr Walther Rathenau is at the head of the Allgemeine Electrizitats-Gesellschaft, and before the war was one of the greatest of German industrialists. He is no theorist. I have not seen the pamphlet in which the plan is set forth, and it is not yet obtainable in English. I write from recollection of a summary, and have got hold only of the central idea. Whether it is an impracticable idea or not is not relevant to the point that Germans are doing some very hard thinking. I had also in my mind Herr Rathenau's 'The New Society,' which faces the facts of post-war German life with a candour which is almost terrible, and yet opens out a path of recovery—a very flinty and toilsome path indeed, for the author is no idealist, but the sternest realist. I make these points purely to illustrate the sort of work German brains are now doing under the stimulus of defeat and poverty. They may be down and under now, but they will be a formidable people to be in competition with in a decade or two."

Applications for British Trade-Marks.—Appended is a summary of the recent applications for British trade-marks in respect of goods and articles connected with the electrical trades and industries :—

Langham (lettering and design). No. 410,982. Class 5. Electromagnetic machinery, motors and dynamos. Francis F. Herbert Schroeder, trading as the Langham Engineering Co., 2A, Park Street, Slough, Bucks. December 24th, 1920.

F.R. (lettering and design). No. 412,960. Class 6. Electric motors and dynamos. Firth & Russell, Stirling Works, Shafton Lane, Holbeck, Leeds. March 1st, 1921.

Newivold. No. 413,143. Class 13: Incandescent electric lamps. Aladdin (Lancashire and Yorkshire), Ltd., 162, Stuart Road, Walton, Liverpool. March 7th, 1921.

Cycaro. No. 412,815. Class 18. Electric welding apparatus. Handstock, Ltd., 2, Harewood Place, Oxford Circus, London, W.C. February 23rd, 1921.

Belleroid. No. 412,420. Class 40. An ebonite compound for electric insulating purposes. Barrett & Elers, Ltd., 127-9, Wallis Road, Hackney Wick, London, E. February 11th, 1921.

Trade with Greece and Spain : Official Visits to London.—Mr. E. C. D. Rawlins, Commercial Secretary to H.M. Legation at Athens, has arrived in this country on a short official visit. He will be pleased to meet manufacturers and merchants who wish to discuss with him questions relating to trade with Greece, and who may desire information or advice regarding the appointment of agents, marketing and distributing goods, terms of payment, Customs duties or general information as to openings existing for British goods. Applications to interview Mr. Rawlins should be made immediately to the Department of Overseas Trade, 35, Old Queen Street, S.W. 1, the Reference Number 3,057 T.G. being quoted.

Captain U. de B. Charles, Commercial Secretary to H.M. Embassy at Madrid, has also arrived here, and will be pleased to meet manufacturers for similar purposes. Interviews with Captain Charles may be arranged by communicating with the above Department, quoting the Reference 3,055 T G.

America and Chinese Industry.—American machine works, electrical, engineering, and shipbuilding companies have opened headquarters in Shanghai, and are planning to keep trained technical men at the offices. Plans for the Tainan waterworks project are being made, and when completed the firms which have been interested will be asked to make tenders. The Chinese are reported to be seeking American participation in the development of the island of Hainan. The Amoy Tinning Co. and the China Canning Co., Amoy, are planning to enlarge their plants with more extensive connections abroad. The Japanese cotton-spinning industry at Tsingtau is developing very rapidly, with 50,000 spindles in operation and 200,000 more in view.—*Commerce Reports.*

The E.T.U. and Non-Unionist Wiring.—The Hackney Case.—According to the minutes of the Electricity Committee of Hackney Borough Council, the employés of the electricity department have refused to connect six installations, including the one which was the subject of the recent action. A summons has been issued against the Council in respect of another of the premises, but the hearing has been adjourned pending the result of an appeal to the High Court against the decision in the first. In view of the serious aspect of the question, the Committee has applied to the Council for definite instructions as to the policy to be adopted.

The summons above mentioned has now been restored to the list for early hearing.

Dr. Rathenau's New Post.—Dr. Walther Rathenau, of the Allgemeine Elektricitäts Gesellschaft, Berlin, has accepted the post of Minister of Reconstruction. Our readers will remember the prominent place that Dr. Rathenau filled during the war as the organiser of raw material supplies on behalf of the German Government. The Berlin correspondent of *The Times* describes him as "next to Stinnes, perhaps the best-known industrialist in Germany."

Australian Wiring Rules.—A copy of the Wiring Rules of the Fire Underwriters' Association of Victoria revised to January, 1921, which has been received from His Majesty's Senior Trade Commissioner in Australia (Mr. S. W. B McGregor), may be consulted in the Inquiry Room of the Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W. 1. These rules, which are those of the Institution of Electrical Engineers adapted to meet Australian conditions have been adopted by the fire underwriters of all the States of the Commonwealth, and embody the requirements and precautions framed to secure satisfactory results with a supply of electrical energy at low and medium pressures.

Oil Fuel.—We have received from the Lawton Machine Tool Co., Burgess Street, Sheffield, some idea of the ease with which coal-fired boilers can be fitted with oil-fuel burners to enable the furnace to burn oil alone, oil and coal, or coal alone. They say that 1 ton of oil is equivalent to 2 7 tons of coal, and that the cost of installing oil burners is in this way soon covered by the economy effected.

Metalliferous Mines.—An Advisory Committee has been appointed for the metalliferous mining industry, with Sir Cecil Lindsay Budd, K.B.E., as chairman. Mr. F. C. Starling, of the Mines Department, will act as secretary to the Committee.

The Bath Show.—Messrs. Jennings, Ltd., of Bristol, are represented at stands Nos. 314 and 315 at the Bath and West Show, which closes at Bristol on June 4th. They have a varied exhibit of their joinery and other goods, including electric casings, asbestos tiles, &c.

German Exports to Russia.—The total value of German exports to Russia between May and December, 1920, amounted to 204,100,000 marks. Insulators represented 4,700,000 marks of the total value ; electric lamps, 20,300,000 marks ; wire and electrical equipment, 2,500,000 marks ; and instruments, 300,000 marks.

Swedish Telephone Manufacture. — The Allmaenna Maustir Aktiebolag H.T. Cedergren reports net profits of 1,295,000 kr. for 1920; as contrasted with 2,300,000 kr. in the preceding year, and it is proposed to pay a dividend of 3 per cent., as against 7 per cent. in 1919. A preliminary agreement has been entered into between the directors and those of the Ericsson Co., with a view to the undertaking of the former being absorbed by latter company.

German Porcelain Exports.—It is announced that the exports of German porcelain for electrical purposes, which have hitherto been subject to limitations, have now been released from control so that makers are able to export as freely as possible.

A French Amalgamation.—The Compagnie Générale d'Electricité proposes to absorb the undertaking of the Société de l'Accumulateur Tudor, and for this purpose is offering an interchange of shares with the shareholders in the latter company.

Spanish Customs Tariff.—The *Board of Trade Journal* for May 26th contained a special supplement giving details of the new Spanish Customs Tariff which came into force on May 21st. This Tariff will remain in force as a provisional measure pending the more permanent revision of the Spanish Tariff.

Lead.—Messrs. James Forster & Co. report, under date May 28th :—"No imports of soft pig lead for the Thames have taken place since 9th inst., nearly all of which were used for declarations against April contracts, and it is doubtful whether any steamers will arrive this month, although two are due about 31st inst. In consequence there has been some pressure this week from consumers for lead *ex* contract, and a considerable premium has been paid for immediate delivery. The market is so entirely under the influence of speculation that any forecast is useless. One thing is certain, and that is, that present supplies are quite inadequate for any normal demand."

Postage Increase.—At the annual meeting of the Northern Section of the Electrical Contractors' Association, at Leeds, on May 25th, representing the trade for the area between Sheffield and Newcastle and between Hull and Liverpool, a resolution was carried unanimously, on the proposition of Mr. Harry Moss, of Bradford, in which, among other things, it was recorded that the meeting viewed with alarm the further increase in postage rates, which was going to add considerably to the expenses of all businesses. The meeting considered that an investigation of the Post Office Department and its working should be made by business men, with a view to finding out the cause of the present deficit, and the necessity for the further increases in postal rates.

Calendar and Blotter.—Messrs. W. Coates & Sons, of Nottingham, makers of rope and twine, have sent us a blotter with the outlines of a bale of rope, bearing a calendar for the July-September quarter.

American Society for Electrical Development.—It is announced that at the annual meeting of the Society, held in New York, Mr. W. W. Freeman was elected president. Among the Society's activities is the following up of reports in the Press of fires caused electrically. The truth is ascertained and published, and this has removed the erroneous impression that the majority of fires in the United States are due to electricity.

New Indian Company.—A new company has lately been formed at Jullander (Rujat), with a capital of 1,000,000 rupees, and the title the Jullander Electric Supply Co., to establish a central electricity distributing station in the town.

Anglo-Canadian Trade.—Reuter's Trade Service learns from the Chief Canadian Government Trade Commissioner, 73, Basinghall Street, E.C.2, that the Minister of Trade and Commerce has appointed Mr. L. D. Willgress, an experienced Trade Commissioner, to undertake a special mission for the purpose of discussing with United Kingdom firms who purchase goods of all kinds on behalf of overseas customers, the possibility of their obtaining a larger proportion of their requirements from Canada. Mr. Willgress has now arrived in London and would be glad to have the opportunity of an interview with any firm interested.

Country of Origin.—The Canadian Government recently decided that all goods imported into Canada must be marked so as to indicate the country of origin. The Council of the British Empire Producers' Organisation has just passed a resolution urging the British Government to take steps without delay to impose similar conditions in connection with the importation of goods into the United Kingdom.

LIGHTING AND POWER NOTES.

Aberdeen.—Extensions Approved.—At a meeting of the Electricity Committee, on May 25th, a letter was received from the Electricity Commissioners intimating their approval to the scheme of extensions submitted to them. It has not yet been decided to proceed with these extensions, which are estimated to cost £200,000.

Bexley.—Immersion Heaters in Houses.—In connection with the Welling housing scheme, the Urban District Council has decided to install in 22 houses electrical immersion tubes for heating coppers, instead of tenants having to utilise fuel or gas.

Bingley.—Loan.—The Urban Council is applying to the Electricity Commissioners for permission to borrow £1,500, the cost of prospective new services.

Chester.—Electricity from Factory.—The Electricity Committee has received a letter from the Electricity Commissioners with reference to the proposal to obtain a bulk supply of electricity from H.M. Factory, Queensferry, which says that this should be utilised by the Corporation, at any rate for the time being. The letter states :—"Pending the establishment of the Joint Electricity Authority, and until such time as the North Wales Power Co. may be authorised to exercise the powers of such authority, it will be necessary for the Chester Corporation to erect the transmission line and install the plant needed to obtain a bulk supply from the Queensferry Works for Chester. It is not possible in the circumstances for the Minister of Transport to construct the line and install the plant under the provisions of Sec. 18 of the Electricity (Supply) Act, 1919. It will, however, be in order for the Corporation to approach the North Wales Power Co. with a view to arranging that they shall take over the line from the Corporation in the event of statutory effect being given to the Commissioners' decision, and with the concurrence of the company a provision to that effect could be inserted in the order. In the meantime the Commissioners will be prepared to entertain an application from your Corporation for sanction to a loan to cover the expenditure in connection with the said transmission line and plant." The Electricity Committee decided that the Town Clerk should communicate as suggested with the North Wales Power Co.

Continental.—Switzerland. — Application has been made to the Federal Authorities at Berne by the Schweizerische Kraftübertragung Aktien Gesellschaft for leave to export from its collecting networks electric energy to the following companies beyond the Swiss borders :—1. To Alsace, to the Société Anonyme Forces Motrices du Haut Rhen, located at Mülhausen, and to the Société Anonyme d'Electricité de Strasbourg, a quota of 9,000 kW of summer energy, deliverable from April 1st to September 30th each year for 180 days, of which 120 are continuous : and a second quota of 4,500 kW daily of summer surplus energy, deliverable in the same period so far as the power is available. Under favourable circumstances the delivery period may be extended, both in the spring and the autumn. From December 1st to the end of February the supply will cease in each year. This arrangement is to hold for 10 years. 2. To Lorraine, to the Compagnie Lorraine d'Electricité, Nancy—a quota of 5,500 kW, 24-hour summer energy for six months from April 1st to September 30th, and a second quota of 6,500 kW summer surplus energy for three months constant on demand, between April 1st and September 30th. From October 1st to the end of February the supply in all cases will cease. The agreement is for a duration of 15 years. Power will also be diverted to the Delle and Laufenberg works of the French companies, and a further 8,000 kW from the Mühleberg power station placed at their disposal from the beginning of the present year. In return for these supplies, the French companies named undertake, for five years, to supply coal at preferential rates to the Swiss company in the ratio of 275 gm. of coal for every kWh. The price is fixed at 75 per cent. of the usual market price on the Swiss frontier for coal, and holds so long as it does not fall below 100 Swiss francs per ton, duty free. After five years the French companies must supply winter energy instead of coal. The compact means that for the supply of from 30 to 60 million kWh the receivers undertake to return 16,125 tonnes of coal a year. This exchange has been variously regarded, but the Swiss company maintains that while it is selling its power much above the usual export price of electric energy, after the deduction of transport costs, a good balance will remain over on the coal acquired.

France.—The Senate has voted the necessary credits for the extensive scheme for the harnessing of the Rhone, and has approved the details of the plan, which should make the river an easily navigable waterway, a source of great hydraulic power, and a means of irrigation. M. le Trocquer, replying to various objections, pointed out that the water power would be so great that it would probably be possible for France to do without imported coal in the future, as the new scheme would effect an economy of 6 million tons of coal a year. The construction of a navigable waterway would connect Switzerland with the Mediterranean, and *via* the Rhine with the North Sea, so that direct communication by water could be obtained for vessels up to 1,200 tons right across Europe from North to South.

No fewer than 18 power stations are to be constructed along the course of the river, the largest of which will be at Genissat, near Bellegarde. The average production of this station will be 200,000 kW, equivalent to about 250,000 h.p. It is estimated that the stations will together produce a total hydro-electric force averaging 1,100,000 h.p.

The two most important utilisers of the new power will be the P.L.M. Railway Co. and Paris. The P.L.M. Railway hopes to electrify the whole of its lines included in the quadrilateral Bellegarde-Lyons-Marseilles-Vintimille. In this there should be no difficulty, as the necessary energy can be obtained all along the river.—*Reuter's Trade Service* (Paris).

The Compagnie Haute-Marnaise d'Electricité has applied for a concession to set up a series of distribution mains for the supply of 27 communes in the Département of the Haute Marne, and nine communes in the Département of the Vosges, of a total length of 175 km. The electricity will be supplied at a pressure of 30,000 volts, stepped down to meet consumers' requirements.

A telegram from New York to the *Journée Industrielle* states that American capitalists are ready to advance sufficient sums for the exploitation of the hydraulic power of the tide in the bay of Mont Saint Michel, which, it is thought, could be utilised industrially. A French Canadian, M. Coriolis, has already submitted a scheme in connection with the work to the French Government.—*Reuter's Trade Service* (Paris).

Sicily.—In a survey of the hydro-electric developments in Sicily, *The Times Engineering Supplement* describes a number of undertakings in course of construction. One of these plants is being erected on the River Alto Belice, and is expected to be completed next year. The station will house three 3,500-kVA three-phase alternators, generating at 10,000 V and driven by three turbines under a head of 1,550 ft. The second plant is that of Salso-Simetto (Catania). This is not yet commenced, but it is hoped to start on it shortly. The design provides for the construction of an artificial lake, with a capacity of 131 million cb. yards, by means of a dam 55 ft. high, on the Salso, near Aderno. The head of water available is 515 ft., and the continuous power output 15,000 h.p., with a maximum of 30,000 h.p. Another undertaking, which had to be suspended for financial reasons, included the construction of an artificial lake, with a capacity of 330 million cb. yards. The available power from this source is estimated at 150,000 h.p., with a maximum of double this figure. Electrochemical works are to be erected on the spot when the scheme is resumed, and the surplus power transmitted a distance of 115 miles to Apulia and Messina.

Sweden.—According to the American Consul-General, at Stockholm, the total income from the Swedish electric power stations in 1920 was about 15,070,000 crowns, while that for 1919 was 12,370,000 crowns. While the length of the lines in the rural district has not been changed, remaining at 1,150 km. as at the close of 1919, the lines in the towns and villages have been increased from 2,960 to 3,425 km. The number of secondary stations remains the same as in 1919, 24 ; tertiary stations for general distribution have been increased from 240 to 270. On the main line from Trollhättan to Västerås (457 km.) surveys have been completed, and the foundations for the poles, from Orebro to Västerås (217 km.) have been already laid. The State Waterfalls Board recently purchased from Trollhättans Elektrotermiska Aktiebolag two power contracts of 5,172 and 8,070 kW in anticipation of the regulation of the waters of Lake Väner.—*Commerce Reports.*

Finland.—The electrification of the rural district of Vihtis, in the Province of Nyland, has recently been completed, and is considered one of the most important undertakings of the kind in Finland. In 1919 the inhabitants of the district organised a company on the plan of each user of electricity subscribing for shares in proportion to the number of lamps and amount of horse-power that he uses. The main line, operating at 20,000 V, runs to a point near the Nummela Railway Station (about 50 km. from Helsingfors), where a large transforming station has been built—probably the largest in the country. The network of lines is so dense that nearly all the people in the district are able to obtain electricity. This system, like the one at Sallila, was planned and installed by the Hankkija Society of Helsingfors.—*Commerce Reports.*

Denny (Stirlingshire).—Working Costs.—At a meeting of the Town Council, letters were submitted from the Scottish Central Electric Power Co. asking its consumers to give an undertaking to pay a proportionate share of the extra costs involved in carrying on the works during the miners' strike. The Council agreed to the request, provided it was satisfied as to the reasonableness of whatever increase might be asked for.

Dorking.—Price Increase.—The Electric Light Co. has been granted an order authorising a charge of 10d. per unit as from May 7th, and as from June 30th, a minimum charge of 12s. 6d up to 15 units for the winter quarters, and of 8s. 4d. up to 10 units for the summer quarters.

Elland.—New Station.—The District Council's new station for distributing of electricity, the energy being bought in bulk from the Yorkshire Electric Power Co., is now complete, and would have been started already but for the coal dispute. The former local generating plant will not be maintained. The generating scheme has never paid, and it is anticipated that under the new system the department will make a profit. The main building of the new station is 70 ft. long and there is an annexe of 12 ft. The plant comprises two 600-kW rotary converters with transformers, and one 50-kW induction motor generator set, with its own transformer. There are foundations, transformer chamber and switchboard panels for a third rotary set up to 500 kW capacity, making a future total of about 1,200 kW direct current if and when required.

Epsom.—Charges.—The Urban District Council has fixed a minimum charge of 40 units per annum to all private consumers as from the June quarter's readings. For the new houses, each tenant is to be charged 1s. 6d. per week on a seven-lamp basis.

Glasgow.—Dalmarnock Station (Correction).—In this column, last week, we described the new set at Dalmarnock as a "Metropolitan-Vickers turbo-generator set." Messrs. Fraser and Chalmers inform us that the turbine was manufactured by them, while the generator is a Metropolitan-Vickers machine. The former firm also carried out the complete installation, including condensing plant.

Govan Station Closed.—The Corporation electricity station at Govan has now been discontinued as a generating station, and the manager has been instructed to dispose of the old plant.

Haywards Heath.—Company Scheme.—At a meeting of the Urban Council, on May 23rd, the clerk submitted a draft order and plans for the erection of a power station by the Haywards Heath and District Electric Supply Co. The General Purposes Committee had previously decided against the inclusion of a purchasing clause in the Order, but the Council thought this necessary, and it was, therefore, moved and carried that a clause enabling the Council to purchase the undertaking at a fair price after a period of years be inserted.

India. — Hydro-Electric Surveys.—Several hydro-electric surveys have been undertaken by the Assam Government. The Hukong Valley scheme appears to be a very promising project. The scheme, if carried out, should prove one of the cheapest and most powerful hydro-electric installations in India.—*Reuter's Trade Service* (Bombay).

Developments at Calcutta.—Extensive developments are being carried out by the Electric Supply Corporation, Ltd. The extensions, which are estimated to cost 130 lacs of rupees, include the increasing of the capacity of the Cossipore plant by 21,000 kW; a new 30,000-V ring main to supply the outer districts; the laying of five submarine cables across the Hooghly to the Howrah district, and the erection of several new transformer stations.

Ireland.—Water Power.—The report of the Committee on Ireland's Water Resources, which has just been issued, says that about 500,000 water h.p. is available continuously, and can be economically developed The water power is equivalent to that generated in coal fired stations by the annual consumption of more than 7 500,000 tons of coal, on the basis of 5 lb. of coal per h.p. per hour, which is the figure taken by the Coal Conservation Sub-Committee as the average practice in the United Kingdom. The value of this water power, if developed, it is stated, would be at least £10,000,000 per annum. Detailed schemes for the development of the Lower Bann, the Lower Shannon, the Lower Erne, and the Liffey are suggested, and the Committee regards the Boyne, the Strule, the Mourne, the Lee, the Boyle, the Corrib, and the Blackwater (Cork) as worthy of immediate investigation.

Kingston-on-Thames.—Loan Sanctioned.—The Town Council has received sanction to a loan of £18,000, for expenditure on the extensions of plant installed by arrangement with the Ministry of Munitions, in excess of the engineer's estimate of £45,000. The sum applied for was £19,750.

Leek.—Deficit.—There was a deficit on the working of the electricity undertaking of the U.D.C. for the past year of £2,149.

Leyton.— Loan.—The Electric Lighting Committee recommends application to the Electricity Commissioners for sanction to borrow £4,972, excess expenditure incurred in connection with the execution of the necessary works for obtaining a bulk supply of electricity from Walthamstow.

London.—Greenwich.—The architect in charge of the Greenwich Council's housing scheme at Charlton informs us that, owing to the high cost of wiring, fittings, and electricity, the houses being erected are to be fitted with gas appliances only.

Mansfield. — Loan. — The Electricity Committee is applying to the Electricity Commissioners for sanction to the borrowing of £2,500 for the purchase, installation, &c., of feeders and distributing mains required in connection with the Mansfield Woodhouse housing scheme, and £1,500 for the purchase of meters.

Newton Abbot.—Extension of Time Required.—The Council has been recommended to ask the Urban Electric Supply Co. for an extension by one year from July next of the time allowed for decision about the purchase of the local electricity supply undertaking.

New Zealand.—Further Lake Coleridge Developments.—Speaking at Christchurch in January, the Minister of Public Works said that the 8,000-h p. plant at Lake Coleridge was overloaded to the extent of 1,500 h.p, but plant of 4,000 h.p. was being installed for the present winter. In 1922 provision would be made for an additional 4,000 h.p. All the money which had been set aside for electrical extensions, £750,000, would be expended. The plans and specifications of the power house had been approved, but certain surveys were still to be made. A new 10-ft. tunnel and a pipe-line would bring the available power up to 30,000 h.p. It would also be necessary to double the capacity of the transmission lines to Christchurch, and make extensions to South and North Canterbury. Government operations were only restricted by the difficulty of obtaining sufficient funds for the purpose.

Nigeria.—Projected Power Scheme.—At a meeting of shareholders of the Keffi (Nigeria) Consolidated Tin Co., it was stated that the only company which had done anything towards instituting an electricity supply was the Northern Nigerian (Banchi) Tin Mines Co., but the undertaking had had to be abandoned owing to lack of funds. The Keffi Co. would not employ its resources in this direction, but it was hoped to give shareholders an opportunity to form another co-operative company to carry out a power scheme.

Plymouth.—Year's Working.—The accounts of the Corporation electricity undertaking for the year ended March 31st last, show that the total revenue was £124,629, as compared with £92,957 in the previous period. Working expenses reached a total of £96,587, as against £69,785, leaving a gross profit of £28,042 (£23,172). The net result, after payment of capital charges, &c., was a profit of £4,666, exceeding the estimate by £1,104. Last year there was a profit of £274.

South Shields.—Loan Inquiry.—On May 24th Mr. J. C. Dawes, of the Ministry of Health, conducted an inquiry into the circumstances attending the Corporation's application for sanction to borrow the sum of £1,890 for the provision of additional charging plant for the electric vehicles used by the scavenging department.

Stoke-on-Trent.—Loan.—Sanction is being sought by the Council to a loan of £1,400, the estimated cost of extensions at the Burslem sub-station.

Todmorden.—Loan Sanctioned.—Sanction has been received from the Electricity Commissioners to the borrowing of £1,860 for new mains, and £400 for meters. The Extensions Sub-Committee has been instructed to consider the question of extending the cable to Cornholme.

Worksop.—Overhead Cable.—The Urban Council has approved the installation of an overhead cable, at a cost of £3,500, to supply a model village being erected by the Shireoaks Colliery Co., Ltd.

Wrexham.—Bulk Supply.—The Town Clerk of Wrexham has written to the Chester Electricity Committee stating that a sub-committee of the Wrexham Electricity Committee desires to meet representatives of the Chester Corporation with reference to a temporary supply of electricity from H.M. Factory at Queensferry. A meeting is being arranged.

TRAMWAY AND RAILWAY NOTES.

Continental.—Switzerland.—On the proposal of the Director-General of Federal Railways, the Council of Administration has agreed to order 32 electric locomotives, and four motor coaches, and has granted a credit of 24 million francs for this purpose.—*Reuter's Trade Service* (Berne).

Russia.—A Reuter telegram from Reval recently stated that the tramway and railway employés of Petrograd were on strike owing to lack of bread. They demanded that the State should distribute the bread rations which were withdrawn when freedom of trade was re-established.

France.—A special electric train proceeding from the Antigues, left the rails on an incline near Gripp Bagnères-de-Bigorre, owing to a failure of the brakes. The train left the rails and overturned down a bank, nine people being killed and 13 injured.

The Riviera.—An entirely new form of transport is to be tried where travelling between the coast and the hilly country inland is not easy on account of the steep gradient, and work has been begun on an "aeroplane railway" which is to link up Peira Cava, 4,500 ft. above the sea level, with Nice and Monaco. The aeroplane will be attached to a fixed line, and will not be able to deviate from it. The scheme has been worked out by the Engineer Coanda, and has been adopted by the Minister of Public Works and by the local authorities. The "railway" will consist of four cables attached to supports, the height of which will vary from 15 ft. to 100 ft. according to the conformation of the ground. The aeroplane will be attached to the cables, electricity being conveyed to the motor by three out of the four cables, the fourth being reserved for telephonic purposes. The aeroplanes employed will be of two types: the first, with a 300-h.p. motor, to carry eight passengers, and the second, with a 600-h.p. motor, to carry 20 passengers. Work has been begun at Escarene, Luceram, and Peira Cava, which, with Nice, will form the four stations of the first line. The line will be perfectly straight, so that the full benefit may be obtained from the ascensional capacities of the aeroplane. The first trials will be made over a distance of 6 km. in that part of of the "railway" where the gradient is the steepest. If the trials are satisfactory, the Nice-Peira Cava line, 40 km. long, will be constructed and the linking-up of Peira Cava with Monaco will then be studied.—*Reuter's Trade Service* (Paris).

Edinburgh.—No "Universal" Fare.—In a report to the Council, the manager of the tramways says that the establishment of a "universal" fare, based upon the average fare paid per passenger, is impossible in Edinburgh, as the undertaking is so dependent upon the short-distance travellers. The effect of such a fare would be to cause short-distance travellers to refrain from riding, and the increase in the number of long-distance travellers would not compensate for the loss. It would be necessary to attract additional traffic by a revision of fares when through-running by means of electric cars was obtained.

Halifax.—New Track.—The Tramways Committee has instructed the borough engineer to construct a cross-over at Lee Mount at an estimated cost of £380.

India.—Electric Railway.—The survey for a railway through the Hukong Valley to Burma is now nearing completion; the early maturing of the railway project is far more likely if it can be shown that a source of cheap power is available for working the line. The line is to be electrified throughout.—*Reuter's Trade Service* (Bombay).

Mansfield. — Increased Price for Power. — The Town Council has entered into an arrangement with the tramway company whereby the latter will pay an increase of 70 per cent. for electricity supplied.

Newcastle. — Light Railway Order. — The City Council is applying to the Light Railway Commissioners, under the Light Railways Acts, 1896 and 1912, for an Order permitting it to construct a light railway commencing at North Gosforth and terminating at Longbenton by a junction with the Council's existing tramways.

Philippines. — Railway Electrification. — With regard to the plans of the Manila Railroad Co. for the use of electric motive power on its road, the bulletin of the Philippine Government Commercial Agency in New York states that the electrical power will be developed from the Agno River, in central Luzon, which is believed to possess a potential capacity of from 12,000 to 15,000 h.p. A thorough topographical survey of the entire water-power site is being undertaken, and early reports of the survey would seem strongly to point to the feasibility of the project.—*Commerce Reports.*

Sunderland.—Year's Working. — The report of the manager of the Corporation tramways for the year ended March 31st last, shows that the total revenue was £158,164, compared with £149,126 for 1919-20. Working expenses amounted to £136,667, as against £122,784, leaving a gross balance of £21,497 (£26,342). The payment of income-tax, loan interest, and £9,159 to appropriation account resulted in a net deficit of £1,142. It is stated that working expenses have risen to 16·8d. per car-mile.

Tynemouth.—Option of Purchase.—At a meeting of the Town Council, on May 25th, the Tramways Committee reported that Mr. Stagg, the local director of the Tynemouth Traction Co., had attended its meeting and referred to the rights of the Corporation to purchase the company's undertaking within six months from December 31st, 1922, or at the end of each septennial period thereafter. Mr. Stagg said the company did not feel justified, under those circumstances, in expending capital upon improving the system. He asked whether the Corporation desired to purchase the undertaking, or, if not, if it would grant the company a lease for, say, 21 years. Alderman Gascoigne, in presenting the report, stated that there would shortly be another meeting, and they hoped to put a definite proposition before the Council.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—Compulsory Wireless on Ships.—Under navigation regulations which have been adopted by the Commonwealth Government, and will come into force on October 1st, practically all ships conveying more than 12 passengers from point to point on the Australian coasts will be compelled to carry wireless telegraph apparatus and operators.—*Reuter's Trade Service* (Melbourne).

Empire Press News.—A deputation representing the British Press was received by Mr. Winston Churchill, Colonial Secretary, on May 25th, when strong representations were made regarding the need for quicker and cheaper means of inter-Imperial communications for Press messages by cable and wireless telegraphy. It is understood that an official report will be issued after Mr. Churchill has consulted with other Ministers.

France.—Wireless Telegraphy.—Hitherto wireless communication from Paris to New York has been *via* Lyons or the new station at Croix-d'Hins, near Bordeaux. Now, however, French experts, as the result of experiments in connecting the sending boards in Paris with the transmission apparatus, declare that direct communication between Paris and New York can be obtained, thus reducing the time of transmission by two hours.—*Reuter's Trade Service* (Paris).

New Wireless Service.—By agreement with the Norwegian authorities, the administration of the French Posts and Telegraphs has opened the wireless service between France and Norway to the public during certain hours of the day, says *The Times.*

Long-Distance Telephony.—Experiments will shortly be made on the longest distance telephone which has yet been installed in France. The authorities are anxious that it should be possible to telephone from Paris to the Moroccan seaport of Casablanca, a distance of about 3,750 miles. M. Laffont, Minister of Posts and Telegraphs, is to conduct the experiments in person, and has left for Casablanca with a number of officials to carry out the trials. If the experiment is a success, similar apparatus will be used for other long-distance telephone lines to link up Paris with various important centres in Europe.—*Reuter's Trade Service* (Paris).

Ireland.—Cables Cut.—Queenstown was unable to communicate by wire with surrounding districts on May 24th, even the Admiralty could not communicate with Haulbowline, as the cables from Whitepoint had been cut.

Italy. — Strike. — Postal, telegraph, and telephone workers in Rome and several other Italian towns left work on May 25th, as a protest against the Government's delay in adjusting their scale of wages.

South Africa.—New Wireless Station.—The plant of the new wireless station, which was opened at Port Elizabeth on May 3rd, is a 1·5-kW set equipped with ampliying valves, and it has a guaranteed range in daylight of 300 miles, but it was demonstrated during the morning that the range can easily be exceeded, and under suitable conditions there is nothing to prevent a range of over 1,000 miles being attained. By virtue of the amplifier with which it is fitted, the new station has a greater range than that of the Durban station; it is exactly equidistant between the Durban and Cape Town stations, *i.e.*, 400 miles each way, and it ensures continual wireless communication along the south-eastern coast.—*Reuter's Trade Service* (Port Elizabeth).

Sweden.—Wireless Telegraphy.—The only wireless post on the West Coast of Sweden for locating ships off the cost is on the Island of Vangä, not far from Gothenburg. It is not, however, equipped with transmitting apparatus, and has to telegraph to Gothenburg the messages to be sent out. It is now intended to set up a second post, to be situated near Smögen. Great services have been afforded to international shipping lately by the former station when heavy fogs have overtaken ships in the Cattegat, Skagerrack, &c.

The Telephone Service.—New Exchange.—A new public telephone exchange called "Chancery" was opened, on May 28th, at 55, High Holborn. Its equipment is of the central battery type, with lamp signalling, and it will accommodate 1,500 subscribers' lines. A total of 520 lines was transferred from the Holborn, Central, and City exchanges on the first day.

U.S.A. — Control of Cable Landings.—The U.S. Senate, on April 26th, passed Senator Kellogg's Bill to prevent the unauthorised landing of cables in the U.S.A., or any of its possessions. The Senate's action followed protracted evidence before a sub-Committee of the Senate Interstate Commerce Committee, during which the story of the controversy between the Western Union Telegraph Co. and the State Department over the attempted landing of a cable at Miami was fully unfolded. The Bill gives the President sweeping authority to prevent cable landings in the U.S. or any of its possessions, to issue licences to land, or to revoke them, and he is given authority to obtain cable concessions for the U.S. in other parts of the world. Moreover, there is a purpose to secure in Latin-America better cable facilities, and to make the United States less dependent on foreign cables. Any cable now laid within the U.S. without a licence granted by the President may continue to operate 90 days from passage of the Act. The President may withhold or revoke a licence when satisfied that such action will assist in obtaining rights for the landing or operation of cables in foreign countries, or in maintaining the rights or interests of the U.S., or any of its citizens in foreign countries, or will promote the security of the U.S. The licence is not to give the licensee exclusive rights of landing, or of operation in the United States. The Bill provides for a maximum fine of $5,000 and imprisonment for one year. It applies to all the territory subject to the jurisdiction of the United States, including the Philippines and Canal Zone.—*T. and T. Age.*

The Western Union Co.'s cable ship has been withdrawn from Miami, which action is construed as evidence that a permit to land the cable connecting Florida with the British cable at Barbadoes has been refused.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia. — Melbourne. — August 10th. Victorian Railways. 250 core-type impedance bonds for power signalling, with a capacity of 1,000 amperes per rail; also 50 miles of solid insulated copper wire, No. 14 Brown & Sharpe gauge, and 50 miles of solid insulated copper wire, 16 standard gauge.

August 15th. Electricity Commissioners. Steelwork for power station buildings, roof covering, &c.; water-tube boilers, stokers, fans, &c; platforms and ladders, steel chimneys, flues and dampers, sooting and dust extraction equipment, ash handling plant. (See this issue.)

August 17th. 3,000 sets of renewals for caustic soda primary cells.

August 30th. Board of Works. Four electrical centrifugal pumps, each with a capacity of twelve million gallons daily.

September 7th. Victorian Railways. Sixteen sets of air-brake equipment, 450 to 600 V., d.c., for single-track tramcars.—*Reuter's Trade Service* (Melbourne).

Tasmania.—P.M G.'s Department. July 11th. Switchboard material (Schedule T. 317). (See this issue.)

Brighton.—June 7th. Electricity Department. Oil fuel plant. (May 20th.)

Dundee.—June 6th. Electricity Department. One coupled motor-generator, consisting of two interpole machines; motor, 400 V, d.c.; generator, 75 V, 130 amp.; also regulator, 60 to 70 V. (May 20th.)

Sudan.—June 30th. Sudan Government. Pumping machinery, consisting of Diesel or semi-Diesel engines and direct-coupled centrifugal pumps, capable of lifting 1,200 litres of water per second against a static head varying between 2·5 and 8 metres. Machinery must be delivered at Khartoum North by February 28th, 1922. Specifications, drawings, and conditions of tender may be seen at the office of the Sudan Agent, War Office, Cairo, Egypt. Tenders to Superintending Engineer, Department of Agriculture, Sudan Government, Atbara.—*Reuter's Trade Service.*

Greenock.—June 6th. Corporation. Electric lighting work in connection with the Upper Cornhaddock housing scheme (18 tenements and six double cottages). Schedules, &c., from Office of Public Works, Greenock.

Leytonstone.—June 16th. West Ham Union. Three months' supply of electrical fittings. Mr. T. Smith, Clerk, Board Room, Union Road, Leytonstone, E.11.

Liverpool.—June 6th. Liverpool Overhead Railway Co. Stores, including electrical fittings for twelve months. General Manager, 31, James Street, Liverpool.

Llandaff and Dinas Powis.—June 22nd. Rural District Council. E.h.p. feeder, with switchgear sub-station equipment complete. (See this issue.)

London.—ISLINGTON.—July 4th. Electricity Committee. H.p. switchgear, flame carbons. (See this issue.)

Manchester.—June 17th. Electricity Committee. Twelve months' supply of static transformers. Mr. F. E. Hughes, secretary, Electricity Department, Town Hall.

New Zealand.—WELLINGTON.—June 28th. Public Works Department. Ten s.p. oil-filled transformers for the conversion of three-phase energy at 50 cycles, the voltage ratio being 50,000/11,000, for Waikato power scheme.*

June 28th. Supply and delivery at Lyttelton of two 50-kVA, two 100-kVA, and two 200-kVA condensers in connection with the Lake Coleridge electric power supply (Section 116).*

July 31st. H.M. Trade Commissioner in New Zealand has forwarded to the Department of Overseas Trade particulars of a call for tenders by the Wairoa Electric Power Board for a 11,000/3,300-V, 600-kW outdoor sub-station. The material required includes the following:—(*a*) Transformers, four 200-kVA, 11,000/1,900 single-phase units; (*b*) Insulators, 11,000 V and 3 000 V; (*c*) Air-break switches, 11,000 V and 3,000 V; (*d*) Fuses, 11,000 V and 3,000 V; (*e*) Lightning arresters and choke coils, 11,000 V and 3,000 V; (*f*) Accessories as per schedule. Tenders to the office of Messrs. Hay & Vickerman, Wellington. Copy of the specifications, conditions of tender and plan may be inspected on application to Room 49, Department of Overseas Trade, 35, Old Queen Street, S.W.1.

August 9th. Public Works Department. Suspension-type porcelain insulators for the Waikato power scheme.*

Nottingham.—June 16th. Electricity Committee. Twelve months' supply of general stores. (See this issue.)

South Africa.—July 5th. Electrification of Capetown-Simonstown and Durban-Maritzburg railway lines.

RHODESIA.—BULAWAYO.—August 3rd. Municipal Council. Electric light and power plant. (May 27th.)

TRANSVAAL.—Rand Water Board. September 9th. Erection of a complete installation of mechanical or other filters capable of filtering 5½ million gallons of water per 24 hours at the Vereeniging main pumping Station (Contract No. 232). Copies of the contract documents may be obtained from the Chief Engineer, Rand Water Board, Johannesburg, upon a deposit of three guineas.*

Uruguay.—MONTE VIDEO.—August 18th. State Electricity Works. Steel petroleum tank, Worthington duplex steam pump for oil, 250 metres steel tubing.*

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—SYDNEY.—Electricity Supply Committee recommended:—

Underground cables (Spec. 628), £32,065.—W. T. Henley's Telegraph Works Co., Ltd.
Spare blading for 5,000 kW Westinghouse turbine, £843.—Metropolitan-Vickers Electrical Co., Ltd.

MELBOURNE.—City Council. Accepted:—

415 a.c. meters, £918.—British General Electric Co., Ltd.
500 d.c. meters, £1,272.—W. G. Watson & Co., Ltd.
13 tons bare h.d. copper cable.—British Insulated & Helsby Cables, Ltd.
10 switch pillars and 275 service boxes, £1,017.—Holden & Lewis.
—*Tenders.*

The Victorian Electricity Commissioners have accepted an Australian tender of £43,000 for the supply of condensing plant at Newport power-house.—*Reuter's Trade Service* (Melbourne).

Belgium.—No fewer than fourteen firms submitted tenders recently to the municipal authorities of Erquennes for the installation of a system of primary and secondary electricity supply mains in the town. The tenders ranged from 77,500 francs to to 134,723 francs, the lowest being that of Messrs. Dosin & Gallée, of Mons.

Glasgow.—Corporation. Electricity Committee. Accepted:—

Switchboards for the Kinning Park, Elliot Street and Partick sub-stations.

For the Kinning Park sub-station, £2,039.—Metropolitan-Vickers Electrical Co., Ltd.
For the Elliot Street sub-station, £1,624.—British Thomson-Houston Co., Ltd.
For the Partick sub-station, £351.—Metropolitan-Vickers Electrical Co., Ltd.

Corporation. Tramways Committee. Accepted:—

Rubber and asbestos goods.—G. McLellan & Co., Ltd., and North British Rubber Co.

Corporation. Lighting Department. Accepted:—

Electrical fittings.—Sloan Electrical Co., Ltd.; Wm. McGeoch & Co., Ltd.; W. Brown & Co.; General Electric Co., Ltd.; Wood & Cairns, Ltd.; British Thomson-Houston Co., Ltd.; Simplex Conduits, Ltd.

Government Contracts.—The following Government contracts were placed during April, 1921:—

ADMIRALTY (CONTRACT AND PURCHASE DEPARTMENT).

Cells.—Fuller's United Electric Works, Ltd.
Carbon rods.—Morgan Crucible Co., Ltd.
Supply and laying of cables, &c.—Macintosh Cable Co., Ltd.
Electrodes.—Quasi-Arc Co., Ltd.

WAR OFFICE.

Crucibles.—Morgan Crucible Co., Ltd.

AIR MINISTRY.

Direction finders.—Marconi's Wireless Telegraph Co., Ltd.
Electric mains.—Siemens Bros. & Co., Ltd.

POST OFFICE.

Telephone apparatus.—L. M. Ericsson Manufacturing Co., Ltd.; Phœnix Telephone & Electric Works, Ltd.; Siemens Bros. & Co., Ltd.; Sterling Telephone & Electric Co., Ltd.; Western Electric Co., Ltd.
Telegraph and telephone cable.—British Insulated & Helsby Cables, Ltd.; Pirelli-General Cable Works, Ltd.
Conduit and fittings.—Brotherton, Ediswan Tubes & Conduits, Ltd.; Perfecta Seamless Steel Tubes & Conduit Co., Ltd.
Cords for telephones.—Siemens Bros. & Co., Ltd.
Cradles for telephones.—Hodge & Co.
Cable drums.—Eames Bros.
Ducts.—Albion Clay Co., Ltd.
Insulators.—J. Bourne & Son, Ltd.
Laying conduits.—Holborn (Chancery Lane area) and London-Dorking (Section 5): J. Mowlem & Co., Ltd. Birmingham area: Whittaker-Ellis, Ltd. London-Uxbridge-High Wycombe (South-Midland Section): W. Jones & Sons. Waltham Cross-Epping-Bishop's Stortford (Section 11): W. & C. French. Borough High Street and City of London: J. A. Ewart, Ltd. Saltcoats and Prestwick: W. Dobson. Monument-Exchange area: H. Farrow.
Manufacture, supply, drawing-in, and jointing cable.—Berkhampsted-Hunton Bridge, London-Chatham and St. Albans-Luton: Siemens Bros. & Co., Ltd. Barnet-Welwyn: W. T. Henley's Telegraph Works Co., Ltd. Preston-Blackpool: British Insulated & Helsby Cables, Ltd. Bury-Burnley: W. T. Glover & Co., Ltd.
Telephone exchange equipment.—Inverness: British L. M. Ericsson Manufacturing Co., Ltd.; sub-contractors for batteries D.P. Battery Co., Ltd.; for charging set, Crompton & Co., Ltd. Edinburgh Relief Exchange ("Museum"): Western Electric Co., Ltd.; sub-contractors for batteries, Hart Accumulator Co., Ltd.; for motor generator, Electrical Construction Co., Ltd.
Bronze wire.—Elliotts Metal Co., Ltd.
Leclanché zinc rods.—Eyre Smelting Co., Ltd.; Siemens Bros. & Co., Ltd.

HIGH COMMISSIONER FOR INDIA.

Accumulators.—J. Stone & Co., Ltd.
Cells.—Fuller's United Electric Works Co., Ltd.
Insulator cups.—Estler Bros.
Generating sets.—Browett, Lindley & Co., Ltd.
Motors, &c.—Veritys, Ltd.
Transformer panels.—British Thomson-Houston Co., Ltd.
Switchboards.—Peel-Conner Telephone Works, Ltd.; Metropolitan-Vickers Electrical Co., Ltd.
Telephones.—Peel-Conner Telephone Works, Ltd
Transformers.—Hackbridge Electric Construction Co., Ltd.
Voltoids.—Brunner Mond & Co., Ltd.
Wheatstone instrument parts.—Elliott Bros., Ltd.

CROWN AGENTS FOR THE COLONIES.

Cables, &c.—British Insulated & Helsby Cables, Ltd.; Callender's Cable & Construction Co., Ltd.; Henley's Telegraph Works Co., Ltd.
Electrifying of crane.—Leeds Engineering and Hydraulic Co., Ltd.
Electric light fittings.—Mather & Platt, Ltd.
Electrical materials.—General Electric Co., Ltd.
Leclanché cells.—General Electric Co., Ltd.
Switchgear.—Ferguson, Pailin & Co., Ltd.; A. Reyrolle & Co., Ltd.
Telephones and telephone apparatus.—British L. M. Ericsson Manufacturing Co., Ltd.
Telephones.—Western Electric Co., Ltd.
Telegraph material.—Bullers, Ltd.
Telephone material.—Siemens Bros. & Co., Ltd.
Telegraph line wire.—Siemens Bros. & Co., Ltd.
Water-cooling tower.—Premier Cooler & Engineering Co.
Welding plant.—Quasi-Arc Co., Ltd.
Copper wire.—Shropshire Iron Co., Ltd.
Copper line wire.—Wilkes, Sons & Mapplebeck, Ltd.

H.M. OFFICE OF WORKS.

Engineering services.—Acton, Ministry of Pensions, electric lifts, &c.: Hammond Bros. & Champness, Ltd. Benenden Sanatorium, electric wiring: Bowden, Higlett & Co. Leeds, supply of electrical labour-in-daywork: Alpha Manufacturing Co. National Physical Laboratory, electric storage battery: Premier Accumulator Co., Ltd. Royal Mint, alterations to motors, &c.: Waygood-Otis, Ltd.

New Zealand.—AUCKLAND.—The list of tenders given in our last issue under the heading "Wellington" was, in actual fact, a list of estimates received and accepted by the *Auckland* City Council.

Salford.—Electricity Committee. Accepted:—

L.p., paper-insulated, lead-covered cable, £580.—W. T. Glover & Co., Ltd.
D.c. ironclad switchboard, £225.—Dorman & Smith, Ltd.

FORTHCOMING EVENTS.

British Science Guild.—Wednesday, June 8th. At the Goldsmiths' Hall, Foster Lane, E.C. At 3 p.m. Annual meeting.

Institution of Electrical Engineers (Wireless Section).—Wednesday, June 8th. At the Institution, Victoria Embankment. At 6 p.m. Paper on "Electric Oscillations along Straight Wires and Solenoids," by Prof. J. S. Townsend.

Physical Society of London.—Friday, June 10th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Lecture on "The Stability of Atoms," by Sir E. Rutherford, F.R.S.

NOTES.

X-Ray Heroes Honoured. — The committee of the Carnegie Foundation has awarded a gold medal to Dr. Infroit, a famous radiologist, who has had several fingers amputated as the result of disease contracted in the course of his X-ray experiments ; a gold medal and £1,100 to M. Vaillant, head of the X-ray laboratory at the Salpetrière Hospital, who has continued his work in spite of losing his left arm ; and a gold medal to the late Dr. Leray, who died on March 26th from burns contracted during his work in radiology.—*Reuter's Trade Service* (Paris).

Junior Institution of Engineers.—A dinner in celebration of the thirty-seventh anniversary of the Institution's foundation was given at the Café Monico, Piccadilly Circus, on May 26th, when the president, Lord Weir of Eastwood, presided over a company of nearly 100 members and guests ; during the evening, Miss Winifred Mansfield and Mr. Roland Merry contributed humorous songs and stories, and Mr. Spencer Shaw, L.R.A.M., acted as accompanist.

Besides the Institution's headquarters in London, there are six provincial local sections and two abroad, one at Melbourne (Australia) and the other at Assam (India) ; the total membership stands at 2,169 of all classes, comprising engineers of all ages, from 18 upwards, who are engaged in the technical and administrative departments of engineering firms, &c.

Following the loyal toasts, Mr. Loughnan St. L. Pendred proposed "The Institution," in a humorous speech, which was much appreciated, and Mr. B. E. Dunbar Kilburn, M.A., in responding, referred to the work of the Institution and the keenness of all members. The toast of "Progress in Engineering" had coupled with it the name of Lord Weir (president and member of the Institution), and was proposed by Mr. C. H. Wordingham (president-elect of the Institution). "Kindred Institutions" was proposed by Mr. S. E. Fedden (president of the Sheffield Section) and replied to by Captain H. Riall Sankey—and thereby hangs a tale. A vote of thanks to the chairman, proposed by Lieut.-Col. A. E. Le Rossignol, brought the proceedings to a close.

Educational.—Exchange of Professors.—There has been for some time a regular annual exchange of professors between individual universities in France and America in regular academic fields, but not hitherto in engineering or applied science. These subjects are taught in France under special faculties, not included in existing exchanges with America, and the French methods of teaching them are unlike the American methods, for various reasons. Arrangements have now been made whereby seven United States universities have agreed with the French University Administration upon the annual exchange of a professor. The French selected for their first representative Prof. J. Cavalier, Rector of the University of Toulouse, and a well-known authority on metallurgical chemistry, and the American universities have selected as their outgoing representative for the year 1921-22 Dr. A. E. Kennelly, Professor of Electrical Engineering at Harvard University and the Massachusetts Institute of Technology. It is anticipated that if the plan continues to operate as favourably as it has commenced, there should not only be a steady annual exchange of a professor in various branches of applied science, but also a steady interchange of advanced students between France and America.

Service Notes.—In connection with the Defence Force, the following temporary appointments have been made :—London Electrical Engineers : Lieut.-Col. A. E. Le Rossignol, C.B., T. D. ; Captains H. K. B. Reed, T. W. G. Ackland, I. S. Macadam, O.B.E., T. C. Mann, M.B.E., and E. Matthews ; Lieutenants G. St. J. Sugg, C. G. Huntley, H. F. Cousins, W. J. Rawlings, A. B. Penney, L. B. Foster, G. O. King and A. W. King ; Quartermaster and Captain S. W. P. Goodwin—all war veterans. Tyne Electrical Engineers : Lieut.-Col. E. Robinson, M.B.E., T.D., Major H. E. Burton, O.B.E., Captain C. M. Foster, Lieutenants C. B. Williamson, R. P. Winter, M.C., E. H. E. Woodward, M.C., R. Sharp, O.B.E., C. F. Fawcett ; Captain and Quartermaster A. Reed. Since being gazetted as above, Lieuts. R. Sharp and Woodward, Tyne Electrical Engineers, have been promoted Captains. Capt. W. H. Pay and Lieut. W. B. Davies have been posted to the Electrical Companies of the Defence Force. Recruiting for the electrical branches of the Navy and Army is very satisfactory, the increased pay and better service conditions attracting a good class of recruits.

Electricity in Farming. At the Oxfordshire Agricultural Show, held at Banbury from May 24th to May 26th, electrical appliances were well to the fore, showing that electricity is fast coming to be recognised as a powerful agent in successful farming.

Messrs. J. Bustin's Electrical Works, Banbury, who specialise in electric light installations in country houses, mansions and public buildings, had on show a fine range of self-contained electric-lighting and power plants, consisting of Crossley engines driving generators. One direct-coupled electric-lighting set, manufactured by Messrs. Dixon Bros. & Hutchinson, was used for lighting the stand and advertising novelties. A small "Aster" lighting set, and also a good show of their own manufactured switchboards, suitable for country house installations, appeared on the stand Both stationary and portable types of Crossley engines driving pumps and farm machinery were shown. There was also an "Albany" electrically-driven, direct-coupled pump, an electrically-driven churn, a washing machine, and a range of farm machinery driven by separate electric motors, showing the advantages of electric drive. "Skefco" roller bearings for an electric clipping machine and several small electric motors were also exhibited.

The domestic appliances on show consisted of electric fans, kettles, irons, hotplates, vacuum cleaners, and many other labour-saving devices ; the electric kettles were used for making tea which was very much appreciated by the many inquirers who commented on the quickness and cleanliness of electricity. A large amount of interest was caused by the "Mystic" Electric Sign advertising Osram Lamps, which was kindly loaned by the General Electric Company. "Exide" Batteries for lighting and self-starting sets for motor cars, and battery charging boards were also included.

Messrs J. Mawle & Sons, of Banbury, also exhibited lighting and power plant.

X-ray Research.—Treatment of Cancer.—Dr. A. E. Barclay, medical officer in charge of the X-ray Department of the Manchester Royal Infirmary, has received through an anonymous donor a gift of £4,000 in aid of research work in connection with "intensive X-ray therapy." The donor has expressed a wish that a portion of the money should be utilised in paying the expenses of a scholar who is to proceed to the Continent to study the methods adopted in various clinical centres *e.g.*, Erlangen, for the utilisation of intensive X-ray therapy in relation to the treatment of cancer, says the *Manchester Guardian.* The Board of Management of the Royal Infirmary has accepted the gift, and made arrangements to have the necessary apparatus installed in the X-ray department. Dr. Anderson has been appointed Research Scholar, and will proceed to the Continent in July. A Committee consisting of Sir William Milligan (chairman), Dr. A. E. Barclay, Prof. Bragg, Dr. Arthur Burrows, Prof. Dean, Prof. Hill, and Mr. James Watts, junior, has been appointed to complete the necessary arrangements and to administer the fund. The intention of the donor is to stimulate inquiry into a recently-suggested means of dealing with malignant disease—a method which has caused considerable stir in medical quarters on the Continent.

Appointments Vacant.—Two junior clerks (£70 + war bonus = £185) for the St. Pancras B.C. Electricity Department ; foreman armature winder (Rs. 450 per month) for the North-Western Railway of India Electrical Department ; assistant lecturer in Electrical Engineering (£200 + war bonus = £433), for the Belfast Municipal Technical College ; electrical engineer for the Ludlow Electric Light Works ; lecturer in Electrical Engineering (salary, including bonus, £520) for the Bradford Technical College ; meter reader and fixer for the Hackney Borough Council Electricity Department ; assistant in electrical technology (Rs. 625 + per mensem) for the Indian Institute of Science, Bangalore. See our advertisement pages to-day.

Fatalities.—An inquest was held on May 23rd, at Plymouth, to inquire into the cause of the death of Fred. Langford, a wireless operator, who was killed at the Cattewater Air Station by an explosion. Sergeant Fred. Coombes, who is in charge of the wireless station, in giving evidence, said the accident was caused by a spark which ignited the celluloid container of an accumulator. The flame set alight Langford's clothing, which was saturated with oil, and an explosion resulted. A verdict of "Death from natural causes was returned," and the Coroner highly complimented Corporal Scott, who endeavoured to reach the power house after the explosion. Scott tied a towel over his head, broke down the door, and tried to drag the man away.

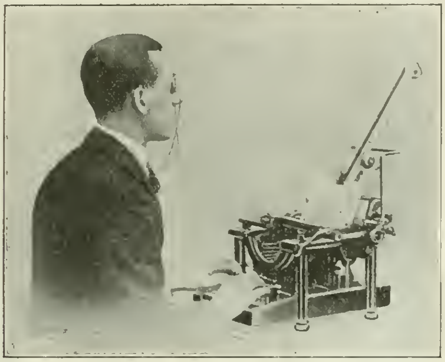
At Huddersfield, on May 28th, a verdict of "Accidental death" was returned in the case of Tom Buckley, whose body had been found in an electric hoist at the works of Messrs. Gledhill Bros. and Co., Ltd., where he was employed. The evidence indicated that he had touched a broken switch, and had died from electric shock.

London Engineers' Club.—The proposal to have an engineers' club situated in London, to serve the needs of British engineers throughout the world, is now coming rapidly to a head. In fact, we may say it has come, for a general meeting of the supporters of the club was to be held yesterday, at the Hotel Cecil, with Mr. E. Manville, M.P., M.I.E.E., &c., in the chair, at which resolutions inaugurating the club on regular lines were to be put forward. Over 1,600 applications for membership have already been received, and these are being added to daily. Applications are coming not only from London and the provinces, but also from Australia, New Zealand, India, South Africa, South America, Canada, Egypt, and the United States, as well as from Norway, Sweden, Denmark, Belgium, Holland, France, Spain, and Italy. It is hoped very shortly to acquire first-class premises in a central situation in London, and there is every prospect of the club's starting in the summer of this year. If a census could be taken on any day in the year, it would probably be found that some 800 to 1,000 British engineers from overseas were in London without any place to call their home, and the Engineers' Club will not only fill this want, but will also serve as an Engineering Exchange for the British Empire. The subscriptions proposed are ten guineas for town members, five guineas for country members, and two guineas for overseas and foreign members. Full particulars can be obtained from the temporary Honorary Secretary, Mr. Edmund L. Hill, 39, St. James's Street, London, S.W. 1.

A Blind Engineer's Invention.—Mr. Gamble, who prior to the war was electrical engineer to a suburban Corporation, after occupying a number of important posts in the Ministry of Munitions, was employed as chief electrical engineer to the National Steam Car Co., which was engaged in the production of war *matériel.* While carrying out his duties, the bursting of a coal calorimeter deprived him of the sight of both eyes, and he was compelled to abandon his profession. Through the kindness of Sir Arthur Pearson, Mr. Gamble was able to enter St. Dunstan's, where he received training in secretarial duties.

The blinded engineer set about devising a means of overcoming the difficulties of typewriting, and the device which he evolved is shown in the accompanying illustration.

The actual keyboard is memorised, and to help, a Braille scale is fitted to the carriage of the machine in place of the ordinary printed scale which is seen on every typewriter. This scale is fitted with "stops" which operate the bell and give warning when the end of the horizontal line is reached. The chief difficulty, however, was found in easily determining when the end of the paper was being reached, and in doing tabular matter, as well as in taking out a document and reinserting it in exactly the same position. Some audible warning was obviously necessary, and the attachment shown in the illustration (for which letters patent have been applied for) gives this. It is made from an aluminium stamping, flanged at each side, and is trough shaped in section. Down the trough works a flat clock-shaped spring, its upper end being wound round the wheel at the top. To the lower end of the spring is fixed a clip somewhat after the shape of the office "bull-dog" clip, only instead of a spring to close the jaws, there is a screw, so that the top end of the paper can be inserted by the operator with the full use of both hands. On the clip is a projection for obtaining absolute squareness of the paper, and a tiny point sticks in the paper for determining the exact position, should the letter have to be taken out and reinserted in the machine. With the spring, and its clip holding the paper, typewriting can proceed in the usual way, and when the end of the paper is being approached the clip above referred to touches another stop with suitable trip-levers, to operate the bell which is shown on the right. The stops and clip are adjustable so that the exact position, working from top to bottom, can always be arranged for, thus permitting tabular matter to be done perfectly. Braille characters (marked out in inches) are stamped at the side, so that the parts can be adjusted according to the actual length of matter required.



We are indebted to Mr. Pringle, of 140, Bishop's Road, Chelmsford, for this description and the photograph.

Popular Science!—From time to time we have had occasion to comment upon wildly exaggerated statements put forward by the non-technical Press in connection with new discoveries and inventions, as well as in connection with things that are neither.

The latest example of this recently appeared in the *Daily Mail* in what purported to be a description of the re-discovery of electrostatic attraction between a semi-conductor and a "good" conductor by Messrs. Johnsen and Rahbek, whose relay, according to the *Daily Mail*, which quotes Mr. Thorne Baker in support of its theory, is "the nearest approach yet seen to the unsolvable problem of perpetual motion." We cannot think that this is what Mr. Thorne Baker really said.

At the demonstration the inventors displayed a small electroscopic detector about the size of an ordinary fountain pen. This is apparently the instrument which leads the *Daily Mail* to think that "it is no exaggeration to say that their new relay makes it possible to have a portable wireless receiving set little bigger than a fountain pen." There are other statements which require to be taken *cum grano salis*, but we will merely disagree with the idea that the new discovery is "more remarkable" than the invention of the amplifying valve.

Whiteley Village.—By means of a bequest of one million pounds left by the late Mr. William Whiteley, the Whiteley Village, providing homes for aged persons, has been built in a beautiful park near Walton-on-Thames; it will ultimately provide accommodation for upwards of 500 villagers, the population at present numbering 281. On May 28th it was visited by the King and Queen, who were received by the trustees of the estate.

Electric lighting has been provided throughout the estate, the supply being derived from the Urban Electric Supply Co., Ltd., Weybridge. The road lighting is controlled by Venner time switches. The main cables were made and laid by the B.I. and Helsby Cables, Ltd.; the house services and road lighting cables are C.T.S. laid in g.i. screwed tubes. Interior wiring is of v.i.r. cable in screwed conduit. The principal contractors were:—For wiring the buildings, and service cables, Messrs. Pinching and Walton; wiring the large hall, Messrs Duncan Watson & Co.; wiring the church, Messrs. Drake & Gorham, Ltd.; fittings and lamps, Messrs. William Whiteley, Ltd.; main switchboard (by Mr. Cecil Hodges), Messrs. Malcolm & Allan; 20-line telephone exchange and stations for the use of the staff, Western Electric Co., Ltd., installed by Messrs. Duncan Watson; electric bells and road lighting cables, Messrs. H. J. Cash & Co.

The church organ blower is driven by a motor which is controlled by an automatic device devised jointly by the consulting engineer, Mr. H. D. Wilkinson, M.I.E.E., M.I.Mech.E. (who was responsible for the whole of the engineering installations on the estate), and the resident engineer, Mr. J. Hetherington.

Electrostatic Adhesion.—The earliest discovery of the phenomenon which Messrs. Johnsen and Rahbek have re-discovered appears to have been made by Elisha Gray. It was recorded in The Telegraphic Journal of September 1st, 1877, in an article by W. H. Preece (afterwards Sir W. H. Preece), as follows:—

"Elisha Gray, of Chicago, in 1873, succeeded in producing tones from the finger when rubbing a dry sonorous body, such as an ordinary tin can, while the intermittent currents sent by a vibrating tuning fork were passing through it, and by attaching an electromagnet to a hollow sounding box, open at one end and closed at the other, he was able to reproduce exactly the *tones* of the musical notes transmitted. His electromagnet had its armature rigidly fixed to one pole, and separated from the other by a space of one-sixtieth of an inch. He called it a *resonator*. The vibrations of this armature were imparted to the sounding box and became thereby magnified."

INSTITUTION NOTES.

Institution of Electrical Engineers.—The results of the recent elections having been announced at the meeting held on May 26th, we are now able to give a list of the officers and Council of the Institution for the session 1921-22. The list, of course, is in addition to past-presidents. The names of those newly elected are given in italics.

President.—J. S. Highfield.

Vice-Presidents.—Dr. W. H. Eccles, A. A. C. Swinton, *Prof. E. W. Marchant*, D.Sc., *C. C. Paterson*, O.B.E.

Hon. Treasurer.—Sir James Devonshire, K.B.E.

Ordinary Members of Council.—H. J. Cash, *Lieut.-Col. Cortez-Leigh*, J. R. Cowie, *S. Evershed*, S. E. Fedden, E. A. Gatehouse, F. Gill, P. V. Hunter, C.B.E., A. H. W. Marshall, Sir W. Noble, Sir A. M. Ogilvie, K.B.E., C.B., *A. Page*, *T. Roles*, Dr. A. Russell, A. W. Tait, C.B.E., P. D. Tuckett, C. Vernier, B. Welbourn.

In addition to the above, we give, as far as we are able, the chairmen-elect and immediate past-chairmen of Territorial and Colonial Centres (chairmen in italics):—

N.E.—*Prof. W. M. Thornton*, D.Sc., and J. R. Beard, M.Sc.
N.W.—*Ald. W. Walker* and J. Frith.
S. MIDLAND.—F. Forrest.
N. MIDLAND.—*W. E. Burnand* and C. J. Jewell.
IRISH.—*R. W. Eaton* and A. G. Biuty.
SCOTTISH.—*E. T. Goslin* and J. E. Sayers.
HONG-KONG.—F. Graham.
CAPE TOWN.—W. F. Long.
CALCUTTA.—J. W. Meares.

ANNUAL GENERAL MEETING.—The forty-ninth annual general meeting of the Institution was held in the I.E.E. building, on Tuesday last, when the President, Mr. Ll. B. Atkinson, introduced the Council's report for the 1920-21 session, which was abstracted in our last issue. In briefly touching on the more important points, Mr. Atkinson said that they had been hardly able to trace any loss of members consequent upon the recent increase in subscription. The report and accounts were adopted, and a vote of thanks to the Institution of Civil Engineers for the facilities it put at the disposal of the I.E.E. for nearly five years was carried, as was also a vote of thanks to the hon. officers of the Institution at home and abroad. Messrs. Allen & Attfield were re-elected auditors. The meeting then terminated.

THE CHARTER.—A special meeting was then held, at which the President introduced the subject of the Royal Charter which the Institution is to ask the Privy Council to grant, and explained that a postcard vote had been taken; 63·5 per cent. of the corporate members had voted, all except three being in favour of the proposal. After Mr. R. T. Smith had seconded the resolution proposing to seek the charter, and Mr. C. H. Wordingham had explained the work he had done in connection with the subject, the motion was put to the meeting, and carried unanimously.

Lecture.—Afterwards an ordinary meeting was held, to hear a lecture on "Research Work in the United States," by Dr. F. B. Jewett, chief engineer of the Western Electric Co., which, said the President, had the largest research laboratories in the world. Dr. Jewett was severely handicapped by the non-arrival of a number of lantern slides which were to have illustrated his lecture, but he substituted an extemporaneous discourse on the development of research in the United States, which was heard with deep interest. He expressed some doubt whether industrial research had not been overdone; people were expecting too much from it, and when the dollars failed to roll in, there might be a reaction. The National Research Council, formed with the aid of the National Academy of Sciences, was founded to carry out war work, which it did very effectively; it was now being reorganised for peace purposes, and covered the whole field of science, each division being provided with a chairman, who was paid an adequate salary. The Engineering Foundation had joined forces with it, and became the Engineering Division. The function of the National Research Council, which was not a Government institution, was to stimulate research in the industries and to provide funds for the purpose; it had some $200,000 a year at its disposal, provided by the Engineering Foundation and the industries. Men of recognised ability were granted fellowships worth from $1,800 to $2,500 a year to carry on research. Particulars were given of some typical researches, to which the industries contributed large sums of money. A research on the fatigue of metals was particularly successful, and while the big firms would not co-operate in a research on electrical insulation, they readily supported the National Research Council with funds to prosecute the investigation. Private research laboratories were now thoroughly established, and able men were being trained for industrial research, not in technical colleges, but in universities. The big firms had their own laboratories; small ones combined for the purpose, and there were also consulting research laboratories. Sir Frank Heath then gave a full account of the organisation of the British Department of Scientific and Industrial Research, and compared its methods with those adopted in the United States. The meeting closed with votes of thanks to the speakers, proposed by Mr. C. H. Wordingham and Mr. C. C. Paterson.

Wireless Section Committee, 1921-22.—The following members have been nominated to serve on the Wireless Section Committee, 1921-22:—Chairman: Dr. G. W. O. Howe. New nominations for membership of the Committee: Mr. B. Binyon, O.B.E., Dr. W. H. Eccles, G. H. Nash, C.B.E., and C. C. Paterson, O.B.E. The following will continue to serve as members of the Committee: Sir Charles Bright, F.R.S.E., Mr. R. C. Clinker, Prof. C. L. Fortescue, Mr. A. Gray, Admiral of the Fleet Sir H. B. Jackson, G.C.B., Captain H. J. Round, M.C., Messrs. A. A. C. Swinton, F.R.S., and L. B. Turner.

Summer Meeting.—The secretary of the Institution informs us that, in view of the continuance of the coal miners' strike, the Scottish Committee has been reluctantly compelled to cancel the proposed Summer Meeting, which was to have been held in Scotland next week.

Electrostatic Adhesion.—On May 26th Messrs. Alfred Johnsen and Knud Rahbek demonstrated the phenomenon of adhesion between the surfaces of a semi-conductor and a good conductor when a potential difference is applied to them. This was outlined in our issue of May 20th. Their first experiment, performed by means of a balance to one side of which a brass disk was suspended in contact with a slab of lithographic stone, showed that when a potential difference of 440 volts was applied, the adhesive force was in excess of 500 grammes.

The most useful form of apparatus constructed to make use of the principle consisted of an agate or flint cylinder, mechanically rotated, over which was fitted a metal band held in position by springs. This arrangement was put into a circuit as a relay, when a series of electrical impulses caused corresponding movements of of the band. In this way it was possible to record the receipt of telephonic or telegraphic impulses, as well as wireless waves. An application of this apparatus demonstrated by the inventors took the form of a stringless violin, which was made to serve the purpose of a loud-speaking telephone, amplifying the impulses set up in a telephone circuit by a violin played in another room. Speech was also transmitted in this way. Another application, shown in action by means of a shadow outline thrown upon a screen, was a small electroscope about the size of an average fountain pen, which can be used to test whether conductors are "live" or not.

Iron and Steel Institute.—The autumn meeting will be held, by invitation of the Comité des Forges de France, in Paris, on September 5th and 6th.—*The Times.*

British Science Guild.—The annual meeting of the Guild will be held at the Goldsmiths' Hall, on Wednesday, June 8th, at 3 p.m. The speakers will be: The Right Hon. Lord Montagu of Beaulieu, K.C.I.E., C.S.I.; the Very Rev. William R. Inge, C.V.O., on "The Road to Ruin and the Way Out"; and Sir Richard A. S. Redmayne, K.C.B., on "The Importance of Research in Promoting the Development of the Mineral Industries." Cards of Invitation may be obtained on application to the Secretary, British Science Guild, 6, John Street, Adelphi, W.C. 2.

Physical Society of London.—At the meeting held on May 13th, a paper, entitled "Notes on Vacuum Tubes used as Detectors of Electrical Oscillations," by Messrs. Hartshorn and E. S. Keeping, was read by the former. The paper describes the development of a robust form of vacuum tube which was used as a detector of electrical oscillations in the "wireless" circuits carried by aeroplanes. Platinum electrodes are avoided, being replaced by strips of tinfoil, to which contact may be made by the spring clips holding the tube in position. It is found that when a discharge is passed through such a tube, the walls are affected in such a way that thenceforth it is much easier to get a discharge to pass. The change produced by the first discharge is annulled by heating the tube above 210° C. Further, if the walls are coated on the inside with a metallic film, this first discharge is unnecessary, and the tube is unaffected by heating, but when the walls are coated with an insulator, it is, if anything, more difficult to pass a discharge. A silica tube behaves like one coated with metal. It seems possible that the change in the tube may be due to the formation of a layer of gas molecules on the walls by the first discharge. The explanation of the behaviour of the silica tube is difficult.

Association of Mining Electrical Engineers.—At the annual meeting of the West of Scotland Branch of the Association, held in Glasgow, Mr. Frank Anslow, who presided, announced that the membership now exceeded 300. Office bearers were elected for the ensuing session; Mr. F. J. Jamieson was elected president. A paper by Mr. J. A. B. Horsley, H.M. Electrical Inspector of Mines, on "Surface Electrical Equipment at Mines, as Affected by the Regulations of July, 1920," was read and discussed.

The Franklin Institute.—On May 18th, at a meeting of the Institute, a certificate of honorary membership was presented to General Pershing. The Franklin Medal and a similar certificate were presented to the French Ambassador for Prof. Charles Fabry, of the University of Paris. A similar honour was paid to Mr. Frank J. Sprague, of New York. The paper read on behalf of Prof. Fabry was entitled "Studies in the Field of Light Radiation." Mr. Sprague presented a review of the progress of electric traction.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Darwen Town Council has decided to increase the salary of Mr. Fletcher, electrical engineer, by £100 a year; and that of Mr. Newholme, tramway manager, by £50 a year, with a further £25 in each of the next two years.

Mr. C. William Skinner, a member of the staff of the I.E.E. from 1912 to 1919, and now with Mr. Fredk. A. Grant, F.A.I., was first in order of merit at the recent examinations of the Auctioneers' Institute, receiving the silver medal, the Institute and Branch prizes, and was also successful at the Intermediate Examination of the Surveyors' Institution.

Messrs. Malcolm & Allan, Ltd., electrical power and lighting contractors, inform us that their London manager, Mr. H. S. Davidson, is now no longer in their employ. Mr. H. Francis Smith, who has been engaged as their London technical manager, was for many years in the employ of Messrs. J. G. White & Co., in South America. Mr. H. S. Butler will continue as commercial manager of their London branch.

Mr. Hugh S. Davidson, late London manager for Messrs. Malcolm & Allan, Ltd., has now joined the staff of Mr. Stanley Johnston, engineer, of 7-9, Queen Street, Belfast, in a similar capacity.

Halifax Tramways Committee recommends the granting of an honorarium of £300 to Mr. J. W. Galloway, tramway engineer, in recognition of extra services rendered by him in connection with the management of the undertaking during the illness of the manager, and pending the appointment of the new general manager.

Mr. E. W. Dorey has opened offices at Norwich House, Southampton Street, W.C. 1, where he is specialising in the installation of apparatus for the improvement of power factor.

Mr. P. O. Willmott, after 15 years with Messrs. Robt. W. Blackwell & Co., Ltd., for the last 12 as purchasing agent and sales manager, has resigned his position, and will start in business handling similar lines, with his colleague and assistant, Mr. F. S. C. Phillips, who has also resigned from Messrs. Blackwell's service. For the present, letters should be addressed to 13, Alexandra Park Road, London, N. 10.

The *Times* announces that Sir Edmund Wyldbore-Smith has accepted the post of chairman of the Metropolitan Carriage, Wagon and Finance Co.

Mr. G. Boorman, manager of the Electrical Department of Messrs. Albert Lee & Co., Ltd., London, E.C., informs us that he has resigned his position as from May 31st.

The *Daily Telegraph* states that Mr. Alexander Moir, O.B.E., superintending engineer of the London District of the Post Office, is about to retire after nearly 47 years' service. On Tuesday last Sir William Noble, the Engineer-in-Chief, presented Mr. Moir, on behalf of the staff of the district, with a grandfather clock, and Mrs. Moir with a diamond brooch.

Mr. W. J. Mathews, 74, Greenway Avenue, Taunton, late sales manager of Messrs. Newtons, Ltd., has been appointed sole agent of the Electric Construction Co., Ltd., for the South-West of England.

Mr. L. W. George, chief assistant at the Horsham Urban District Council electricity works, has been appointed to a similar position in the Aldershot Urban District Council's electricity department.

A correspondent is anxious to get into communication with Major Pope, R.E., ex-O/C. 34th (Eastern) Division Signal Company, R.E., who returned to South America after the war.

Obituary.—Mr. E. L. Orde.—We regret to record the death, which occurred suddenly in London, on May 27th, of Mr. Edwin Lancelot Orde, ex-President of the North-East Coast Institution of Engineers and Shipbuilders and a director of Armstrong, Whitworth & Co., Ltd., of Newcastle-on-Tyne. Mr. Orde was 58 years years of age. He was greatly interested in the use of oil fuel for sea-going vessels.

Mr. E. Brown.—The death took place on May 23rd, at the age of 36 years, of Mr. Ernest Brown, who had for 16 years been on the staff of the Northampton Electric Light Co. For the past eight years he had been foreman of the wiring department.

NEW COMPANIES REGISTERED.

Lancashire Industries, Ltd. (174,761).—Private company. Registered May 18th. Capital, £1,000 in 900 ordinary shares of £1 each and 200 ordinary shares of 10s. each. To carry on the business of electrical engineers, factors of and dealers in electrical and mechanical appliances, shippers, warehousemen, clothiers, leather merchants, importers, exporters, and agents, &c. The subscribers are: F. W. Roberts, 11, St. Oswald Street, Manchester, electrical engineer; E. Tracey, 10, Argyle Avenue, Victoria Park, Manchester, secretary; J. Moorland, 6, Tennis (?) Street, Old Trafford, Manchester, director. The first directors are: F. W. Roberts, E. Tracey, and H. D. Barker. Qualification: Twenty ordinary shares. Registered office: 63, Cannon Street, Manchester.

Lift & Engineering, Ltd. (174,800).—Private company. Registered May 20th. Capital, £5,000 in £1 shares. To carry on the business of manufacturers and constructors of and dealers in lifting and hoisting machinery, contractors, electrical, mechanical and general engineers, machinists, fitters, founders, &c. The subscribers (each with one share) are: W. G. Clark, 2, Hill View Road, Orpington, Kent, insurance official; H. F. C. Smith, 65, New Bond Street, W. 1, engineer. The first directors are not named. Registered office: 4, Tokenhouse Buildings, King's Arms Yard, E.C.2.

H. J. Harding, Ltd. (174,831).—Private company. Registered May 23rd. Capital, £8,000 in £1 shares. To carry on the business of motor, electrical, and general engineers as formerly carried on as "H. J. Harding," at Low Row, Sunderland. The first directors are: H. J. Harding (permanent managing director), 38, Elmwood Street, Sunderland; F. W. Douds, 57, Dundas Street, Sunderland; J. R. Smith, 40, Church Street, Deptford, Sunderland. Secretary: J. R. Smith. Registered office: Low Row, Sunderland.

Lacy-Hulbert & Co. (1921).—Private company. Registered May 20th. Capital, £40,000 in £1 shares. To carry on the business of pneumatic and general, mechanical, and electrical engineers, machine, tool, and motor makers, vacuum cleaners, boiler makers, makers of air compressors, vacuum pumps, and other pneumatic machinery, iron, brass, metal, and other founders, smelters, refiners, engineers, &c., and to adopt an agreement with Lacy-Hulbert & Co., Ld. (incorporated in 1903). The first directors are: C. E. Lacy-Hulbert, Morden Grange, Mitcham, Surrey; A. G. London, Oakleigh Lodge, Sunbury, Middlesex; D. G. Halsted, no address given. Registered office: Boreas Works, Beddington, Croydon, Surrey.

Tidd, Siday & Co., Ltd. (174,902).—Private company. Registered May 26th. Capital, £20,000 in £1 shares. To carry on the business of electricians, engineers, telephone and scientific instrument manufacturers, chemists, manufacturers of perfumes, disinfectants, deodorant and chemical preparations, &c., and to adopt an agreement with W. E. Siday. The first directors are: J. T. Tidd, 22, St. Stephen's Avenue, West Ealing; W. E. Siday, 43, St. Helens Gardens, North Kensington; H. S. Grimston, 101, Grosvenor Road, Ilford; H. Buss, 341, Ivydale Road, Peckham Rye, S.E. The two first-named are permanent. Qualification: £100. Registered office: 180, Drury Lane, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Jones, Burton & Co., Ltd.—Mortgage dated May 11th, 1921, to secure £5,000 charged on certain land and buildings in Liverpool. Holder: G. L. Burton, 16, Victoria Street, Westminster.

Simms Motor Units (1920), Ltd.—Land Registry charge on "The Grange," East Finchley, dated May 4th, 1921, to secure £40,000. Holders: W. E. Martin, The College, Maidstone, and E. J. Townsend, Tynwald, Packhorse Road, Gerrards Cross, Bucks. (trustees of prior deed securing £40,000 mortgage debentures).

Altrincham Electric Supply, Ltd.—Debenture dated May 13th, 1921, to secure £32,000 charged on the company's undertaking and property, present and future, including uncalled and unpaid capital. Holders: London County Westminster & Parr's Bank, Ltd.

W. H. Dorman & Co., Ltd.—Deposit on May 2nd, 1921, of deeds of certain lands and premises in Stafford, to secure all moneys due or to become due from company to Lloyd's Bank not exceeding £10,000 (in addition to £40,000 secured by prior charge).

Pontelec Welding Patents, Ltd.—Return dated January 6th, 1921. Capital, £30,000 in £1 shares (20,000 ordinary and 10,000 preference). 20,000 ordinary and 5,000 preference shares taken up. £5,000 paid, £20,000 considered as paid. Mortgages and charges: £2,000.

Notting Hill Electric Lighting Co., Ltd. (25,921).—Return dated March 29th, 1921. Capital, £201,352 10s. in 17,002 6 per cent. non-cumulative preference and 2,998 6 per cent. cumulative preference shares of £10 each and 27,050 ordinary shares of 1s. each. 11,402 non-cumulative preference, 2,998 cumulative preference, and 27,050 ordinary shares taken up. £145,352 10s. paid. Mortgages and charges: £64,000. Also guaranteed by this company and the Kensington & Knightsbridge Electric Lighting Co., Ltd., and issued under the powers of the Kensington & Notting Hill Electric Lighting Companies Act, 1899: £221,550.

Telegraph Construction & Maintenance Co., Ltd. (11,470).—Return dated March 24th, 1921. Capital, £896,400 in £12 shares. All shares taken up. £448,200 paid. £448,200 considered as paid. Mortgages and Charges: Nil.

London Electric Supply Corporation, Ltd. (24,957).—Capital, £1,300,000 in 200,000 ordinary shares of £3 each and 90,000 preference shares of £5 each and £250,000 to be divided into preference or ordinary shares as the board may determine. To March 7th, 1921, 111,000 ordinary and 89,840 preference shares had been issued and £782,200 paid thereon. A further £160 had been paid on 160 shares forfeited. £587,355 debenture stock was outstanding.

Yorkshire (West Riding) Electric Tramways Co., Ltd. (84,167).—Capital, £600,000 in 70,000 6 per cent. cumulative preference and 50,000 ordinary shares of £5 each, of which, to February 17th, 1921, 46,261 preference and 40,977 ordinary had been taken up. All credited as fully paid (total £436,190). £272,373 4½ per cent. first debenture stock was outstanding (part of £400,000 authorised).

Newmarket Electric Light Co., Ltd. (44,450).—Capital, £30,000 in £10 shares. Return dated April 4th, 1921. 2,656 shares taken up. £26,560 paid. Mortgages and charges: £14,200.

Newcastle & District Electric Lighting Co., Ltd. (28,022).—Capital, £300,000 in £10 shares. Return dated March 25th, 1921. All shares taken up. £297,500 paid, leaving £2,500 in arrears. Mortgages and charges: £303,100.

New Development Co., Ltd. (112,145).—Capital, £5,000 in £1 shares. Return dated March 30th, 1921. 1,275 shares taken up. £1,275 paid. Mortgages and charges: Nil.

CITY NOTES.

Anglo-Argentine Tramways Co., Ltd. The gross receipts for 1920 were £4,413,165, less expenditure £3,198,028. Including £44,513 interest received and transfer fees, there is £1,259,650 available. From this there is deducted £70,660 annuity to City of Buenos Ayres Tramways Co. (1904), Ltd., £587,821 interest and sinking funds for debenture stocks, and £7,295 sinking fund for redemption of preference and ordinary shares, leaving £593,875, plus £175,510 brought forward. The following distributions were paid during the year in satisfaction of all the arrears and current dividends on the 5½ per cent. first preference shares: July, 1920, dividend for year to June 30th, 1918, £176,000; October, 1920, dividend for year to June 30th, 1919, £176,000; December, 1920, dividend for 18 months to December, 1920, £264,000; total £616,000. The directors now recommend the payment of a dividend of 5½ per cent. on the second preference shares in satisfaction of the arrears to December 31st, 1916, £137,500; leaving to be carried forward £15,884. £133,172 has been allocated out of revenue to the general renewals fund, against £97,000 in 1919, the additional provision being considered desirable in view of the high cost of materials. The number of miles open for traffic was 395½, the actual mileage run during the year being 61,303,692, and the number of passengers carried 432,636,355. The traffic receipts received the benefit of the revised fares from April 10th, 1920, and show an increase of £886,981. The increase is equal to 28.36 per cent. The working expenses were 75.60 per cent., as compared with 79.91 per cent. in 1919. Traction expenses were £52,970 lower than the previous year, due to decrease in cost of fuel. The death is reported of Monsieur G. de Laveleye, president of the Banque de Bruxelles, who had been a director of the company for nine years. On his appointment as Parliamentary Secretary to the Board of Trade, Sir Philip Lloyd-Greame, K.B.E., M.P., relinquished his seat on the board, and the vacancy was filled by the appointment of the Rt. Hon. Sir Edward Goulding, Bart., P.C., M.P. The board record their appreciation of the services rendered by the members of the local committee, Mr. Pedriali, the general manager, Mr. Dawes, the London manager, and the staff both in the Argentine and London.

Mr. J. Pedriali, the general manager, reporting at length upon the undertaking, says that the year 1920 may be classified as a year which commenced full of promise and terminated in a disappointing manner. The post-war prosperity, which was world-wide, coupled with the excellent harvests and very high prices obtainable for all the produce of the country, had the effect of producing an extraordinary growth of activity during the first half of the year, but the slump in prices and consequent business stagnation which marked the reaction in Europe and the United States was not long in producing effects in Argentina, and towards the close of the year the crisis was acute. The immigration continues poor, and this, no doubt, is due in great measure to the unsettled state of affairs in Europe, the Argentine Republic not offering, on the other hand, at the present time, any special inducement to the labourer abroad. The work undertaken by the technical department (surface) during the year was exceptionally heavy. There are 43 fewer motor cars and 96 more convertible trailers in service than in the previous year. The number of breakdowns in the overhead installations show a still further improvement upon the results of the previous year, notwithstanding the fact that this year several exceptionally violent storms were experienced. The methodical unification of all materials and accessories, and the systematic inspection of the lines upon the basis of the actual traffic borne, have given excellent results in practice. During the course of the year the subway rolling stock was reinforced by the arrival from Europe of 31 motor cars, thus bringing the number of cars up to 120. The general passenger traffic for the year compared favourably with the corresponding returns of the previous year. In 1919 there was a serious strike lasting three weeks, which completely upset the normal passenger transport. In

1920 there was a general taxi-cab strike, which had a beneficial effect upon traffics; the increased revenue represented by this strike amounted to at least $7,000 to $8,000 paper per day. Then again in 1920 they had the 12 cent tariff from April 10th. The number of passengers carried during the year was 391,312,991, giving an average return of 4.19 passengers per car km. run. In 1919 the passengers carried amounted to 335,068,599, the average per car km. being 4.10 passengers. There was thus an increase of 16.8 per cent. in the total number of passengers carried in favour of 1920. The subway traffic receipts for 1920 compare very favourably with those of previous years. The number of passengers carried was 41,323,364, as compared with 35,666,386 in 1919, or, say, an increase of 15.86 per cent. The average number of passengers carried per car km. shows also an important increase, the figure for 1920 being 7.86, as against 7.69 in the previous year. The average receipts also show an important increase, the return per car km. being 90.5 cents, whereas in 1919 the average was 76.9 cents. For 266 days the receipts were benefited by the increased fare of 12 cents, and for the first 100 days the fare was at the old rate of 10 cents. In forecasting the probable increase from the altered fare it was roughly calculated that one million passengers per day would contribute the additional 2 cents, giving an increase of $20,000 per day. But this figure has been reduced by the largely increased sale of workmen's return tickets, issued at 10 cents for the double journey. The increase in passengers has been 16.7 per cent. and the increase in car kilometres run 14.4 per cent. The wages, taxes, and pension fund have taken $7,176,653, which has been met by the increased receipts. The cost of electricity has been less by $830,255. The difficulty in the middle of the year in procuring fuel affected very disadvantageously the cost of producing electricity. The fuel situation got worse in place of better, and in the latter months of the year 1920 energy cost more than in 1919. The net amount debited to capital account for the year was £567,333. The expenditure on renewals account was £82,011. As a result of the tariff question the company presented its scheme for the construction of the new 30 kilometres of track, which it had agreed to build within the next three years, and this scheme is now being studied in the municipality. Mr. Pedriali concludes as follows:—

"Although the increase in passengers of the year 1920 over 1919 surpassed the estimate given in my report for 1919, this cannot be attributed to a continuation of the flourishing situation during the whole year, but rather to the fact that, in calculating the effects of the application of the new 12 cent tariff I slightly over-estimated the losses of passengers we would have. The latter months of 1920 certainly gave signs of the recommencement of a commercial crisis, the direct result of the world-wide post-war reaction, which became acute in the first months of 1921, and still continues. This has affected our traffic, and is likely to continue doing so throughout the year, for the reasons given at the commencement of this report. All things considered, therefore, I think we cannot estimate an increase in receipts beyond 5 per cent. upon the year 1920. The great drop in prices of fuel will, however, favourably affect our working expenses, especially after the month of April, when the present stocks of coal at higher prices are exhausted."

At the meeting, on June 7th, a resolution will be submitted authorising the directors to borrow a temporary loan up to not exceeding £500,000 in the aggregate at any one time.

Barcelona Traction, Light & Power Co.

The *Financial Times* states that owing to adverse conditions, the company warns the 5½ per cent. first mortgage bondholders that it may not be possible to pay the increased rate of interest on December 1st next. The company states that apart from the general difficulties following upon the war, unforeseen and adverse events, both of an economic and social character, have occurred in the Barcelona region, which have hindered the development of business, brought about financial stringency, and caused considerable depression in the textile industry, which is such an important factor in the business life of Barcelona. Spanish exchange itself, which until recently, had been advantageous, has seriously reacted. In May, 1920, it stood at 22.99 pesetas to the £, whereas in the present month it has been as high as 30 pesetas to the £. Having regard to these unfavourable conditions, the directors and the Bondholders' Committee consider it their duty, in fairness to the bondholders, to issue a warning note that, although the receipts of the operating companies have shown considerable increase, it is possible that the net revenue of the Barcelona company may not justify payment of the interest at the increased rate on December 1st next. The question can only be settled in August, when the results of the operating companies for the first six months of the current year are known.

Italian Companies.

Società Anglo Romana (Rome).—This company closed its working year (1920) with a loss of 6,825,889 lire, the obstacles which it had had to contend with rendering it impossible to equate prices with costs. The Labriola Wages Award alone had saddled the company with a 75 per cent. increased wages burden. The meeting decided to cover the loss by drawing upon the extraordinary reserve.

Officine Elettro-Ferroviarie (Milan).—Notwithstanding the unhappy events of 1920, when the works were seized by the workmen, and despite the growing burdens on all branches of the business, the year closed with a good financial result. The net balance amounted to 1,420,021 lire, which allowed of the payment of a dividend of 12 lire to each of the 80,000 shares of the nominal value of 100 lire.

Società Elettrica Bergamasca (Bergamo).—The report showed that the year 1920 had been a hard trial for the company, which had to face continually increasing costs, with no possibility of augmenting the returns. In October they were planning the new plant on the Parina, and they were now considering the definite scheme. The accounts disclosed an available net balance of 497,467 lire, out of which a distribution of 6 per cent. would be made.

The balance sheet of the *Società anonima Gas ed Elettricità di Erba Incina* (Milan) showed an available net sum of 56,296 lire, from which a dividend of 12.50 lire would be apportioned. Other dividends declared were: *Società Idroelettrica dell'Ossola*—8 per cent. *Società Elettrica Comense A. Volts* (Como)—8 per cent. *Società Pandana di Elettricità* (Milan)—10.50 lire per share of 150 lire.

The following companies have increased their capital: *Società anonima Officine di Energia Elettrica* (Novara), from 800,000 to 1,200,000 lire.

Società Litoranea di Elettricità di S. Dona del Piave, from 700,000 to 1,400,000 lire.

Società Elettrica Alto Cremonese (Milan), from 400,000 to 800,000 lire.

Società per Imprese Elettricità di Macerata, from 1,500,000 to 2,000,000 lire.

The Società Italiana di Elettrochimica, of Rome, which has a paid-up capital of 10,500,000 lire, announces the distribution of the dividend of 7.70 lire per share for 1919-20, which was decided on at the general meeting held last January. At the same time the share capital is being increased to 21,000,000 lire by the issue of 150,000 new shares of 70 lire each at par.

Swiss Companies.

The *Elektrizitats Gesellschaft Alioth*, of Basle, which is in close relationship with Brown, Boveri & Co., of Baden, has decided to pay a dividend at the rate of 5 per cent. out of net profits of 345,000 fr. in 1920, being the same rate as in preceding years.

The report of the "*Motor*," *A.G. fur Angewandte Elektrizitats*, of Baden, Switzerland, which is a holding company for the Brown-Boveri group, reports that the investments in 1920 suffered considerably from the situation of exchange. The net profits amounted to 810,000 fr., of which 730,000 fr. has had to be written off for exchange losses, and the balance has been carried forward. The share capital remains at 36,000,000 fr., and the loans at 45,000,000 fr. The interests held by the company in the Forces Electriques Alsacienne, Forces Electriques Lorraine, and Forces Electriques Sundgo Viennes were transferred during the year to the Societé Alsacienne et Lorraine, of Nancy, in which the company holds shares.

French Companies.

The *Société Francaise des Electrodes*, of Lyons, reports net profits of 1,145,000 fr. for 1920, as compared with 1,530,000 fr. in the preceding year. A dividend at the rate of 7 per cent. has been declared, as against 8 per cent. in 1919.

The *Compagnie Le Moteur Electrique*, of Lyons, which produces motors for 25 cycles and special apparatus for starting looms, &c., has declared a dividend at the rate of 6 per cent. per annum for the first financial year, which comprised nearly ten months.

The *Société t'Electro-Métallurgique de Dives* reports that a fair resumption of business took place at the beginning of 1919-20, but was unfortunately succeeded by depression in the latter months of the year. Nevertheless the profits were materially higher than in 1918-19. After placing 1,500,000 fr. to depreciation, the accounts show net profits and balance forward amounting to 5,620,000 fr., permitting of the payment of a dividend at the rate of 60 fr. per share and the carrying forward of 2,289,000 fr.

The *Compagnie Francaise Thomson-Houston* proposes to pay a dividend at the rate of 45 fr. per share for 1920 on the 400,000 shares of 500 fr., this contrasting with 40 fr. per share in 1919. The net profits amounted to 22,900,000 fr., as against 15,685,000 fr. in the previous year. It is stated that the value of the turnover last year was 110,555,000 fr., as contrasted with 62,517,000 fr. in 1919, and that of the orders on hand at the end of the year reached 100,033,000 fr., as against 61,985,000 fr. at the close of 1919.

Compagnie d'Electricité de Limoges.—The ordinary meeting passed the accounts for the year 1920, which showed a credit balance of 494,992 fr., exceeding by 33,397 fr. that of the foregoing year. The receipts from lighting and motive power had risen to 3,255,698 fr., against 1,928,615 fr. in 1919, or an increase of 1,327,083 fr. The increase in the receipts was due to the raising of the tariffs, and applied to power users from the second quarter of the year. Working expenses were 2,340,521 fr., or an increase of 1,118,975 fr. The meeting approved of a dividend of 8 fr. per share.

Compagnie générale de Travaux d'Eclaïrage et de Force.—The accounts for 1920 were approved by the ordinary meeting, showing profits of 842,826 fr., or an increase of 123,542 fr. on the preceding year's figures. The distribution of a dividend of 32.50 fr. per share was sanctioned.

Direct Spanish Telegraph Co., Ltd.—The accounts for 1920 show that including the balance brought forward, and the payment of income tax and E.P.D. for 1919, there is a balance of £46,638. After paying 10 per cent. preference dividend, 10 per cent. dividend on the ordinary shares, free of tax, putting £7,000 to investment fluctuations and £5,000 to reserve, there is a balance of £25,173 to be carried forward subject to E.P.D. and corporation profits tax. The cables have worked well during the year, and duplex working on the Bilbao cable has been installed with satisfactory results.

North Melbourne Electric Tramways Co., Ltd.—The directors state that in consequence of the strikes in Australia and the increased cost of fuel, materials, and wages, the company will not be in a position to pay the interest due on June 1st on the 5 per cent. debentures. The *Financial News* states that a meeting of the holders of these debentures was to be held on Tuesday to consider a resolution agreeing that the security of the debentures shall not become enforceable on account of the interest becoming in arrear, and that the interest due June 1st, 1921, and subsequently shall only be paid when the directors consider it advisable.

India Rubber, Gutta Percha & Telegraph Works, Co., Ltd.—On May 28th the directors advised the shareholders that, owing to the coal strike, it was found necessary to close the works at Silvertown "on the 22nd inst., and there is at present no indication when normal work can be resumed." Under the circumstances, the directors could not recommend the payment of an interim dividend on the ordinary shares. The half-yearly dividend on the preference shares will be paid on July 1st.

Mexican Electrical Companies.—Particulars have appeared in the financial Press this week of a plan for reorganisation and the settlement of arrears in the case of the Mexican Light & Power Co., the Mexican Electric Light, the Pachuca Light & Power Co., and the Mexico Tramways Co., which has been prepared by the committees of these companies, and the proposals will shortly be submitted at meetings of the bondholders. While the position in Mexico continues to be difficult, the outlook is stated to be more hopeful.

Oriental Telephone & Electric Co., Ltd.—Final dividends for 1920 3 per cent. on the preference shares, less income tax, making 6 per cent. for the year; 6 per cent. on the ordinary shares, free of income tax, making a total of 10 per cent. for the year, free of tax; a bonus of 2 per cent. on the ordinary shares, free of income tax.

Electric Construction Co., Ltd.—Final dividend at the rate of 7 per cent. on the preference; also at the rate of 9 per cent. per annum on the ordinary shares, making 7½ per cent., also a bonus of 2½ per cent. on the ordinary shares; all subject to tax.

Aster Engineering Co., Ltd.—Available balance £57,165. Depreciation is provided for, 7½ per cent., free of tax, is to be paid on the ordinary shares, and £40,573 is to be carried forward, subject to E.P.D. and corporation tax.

John I. Thornycroft & Co., Ltd.—After paying interim dividends on the cumulative preference and participating preferred ordinary shares, the directors say it is not prudent at present to pay interim dividends on the ordinary shares, owing to the universal financial stringency.

Prospectuses.—*General Electric Co., Ltd.*—The prospectus offering £3,500,000 seven per cent. mortgage debentures at 92½ was to be published yesterday, Thursday.

Metropolitan Electric Supply Co., Ltd.—It is reported that the recent issue was subscribed for more than six times over.

Kalgoorlie Electric Power & Lighting Corporation, Ltd.—The profit for the year ended December, 1920, was £10,708, against £5,452 for 1919. After providing for debenture interest and £9,500 for depreciation, £108 remains to be carried forward. £7,500 debentures were paid off, leaving £7,500 outstanding.

Metallic Seamless Tube Co., Ltd.—The net profit, including balance brought forward is £40,006, less issue of bonus shares £26,000. A dividend f 10 per cent., free of tax, on the ordinary shares is recommended.

Anderston Foundry Co., Ltd.—Final dividend of 15s. per share (making 18s. per share), less tax; £10,000 to reserve fund, carrying forward £11,164.

Stock Exchange Notice.—The Committee has ordered the following to be officially quoted :—

Eastern Telegraph Co.—£1,000,000 ordinary stock.

Rothesay Tramways Co.—After putting £1,000 to reserve, the directors recommend a dividend of 3 per cent. on the ordinary shares, carrying forward £1,609.

Shawinigan Water & Power Co.—Dividend of 1¾ per cent. on the common stock for the quarter ended June, 1920.

STOCKS AND SHARES.

Tuesday Evening.

The dragging-out of the coal crisis is the main influence in the Stock Exchange markets for the time being. It begins to get upon the nerves of investors and speculators alike. Gilt-edged stocks are not quite so firm as they were, and, in the more speculative markets, the fact of trade being in so many cases at a standstill, thus leading to the tying-up of money, prevents any enterprise or initiative being shown in Stock Exchange directions. There was a lively rush for the underwriting of the General Electric 7 per cent. debenture stock, and the original underwriting of 2½ per cent. commission became readily saleable at 1¼ per cent. Indeed, there is more activity in underwriting circles than there is in most of the markets round the Stock Exchange. Cable stocks are amongst the few which show a stout resistance to a heavy tendency. Derby Week is invariably a time of quiet markets, and the present year has maintained this tradition to the full.

Owing to the way in which the value of the £ has declined in relation to that of the dollar, American bonds and stocks have advanced sharply. The Utilities are better with the rest, and any security upon which the coupons are payable in New York as well as in London can count upon a place in rising markets. Canadian General Common have risen to 127½ and the preferred to 111½. Electrical Development of Ontario bonds strengthened to 106½, and Kaministiquia shares reached 100. The bonds of the latter, together with the Rio Firsts, are better at 90½. Shawinigan capital stock is several dollars up at 122½.

Argentine stocks and shares are better, by reason of the unexpectedly good showing made by the report of the Anglo-Argentine Tramways Company. The first preference hardened to 2 11/16, the seconds to 3⅛, and the 5 per cent. debenture stock is better again at 64½. The gross receipts for last year advanced by well over a million pounds sterling, or nearly twice as much as the expenses. The arrears and current dividends on the 5½ per cent. first preference shares were paid during the year 1920, and the directors have decided to pay one year's arrears on the second preference shares, which will bring the payment of arrears up to December 31st, 1916. The manager takes a fairly cautious view with regard to the outlook for the current year, stating his opinion that an increase of traffic cannot be estimated beyond 5 per cent. upon the year 1920. At the present rate of progress, however, it should not be long before the four years' arrears of dividend on the second preference are wiped out, which would bring the chances of a dividend on the ordinary shares into prospect. These figures emphasise the security for the 5 per cent. debenture stock, and the latter still pays 7¾ per cent. on the money.

The various London traction issues have turned back after their somewhat rapid upward progress. Underground Electric Income Bonds gave way 2 points to 76½, and the £10 shares, which had been as high as 2 11/16, reacted to 2⅜, sympathetically reducing Bus "A" shares to 7s. Optimism ran unduly fast in considering prospects of a dividend on the £10 shares, and appreciation of this point no doubt brought in sellers, influenced by the dullish tone which prevailed throughout the markets in the early part of the week. The Government's intervention in the coal crisis is not taken very seriously, but neither masters nor men appear to be at all anxious to get their dispute settled. Districts and Metropolitans have held their prices; London General Omnibus Income debenture stock has risen to 66½. London and Suburban Traction preference gave way to 7s., after being 8s. 6d., and London United Tramways preference at 4s. are also a few pence down from their recent best.

Substantial improvements have occurred in Anglo-American stocks, Globe ordinary and Great Northern Telegraphs. The rise of 50s. in the last-named is due, of course, to the increase in the dividend, to which reference was made here last week. It is said that some of the buying has come from Denmark, which is not improbable, seeing that the company has a considerable following in Copenhagen, where its headquarters are situated. The Eastern group continues in favour, owing to the financial strength of the various companies, added to the fact that the dividends on the ordinary stocks are paid free of tax. In Marconis there is very little going on. All the recent effervescence has escaped from the market, which is now as uninteresting as champagne in a decanter. Indo-Europeans have gained £2 in sympathy with the jump in Great Northerns.

Important and unexpectedly pleasant circulars are issued this week by the Mexican Light and Power, the Mexican Electric Light, the Pachuca Light and Power, and the Mexico Tramways companies, with reference to a plan of reorganisation between the respective companies and the bondholders. These proposals are to be submitted for the approval of bondholders at meetings to be held later. Arrears of interest on the first three named companies' bonds, it is suggested, shall be satisfied by payments of 75 per cent. in cash on the ratification of the agreement, while the remainder will be disbursed by instalments before July, 1923. The Tramways Company arrears are to be dealt with later on, and, meanwhile, regular interest payments will be resumed on its 5 per cent. bonds next September. This is better than even optimism had looked for, but, so far, it has had little quotable effect upon the prices of the bonds, for the simple reason that nobody wants to sell, and prices are therefore practically nominal. Mexican Electric Light Fives have risen to 65½, Mexican Light and Power Fives to 70½, and Pachuca Fives to 64½. After having waited so long for their interest, bondholders will feel exceedingly gratified at the proposed arrangement, for the most hopeful views that have prevailed hitherto were that half the interest would be met in cash and the other half in scrip.

Electric Constructions are sixpence better at 16s. 9d., but Babcock & Wilcox at 2¼, ex dividend, are ⅛ lower on the week. India-Rubber shares have eased off to 16s. 3d., showing a fall of 1s. 3d. Telegraph Constructions are hardening, together with the prices of cable stocks, and are now 20½. Siemens are 23s. 3d. ex 1s. net dividend, and the new shares are about 6d. less, continuing the cheaper of the two. County of London Electric ordinary stiffened to 8, and Metropolitan ordinary to 3½. The Metropolitan Company's debenture stock was largely over-subscribed. Applicants for £10,000 received allotments for £1,000; and those who applied for anything under £400 were given £50. Evidently, however, a certain amount of stagging occurred, for the price opened at 2¾ premium, and lost the fraction later on. Rubber shares are better, on the fact that deliveries of rubber exceeded landings last week, for the first time in six months. Armament and similar shares are still inclined to be dull, in consequence of the deadlock in the coal trade.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend 1919.	Dividend 1920.	Price May 31, 1921.	Rise or fall.	Yield. p.c.
Brompton Ordinary..	12	12	6	—	£10 0 0
Charing Cross Ordinary . ..	7	8	8⅞	—	10 6 8
do. do. do. 4½ Pref...	4½	4½	8	—	7 10 6
Chelsea..	4	6	8¼	—	9 4 8
City of London	18	14	1 3/16	—	11 16 0
do. do. 6 per cent. Pref...	6	6	17/-	—	7 1 2
County of London	8	8	8	+ ¼	10 0 0
do. do. 6 per cent. Pref...	6	6	8⅛	-	7 7 8
Kensington Ordinary	7	9	4⅛	—	10 18 2
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref. ..	8	6	2¾	—	10 18 2
Metropolitan	6	7	8½	+ ⅛	10 0 0
do. 4½ per cent. Pref. ..	4½	4½	2 15/16	—	7 18 2
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	6	7	2⅛	—	9 2 10
South Metropolitan Pref... ..	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	6⅛	—	9 16 2

TELEGRAPHS AND TELEPHONES.

	1918	1919			
Anglo-Am. Tel. Pref.	8	6	81½	+8	7 7 8
do. Def...	83/6	1½	17½	+1⅜	8 11 8
Chile Telephone	8	6	5¼	—	5 6 8
Cuba Sub. Ord.	7	7	7½	—	9 6 8
Eastern Extension	10	10	16⅜	—	8 2 2
Eastern Tel. Ord.	8	10	166½	+3	6 0 4
Globe Tel. and T. Ord.	8	10	16⅜	+ ¼	8 0 4
do. do. Pref.	6	8	9¼	—	6 9 9
Great Northern Tel.	22	22	26½	+2½	9 1 2
Indo-European	18	10	84	+2	7 7 1
Marconi	25	26	2⅛	+ ⅛	—
Oriental Telephone Ord.	10	12	2 13/16	—	*5 13 0
United R. Plate Tel.	8	8	6⅛	—	6 10 8
West India and Panama	1/3	Nil	9/16	—	Nil.
Western Telegraph..	8	10	16⅞	+ ⅛	*6 18 6

HOME RAILS.

	1919	1920			
Central London Ord. Assented ..	4	4	45½	—	8 15 10
Metropolitan	1½	1½	26½	—	5 17 8
do. District	Nil	Nil	19	—	Nil
Underground Electric Ordinary ..	Nil	Nil	2⅜	— ¼	Nil
do. do. "A" ..	Nil	Nil	7/-	- 1/-	Nil
do. do. Income ..	4	2	76½	—2	2 12 4

FOREIGN TRAMS, &c.

	1918	1919			
Anglo-Arg. Trams, First Pref. ..	Nil	5½	2 11/16	+ 1/16	8 3 6
do. do. 2nd Pref. ..	Nil	Nil	8⅛	+ ⅛	8 16 0
do. do. 6 % Deb. ..	5	5	64½	+1	7 16 0
Brazil Tractions	Nil	Nil	36	—	Nil
British Columbia Elec. Rly. Pfce.	5	6	56	+1	8 18 6
do. do. Preferred	2½	6	68½	—	*8 15 0
do. do. Deferred	Nil	8	51½	—	*11 17 6
do. do. Deb. ..	4½	4½	69½	—	7 2 10
Mexico Trams 5 per cent. Bonds..	Nil	Nil	42	—	Nil
do. 6 per cent. Bonds..	Nil	Nil	23½	—	Nil
Mexican Light Common	Nil	Nil	11½	—	Nil
do. Pref.	Nil	Nil	17½	—	Nil
do. 1st Bonds	Nil	Nil	70½	—1½	Nil

MANUFACTURING COMPANIES.

Babcock & Wilcox	15	15	2¼xd	— ⅛	7 2 3
British Aluminium Ord.	10	10	16/3	—	12 8 2
British Insulated Ord.	12½	15	1 3/16	—	9 12 0
Callenders	25	15	1½	—	10 0 0
" 6½ Pref.	6½	6½	17/6	—	7 8 7
Crompton Ord.	10	10	16/3	—	12 6 2
Edison-Swan	10	10	11/3	—	—
do. do. 5 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	16/9	+6d.	11 18 10
English Electric	—	8	12/-	—	13 6 8
Do. Pref.	—	6	14/6	—	8 5 6
Gen. Elec. Pref.	6½	6½	17/6	—	7 8 7
do. Ord.	10	10	22/-	—	*9 1 10
Henley	25	15	1 7/16	—	10 8 8
do. 4½ Pref.	4½	4½	8¼	—	6 18 6
India-Rubber	10	10	13/16	— 1/16	—
Met.-Vickers Pref.	—	8	1 13/16	—	8 16 10
Siemens Ord.	10	10	23/3xd	—	*8 12 0
Telegraph Con.	20	20	20½	+ ¼	*6 17 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, May 31st.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Oxalic	per lb.	10d.	..
a	Ammoniac Sal	per ton	£76	..
a	Ammonia, Muriate (large crystal)	"	£65	..
a	Bisulphide of Carbon	"	..	..
a	Borax	"	£34	..
a	Copper Sulphate	"	£38	..
a	Potash, Chlorate	per lb.	7d.	1d. inc.
a	" Perchlorate	"	8d.	..
a	Shellac	per cwt.	£20 10s.	20/- inc.
a	Sulphur, Sublimed Flowers ..	"	£18	£1 dec.
a	" Lump	"	£16	£2 dec.
a	Soda, Chlorate	per lb.	5d.	..
a	" Crystals	per ton	£7	..
a	Sodium Bichromate, casks ..	per lb.	9½d.	1½d. inc.
	METALS, &c.			
p	Babbitt's Metal Ingots	per ton	£95 to £300	..
c	Brass (rolled metal 2" to 12" basis)	per lb.	11⅛d.	¾d. inc.
c	" Tubes (solid drawn) ..	"	1/1¾ to 1/2	..
c	" Wire, basis	"	11⅞d.	¾d. inc.
c	Copper Tubes (solid drawn) ..	"	1/8¾	..
c	" Bars (best selected) ..	per ton	£116	£2 inc.
c	" Sheet	"	£116	£2 inc.
c	" Rod	"	£116	£2 inc.
d	" (Electrolytic) Bars ..	"	£77	£4 inc.
d	" " Sheets ..	"	£145	..
d	" " Wire Rods..	"	£93	£4 inc.
d	" " H.C. Wire..	per lb.	11⅜	7/16d. inc.
f	Ebonite Rod	"	3/6	..
f	" Sheet..	"	3/-	..
n	German Silver Wire	"	2/9	..
h	Gutta-percha, fine	"	14/- to 16/-	..
h	India-rubber, Para fine	"	10¾d.	¼d. inc.
j	Iron Pig (Cleveland Warrants) ..	per ton	Nom.	..
j	" Wire, galv. No. 8, P.O. qual.	"	£40	..
g	Lead, English Pig	"	£23 15s.	25/- dec.
g	Mercury	per bot.	£11 5 to £11 10	..
e	Mica (in original cases) small ..	per lb.	4d. to 4/-	..
e	" " " medium ..	"	5/- to 10/-	..
e	" " " large ..	"	12/6 to 25/- & up	..
p	Phosphor Bronze, plain castings..	"	1/4 to 1/9	..
p	" " rolled bars and rods	"	2/1 to 2/6	..
p	" " rolled strip & sheet	"	2/2 to 2/7	..
d	Silicium Bronze Wire	per lb.	1/4	½d. inc.
r	Steel, Magnet, in bars	"	1/8	..
n	Tin, Block (English)	per ton	£174	£1 dec.
n	" Wire, Nos. 1 to 16	per lb.	4/-	..
p	White Anti-friction Metals ..	per ton	£78 to £300	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
j Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
p ————
r W. F. Dennis & Co.

Belgian Pension Funds.—The directors of the Belgian investment company having the title of the Société Générale Belge d'Entreprises Electriques, in the course of their report for the past year, mention that independently of a share in the profits which they have granted to the *personnel*, they have provided for an allocation of 50,000 fr. in view of the organisation of a provident fund in favour of the staff. For this purpose they have come to terms with the Caisse Nationale de Retraite et d'Assurance to ensure to the company's *personnel* at the age of 65 years a retiring pension which can amount to three-fourths of the final salary. In the event of death a life annuity of 40 per cent. of this salary will be paid to the widow or to orphans who have not reached their majority. The Société Financière des Transports et d'Entreprises Industrielles, which is a second Belgium investment company, has followed on similar lines. The directors state that they have decided to allot to the *personnel* every year an amount corresponding to the dividend on 3,000 shares, two-thirds of the amount representing a participation in the profits and the remainder serving for feeding a pension fund. It will be possible for the *personnel* to increase their pension funds by voluntary payments, to which the company will every time add a premium of 10 per cent. A first endowment of 50,000 fr. corresponding to the dividend for 1919 has been placed to the pension fund during the past year. This sum has been put to the debit of the profit and loss account, as well as the allocations for 1920 of 120,000 fr., as the share in the profits, and of 60,000 fr. for the pension fund. In making these arrangements, which have been under investigation for a long time past, the directors remark that they have desired more directly to associate the staff with the financial results obtained by the company on the one hand, and on the other to constitute in their favour a pension fund which will remove the anxieties which they could experience when thinking of the time when age would prevent them from working, or of the eventuality of a premature end, leaving their families in pecuniary difficulties.

ELECTRICITY SUPPLY TARIFFS.

(*Concluded from page* 697.)

The first paper that was discussed at the Institution of Electrical Engineers on April 26th was abstracted in our last issue. Mr. Beauchamp's paper is abstracted below:—

Multi-part Tariffs for Domestic Electricity Supply.

By J. W. BEAUCHAMP (*Abstract*).

The object of this brief paper is to draw attention to the urgent necessity of accepting the principle of multi-part charging for electricity supply; to show that flat rates, and minimum charges based upon them, have outlived their usefulness, and that the progress of electricity supply has left behind the conditions which gave rise to certain features of early electricity legislation, and so rendered them out-of-date and obstructive to progress.

It is generally accepted that the multi-part tariff in some form is the most promising and equitable, and its progress has been delayed perhaps by too strong a desire to fix upon a correct or uniform tariff, rather than acceptance of the underlying principle and determination to put it into use and allow experience to dictate the details most suitable for each district. Furthermore, there has perhaps been too much tendency to consider proposed tariffs in relation to individual consumers, rather than in relation to groups of them.

The multi-part tariff and its calculation divides itself into two sections, one concerning the running rate or rates per unit for the energy supplied, which is not difficult to determine, the other concerning the fixed charges. The latter present greater difficulties, because they must bear some relation to standing costs incurred now, and to be incurred later as a result of the new tariff and the extra business it will bring; in addition, they must bear a relation to something tangible and easily understood by the consumer in order that he may feel their equity.

Development will entail extension and must be able to pay for it, and it is for this reason that new tariffs should be designed to take care of the standing costs so that the unit charge may be kept low, resulting in a distinctly dropping average cost as the load factor increases. Many tariffs have failed in their object because, whilst sound perhaps in principle, they did not in practice offer progressive encouragement to the steady introduction of more and more consuming devices. The home supply tariff may start with quite a high rate for normal lighting, and may secure a fair price for small additional use in fans, kettles, &c., but should continue to decrease through the consumption in cookers, fires, &c., ending in a minimum value which would apply to storage heaters or other 100 per cent. load-factor uses.

Most of the two-part tariffs in use constitute a minimum charge, the annual or quarterly amount being payable irrespective of the number of units used. In some systems the fixed charge covers a certain number of units, and is so far an agreed minimum payment; in others the fixed charge covers no supply but only readiness to supply, or service.

This form is the best and should be developed, because the charge is not made for any particular supply, but rather for maintaining the connection, so disputes cannot arise as use is restricted. On the other hand, the knowledge that every unit is supplied at one or more low rates and that the meter records only these cheap units encourages use and reduces anxiety about waste. This is as it should be, because the increasing use of the supply and particularly the employment of apparatus always in circuit soon causes the average cost of the unit to approach the running rate.

The best method of bringing home the soundness and advantages of the multi-part tariff lies in putting it forward as an alternative to a very high flat rate, and it will be necessary either: To secure the right to associate such tariffs with much higher statutory maximum rates than now possible; or to introduce the new systems by means of very active propaganda, and support them by hiring out many of the appliances which the consumers will need if they are to take the fullest advantage of such tariffs.

A request was made that the Electricity Commissioners should have the power to make such tariffs compulsory in any district or part of a district where the suppliers desired it, and could show good reason for its adoption; or failing this that where the suppliers were willing to charge on such a system their action should be supported by permission to impose an alternative flat rate much higher than would otherwise have been allowed.

Suggested Skeleton Domestic Tariff.

Fixed Charge per Annum.—On capacity of apparatus in use or usable (divided quarterly into equal p[illegible] or otherwise).

1. *Lighting.*—Up to and including 250 watts, £x per annum. Above 250 watts, per complete 50 watts, £$x/10$ per annum.

(Intermittent lighting can be excluded, or a percentage only of installed lighting taken into account.)

2. *Heating and Power.*—Small appliances (say, up to 600 watts each, with an aggregate limit of 2,000 watts) having a very high "group" diversity in time and extent of use. No fixed charge.

3. *Heating and Power.*—Appliances as (2), above 600 watts each and 2,000 watts aggregate. Ranges, fires, water heaters, &c. At the rate of 250 watts for £$x/20$ per annum in steps of 250 watts.

Running Charge per Unit.—A flat rate for all purposes.

Under such a system as outlined above, the average cost of energy would decrease upon the addition of extra appliances.

The introduction of electricity supply into the new housing colonies affords a good opportunity for experiment with multi-part tariffs on account of the standardised character of the houses and the probable similarity of habits amongst those who will occupy them. The best method is to impose a fixed charge and provide for all supply to be recorded by one meter for each consumer and charged at a simple flat rate for all purposes.

The lighting business in connection with such property should be regarded rather as a means than an end, and the tariff and metering systems should permit of that progressive electrification of the houses from which so substantial a return is promised. For the same reasons, special treatment of such installations with regard to pressure of supply is to be deprecated, as the smallest house occupied by a family would consume not less than 1,000 kWh per annum, and should take a great deal more.

Every encouragement should be given to devices of the heat-storage class. There will no doubt be a field for small geysers, and the difficulties arising from this class of apparatus are only relative; where distribution mains are heavy they may not be so unwelcome, and the use of very large numbers would produce a valuable load owing to diversity in use, but the heavy cost of internal wiring must also be against them from the consumer's point of view.

To allow of developing the domestic load, mains must be provided on a generous scale and can only become remunerative when the load is obtained. Under present circumstances it is not easy to obtain money for such works which, although practically imperishable, may yet be a source of loss for a considerable time. As against this it must be remembered that the cost of a mains network does not rise at the same rate as the energy-delivering capacity provided; particularly is this the case where road work is expensive.

One undertaking in the Midlands with a very high output per head of population, low average price, and good financial results, reports:—

"The use of multi-part tariffs has greatly increased the demand for supply and for apparatus; very few complaints have been received, and although the accounts of this group of consumers have increased considerably they are the most satisfied of all the consumers. . . .

"The multi-part tariff has helped the business in small appliances by cutting out the cost of special wiring and plugs. At the present high lighting rates people hesitate to use irons, &c., on lamp circuits, and object to the cost of separate circuits for small apparatus. The multi-part tariff has overcome this difficulty. Tariffs of this class have come to stay."

Discussion.

The President said that Mr. Blaikie's paper covered very wide ground from Hopkinson's original paper to the modern idea. Upon first reading through the paper, he (the president) was inclined to disagree with many points as impossible of attainment; later, however, he came to believe that Mr. Blaikie's broad conclusions seemed to provide a solution of the tariff problem. Mr. Beauchamp's paper gave some data of great value in view of the large number of houses now being erected. There *was* a proper system of charging, and it remained for engineers to find that way and bring it forward, even if it meant special legislation.

Mr. Arthur Wright said that as a supplement to Messrs. Blaikie's and Beauchamp's very opportune and suggestive papers, he would like to mention some conclusions he had arrived at during the 20 years that had elapsed since he read his paper on "The Profitable Supply of Electricity." The following modifications and additions might be made to the original Hopkinson proposals: (*a*) As it was impossible to obtain by measurement the true demand on the supply authority of the numerous and ever-increasing small electric appliances and occasionally-used lamps in dwelling houses, it was necessary to adopt some demand charge based on the number of installed lamps in the living rooms or these rooms' cubic capacity, thus leaving out all the rest of the consuming devices whose combined load factor and time-incidence of their use were, in all probability, such as to entitle their owners to the lower rates given to small power users. (*b*) All consumers were entitled to a sliding scale of rebates based on their total annual consumption. (*c*) An adequate monthly service charge should be imposed instead of meter rentals or minimum number of units chargeable. (*d*) A power factor clause should be insisted upon for all alternating industrial supply based on the monthly maximum kVA demanded, and not on the average power factor during the month. At present there appeared to be two distinct methods of designing tariffs. First, those based on what the market could bear, and secondly, those based on a reasonable profit on the approximate cost of individual supply. While the first had the advantage of following ordinary commercial practice, and were easy of application, he thought the second had a much greater chance of extending the profitable use of electricity and of meeting with the support of the governing commissions, because of their greater equity. Industries dealing with more than one town, to be really efficient, must be carried on by private enterprise and rewarded by a substantial return on the actual investment. He was convinced that salesmanship and exhibits had much more effect in getting business than had simplicity or lowness of tariffs. The complexity of the rates in America had not prevented electrical development. The heavy cost of wiring and appliances to-day required skilled salesmen to obtain orders for a supply, and the public who could never hope to understand the necessity of differential rates had now the Electricity Commissioners to look to for fair treatment. Unless he had misunderstood Mr. Blaikie, the latter seemed to think that the present day fixed costs bore a smaller proportion to the total costs than they did in pre-war days. This was such a vital point in Hopkinson's analysis that he thought it well to point out that in dealing with future costs it was probable that the high rates of standing and running charges in all the usual 20 per cent. load factor business would be likely to continue, because of the increase in the cost of money, equipment, taxation, skilled labour, and the now ascertained large amount of coal used for standing by ready to serve. Running coal and rough labour were more likely to become cheaper in the near future than the above standing cost items. The increased use of the present investment was so vital and helped so much to lower total charges that Mr. Wright thought some sort of rebate on an individual's increased yearly consumption was a tariff clause worth considering, and that a stepped discount on quantity was the proper method of lowering the present high charges when times justified some reduction. The real test of a tariff's soundness was the resulting increase of the profitable part of the business. Office and shop window lighting would always be unprofitable, even at present high rates, and should be looked upon as a price for the franchise or as a necessary tax only to be taken on for reasons of policy. With regard to Mr. Beauchamp's strong advocacy of an adequate service charge, the speaker thought it should be known that at least ten Public Service Commissions in the United States had admitted the equity and commercial necessity for such a charge. While on the subject of changes that required the assent of the authorities, he considered it would be advisable to obtain some relaxation of the pressure regulations, which were evolved during the carbon lamp and cheap equipment times, and which entailed needlessly expensive mains and regulators, owing to the fact that tungsten lamps were almost self-regulating.

Mr. H. W. Couzens considered that any tariff which appeared within reason would satisfy considerate consumers. Not only were special rates required for cooking apparatus, there was a necessity for consultation between manufacturers, traders, and station engineers so that the appliances should be improved to a great extent. Referring to a fixed charge, he gave one or two instances where this appeared exorbitant, although it was really a just charge. It was difficult to explain the fixed charge to the consumer. In connection with the development of the cooking load, Mr. Couzens said that the Brompton & Kensington Co. now had about 500 cookers connected to its mains, representing a load of about 2,000 kW. The actual increase in the company's peak load, due to these cookers, amounted to about 250 kW. The speaker said that often charges were based on the kilowatt-capacity of the apparatus installed, and cited a case where the annual charge was £30 per kW with a flat rate of 2d. per unit. He thought the mains problem was not so difficult as it appeared, especially where alternating current was used.

Mr. P. D. Tuckett said that Mr. Beauchamp's paper indicated the most hopeful way out of the difficulties of the smaller undertakings. At present thousands of consumers were being supplied at a loss, and thousands at a price higher than they wished to charge them. With a contract tariff on a sound basis, the supply undertaking would make an adequate fixed charge and a small unit charge. To aim at a scientifically correct tariff was hopeless. The best course was to induce the Government to allow a high maximum rate, with an alternative multipart tariff. The expenditure of new capital involved a much higher charge per kilowatt than was formerly the case, and in increasing the fixed charge this should be kept in mind. If the multipart tariff was to be successful, the accessory uses of electricity must be developed. Were they satisfied that the heating load was really better than the lighting load? It came on the peak and in the winter season.

Mr. F. W. Purse was inclined to differ from Mr. Beauchamp. Consumers were apt to compare their bills and to make trouble. A simple tariff was essential. Manufacturers ought to make heating and cooking apparatus of greater reliability. Even with a multipart tariff and a single meter, a single circuit could not be used for all purposes; the lighting circuit should be separate from the heating and power circuit throughout. Further, owing to the wide range of load, a single meter was not satisfactory, as light loads would not be accurately recorded. The cost of mains to provide for increased consumption was a serious obstacle to development. Lighting was cheap at 8d. or even 1s. per kW-h, and the peak load must bear a higher charge. Power was far preferable to heating as a load.

Mr. E. W. Cowan dealt with fundamental principles, distinguishing between cost of service on the one hand and value of service on the other. For many years people had dealt only with the former aspect of the question, ignoring the latter, but that attitude of mind was not now so prevalent. The electrical industry was endeavouring to adapt prices to market conditions. Dr. Hopkinson never confined his attention to the cost of service, which in any individual case could only be approximately estimated, and should only be used as a guiding influence, not as the determining factor. Both aspects should be taken into account. Mr. Blaikie's proposal was open to the charge of profiteering; no group or class should be charged at a low rate at the expense of another, nor should consumers be taxed for the benefit of non-consumers. All businesses must necessarily include items which appeared to show a loss, and price-making could not be treated as an exact science.

Mr. Minton said Mr. Blaikie's 6-day group could be called the one-meter group, and the 7-day group the hundred-meter group. With regard to bulk supply, a meter accuracy clause should appear in the agreement—it was a very important matter when dealing with energy in large blocks.

At the resumed discussion on May 5th, Mr. J. R. Blaikie said that in accordance with the desire expressed by Mr. Wright, he would display two charts. One showed the relationship existing between the number of units generated and the number of tons of coal consumed; this showed a serious increase for the years 1917 and 1918, and this was, in a great measure, attributable to the seven-day group. The other showed the reconstitution of coal bills, and proved that the figures obtained came very near to the actual figures.

Mr. Beauchamp, showing some diagrams prepared by Lieut.-Col. W. A. Vignoles, said that the experience gained at Grimsby proved the unit of electricity to be an unsatisfactory basis of charging for lighting. As stated previously, the first chart showed that until a consumer took 100 units he was unremunerative, and 9 per cent. of the Grimsby consumers did not use 100 units. The second diagram showed the cost per unit in relation to the maximum demand. This brought out the impossibility of fixing a flat rate fair to all classes of consumers.

Mr. A. N. Rye said he was pleased with Mr. Beauchamp's paper. His company had adopted a two-part tariff, and it soon became so popular that it represented 50 per cent. of their revenue. The two-part tariff, however, was now dying out, probably because of the insufficiency of maximum charges. The company had had to force up minimum charges by 100 per cent., which penalised the smaller consumers. The improved efficiency of lighting had caused a large falling off in load. Mr. Rye mentioned that 12 cases, which in 1905 required 10,000 units, had only taken 5,000 units in 1920. In spite of the doubled prices the revenue was, therefore, practically the same.

Mr. W. A. Gillott said that only by close attention to characteristics of the load on particular systems could a satisfactory tariff be arranged. A tariff, to succeed, must be competitive and easy to understand. In Newcastle many systems of charging had been devised, and this enabled the suppliers to differentiate to a large extent between different classes of consumers. It was best to make a fixed charge having some relation to the actual consumption of the consumer; any fixed charge should be such that a consumer could understand its connection with his own installation. This fixed charge would be dependent on local conditions. Mr. Beauchamp had suggested a separate fixed charge for lighting and for each appliance. The speaker did not agree with this, as the general diversity factor permitted an average fixed charge to be made reasonably. Mr. Gillott said that it had been observed in Newcastle, where there was a very heavy cooking load, that this just filled up the valleys in the load curve which occurred when the works shut down during the dinner hour. In conclusion, he would state that there was no doubt that the domestic load was *the* load of the future.

Mr. W. R. Cooper considered that the provision of electricity for water heating should be made as a matter of expediency, not of revenue, as this would be a great advertisement for electricity. This could be done on a two-part tariff if the running charge was low enough. He did not feel convinced by Mr. Beauchamp's paper. Tariffs should be sound and not merely convenient. The principles propounded by Hopkinson were still sound, although necessary adjustments due to progress would have to be made from time to time. Mr. Blaikie would favour the six-day consumer, but surely he used just as much station plant, although, no doubt, there would be a saving on his mains. No provision was made for a six-day consumer running two shifts. The seven-day loads were generally very desirable ones, including, as they did, tramways, public lighting, cooking, &c. The speaker criticised Mr. Blaikie's use of simultaneous equations in the allocation of coal and fixed charges. He pointed out that to give satisfactory results the x and y would have to remain the same from year to year. Mr. Cooper showed slides giving the Klingenberg daily characteristics of a power station with one and more sets running. In the curves thousands of pounds of coal were plotted against hundreds of kW-hours produced.

Mr. J. R. Dick said that the fixing of tariffs was a question of costs, and the problem of charging for electricity had its analogies in many other industries. It used to be considered adequate to call fixed charges the same as capital charges. But fixed charges contained so many different items. Under the old systems of works costing it was considered sufficient to take overhead charges and add them as a percentage to the prime cost. It had been found necessary, however, to split these up according to the various jobs. One job might require the running of a heavy machine for a short time and another a lighter machine for a longer time. Then there were indirect labour, rent, rates, and taxes to be taken into account. He considered Mr. Blaikie's six and seven-day principle quite sound, although the accuracy of the simultaneous-equation method might be doubted. He praised the apportionment of charges adopted. The speaker pointed out that the cost of labour, coal, &c., was a function of the currency, and when this became normal prices would reach their proper level. Mr. Beauchamp was conscious of the danger of a suddenly increased lighting load rendering the fixed charges inadequate. The existing cables would no doubt be able to carry all that was required of them for the present, but in the event of an increase due to a popular tariff many additions would have to be made to the networks. He suggested that the constant current-density principle should be applied in certain cases instead of the constant-pressure system. The obtuseness of consumers in failing to understand the method of charging was often quite wilful.

Mr. W. L. Madgen, speaking from the commercial point of view, said that in some districts the number of possible consumers had been connected, and therefore the number of outside people who could be induced to take electricity was small. The introduction of a satisfactory differential tariff would no doubt cause the existing consumers to increase their load. The Electricity Commissioners had been asked to insert a clause permitting two-part charges in the No. 2 Electricity (Supply) Bill which was now pending, and which he (Mr. Madgen) hoped would continue to "pend." There was a tendency on the part of mains engineers to connect up any sort of consumer—large or small—indiscriminately, and many of these were unremunerative. Lighting consumption had been severely reduced by the daylight saving scheme, early closing, and the growing efficiency of the electric lamp. He had been assured that German and Austrian scientists had been working very hard during the war, and that a ¼-watt lamp was on the horizon. Before that happened they must have a two-part tariff system.

Mr. J. C. Elvy remarked upon the fact that meter manufacturers had been silent in the discussion. The condition of meters was a vital factor in the collection of revenue. A meter that was fast or slow would result in a loss to either the consumer or the supply undertaking. He spoke of an undertaking where half a dozen or more different rates were in force, each requiring a separate meter, and he wondered if the cost of maintenance was worth it. To permit lower charges the cost of installation would have to be lowered.

Mr. H. M. Sayers objected to classing traction supply with that of seven-day consumers. He noticed that Mr. Blaikie had given a curiously high coal consumption for the no-load period; his own investigations had produced a result which was materially different from that obtained by the author. The method of using simultaneous equations had not been fully explained in the paper, and, therefore, it could not be properly criticised. He asked Mr. Beauchamp if it was any good discussing the value of various tariffs when a tariff could only be enforced by means of a monopoly, which was not a desirable procedure. It was not possible to obtain even a regulated monopoly neither was it possible to evolve any suitable tariff if it was not based on costs. The domestic tariff problem was a difficult one, but there were other difficulties such as those of the costs of apparatus and installation. They should follow the example set by the gas companies and make the charges for rental of apparatus take the place of the fixed charges.

Mr. W. B. Woodhouse explained that they sold only one article, but they were obliged to stock electricity for all purposes and, therefore, they should be allowed to charge for doing so. Alternatively they should be given some sort of relief; either they should be able to refuse to supply unprofitable customers, or charge them. In some areas served by small stations even a charge of 2s. per unit would not pay, a fact which had to be faced. They must divide their customers into classes, and be prepared to vary the profit they were to realise from each class. Unless they could find the capital required for development the expansion of the domestic supply, which they were all discussing, would not take place.

Mr. W. R. L. Phillips thought that the principle advocated in Mr. Blaikie's paper was sound; it was not a matter of dividing into six or seven-day consumers, but of some form of grouping, and that should be encouraged. It was evident that current tariffs were quite out of date, and the sooner that subject was settled the better.

Mr. Ritter was also of the opinion that all evidence pointed to the present tariffs being quite unsuitable. He thought that there must be something wrong with the figures in Mr. Blaikie's revenue sheet for 1915-16.

The President (Mr. Ll. B. Atkinson) pointed out that the discussion had shown a more or less general desire for some form of two-part tariff; the question, however, was: How were they to enforce it? When the matter was brought before the Electricity Commissioners they were received with courtesy and fair words, but unfortunately nothing further was done. He, nevertheless, was quite sure that the Commissioners realised the position they were in just as well as they did, but they were bound by circumstances, political ones, over which they had no control.

Mr. J. R. Blaikie, in briefly replying to the discussion, referred to the criticism of his use of simultaneous equations, and reminded the meeting that he had dealt with that matter very cautiously in his paper.

Mr. J. W. Beauchamp, also in reply, said there was no reason why a number of supply undertakings should not put multi-part tariffs into use immediately. Several such tariffs already existed, but had been allowed to languish as a result of the price increases introduced. It was not reasonable to suggest that they should sell energy at a price less than the highest they could get from the buyer. The real problem, however, was the distribution system. If the development of the domestic load came about to the extent that they expected they would have to deal with some gigantic distribution networks.

JOINT ELECTRICITY AUTHORITIES.

The West Riding Inquiry.

(*Continued from page* 699.)

Continuing the examination of Mr. Arthur Collins, city treasurer of Birmingham, as a financial expert, on behalf of the Leeds scheme, Sir Harry Haward suggested that in order to obtain a proper view of the position of the Joint Authority, with which the Commission was primarily concerned rather than with the existing stations, the financial tables ought to be split up, differentiating the figures as to the new Joint Authority from the general figures. The tables were on a paper scheme and not in correspondence with actual facts which would result from the Leeds scheme, which showed that in 1925 the working costs of the new capital station would be 0.625d., and the capital charge would be 0.525d. The cost of supplying energy from the new station of the Joint Authority would be 1.19d., and Leeds Corporation supplying from its own undertaking, stated in column D of the table, would have working expenses of 0.768d.—Witness suggested that the average figure must be taken. Sir Harry said he was taking the existing station. Taking it at 0.727d., that included, he presumed, the new station at Leeds, and the capital charges would be 0.692d., giving a total of 1.419d. for Leeds. Was not that the proper comparison?—Witness agreed, taking that test; taking an average price from the new station, plus the local charges on existing stations, he thought it would be dangerous to take that figure, because it assumed that the price at which Leeds would get energy from the Joint Authority would be an average price, whereas it would depend on the kW taken, and that might not be an average price. On the whole, he had concluded it would be safer to take the average throughout. Until they knew the demand it was difficult to take the table figures as an average price. He agreed with Sir Harry that the question of price to be charged had not actually been raised, but it was a material point. Leeds, he continued, took the view, in the matter of capital outlay, that this was exactly the type of case in which the Commissioners might be asked to exercise their power to recommend the Ministry to finance this scheme in its early stages. Whereas promoters of electricity schemes generally started out with the idea that Joint Authorities should buy out the undertakings in their areas, the conclusion had now been come to generally that there were certain limits beyond which it was dangerous to go. Very old stations, likely soon to be discarded, should not be saddled on the new authorities. Where the authority could sell energy to an old undertaking at such a price that the old undertaking could not compete with it, the old local undertaking should remain at the cost of the local area. The temptation would be open to owners of the old plant to change from generators to distributors if they had bulk supply at an equal charge. It was difficult to draw a line as to which stations should be taken over, particularly where stations had to be kept as a stand-by for the common good. He expressed no technical opinion, but the Joint Authority would be well advised financially to keep clear of purchasing an undertaking which was working efficiently under existing powers, at any rate until it was thoroughly well established. The Yorkshire Power Co. covered an area beyond the Aire and Calder district, and if the company were to be bought out in respect of the part within the district there would be a substantial claim for severance which would involve heavy capital on which there would be no direct benefit. In the course of less than 42 years it was possible, as was being shown by London companies, for the company so to readjust its conditions as materially to reduce the amount of severance claim. The delay would make it possible for the company to work out the money involved in the undertaking. He did not think the Conference scheme, depending so greatly on acquisition of the company, could be carried out except by Act of Parliament.

The Chairman: Or by agreement.—Quite; but I should not expect the company would be willing sellers except at a price which it would not pay the Joint Authority to give.

Witness then went on to explain the capital involved in the Leeds scheme, and remarked that one had to consider how that capital was to be provided having regard to the many local requirements of the various local authorities claiming the use of their available capital. Even if the Bill passed, he was afraid there would be difficulty in measuring the credit of the prospective Joint Authority. It was more difficult to raise capital in the money market for a body comprising various authorities than for a body comprising a primary authority. The prospectus could do little more than intimate a rosy future and rather intangible assets. Probably it would get the money, but it would be at a price which would defeat the object of the cheapest possible electrical supply. His own experience indicated that the money market would favour a combination of local authorities and companies rather than of local authorities alone, the view being that companies were accustomed to the market, and that would bring the prospectus to the notice of a wider sphere of investors. Joint Authorities would be well advised to keep out of the money market at present. The second course would be for local authorities to secure the money amongst themselves, but when faced with shortage for their own various local purposes there would not be marked enthusiasm to provide their local quotas, and the burden in the main would probably fall on the five bigger towns. They might be sufficiently public-spirited to find the money, but when they had got their original flotation, the second and third calls might lead to unfortunate consequences in one or two bigger towns having to find the money alone at the finish. With regard to repayment of the advance suggested in clause 48 of the Leeds scheme, witness asked for the insertion of the words "within such periods as are ordinarily regarded for repayments of loans for the various purposes of an electricity undertaking." He asked the Commissioners to consider making this advance exactly in the manner of advances by the Public Works Loan Commissioners. The worst stile in the Leeds scheme was the provision of the first instalment, after which there would be tangible assets.

Leeds had taken the only logical course. The basis on which electricity could be supplied to any authority in the area depended on natural advantages at the point of production as much as on anything, and with a number of sites available the claims of the Power Co. must be considered. Local authorities were more deeply concerned in distribution than in generation, and if the Power Co. would supply in bulk and provide the capital itself, the local authorities would be well advised to take electricity from it unless they had such natural advantages themselves that they could produce more cheaply, which was not so in this case. The Leeds scheme was the best possible compromise.

Mr. Miller, cross-examining Mr. Collins, drew witness's attention to figures showing, as against Mr. Collins's contentions as to comparative coal costs between Leeds and Bradford, that in the years 1917-18-19, the Bradford costs were less than those of Leeds. With regard to finance, witness agreed that if the local authorities could get over the difficulty of having to pledge the rates as security they might be in a better position in the money market, but the companies, in issuing a prospectus, could say: "We have a running station and its revenues," whereas the Joint Authority would have nothing but a station in embryo, unless it offered its rates as security. He was afraid some of the smaller authorities in the Conference scheme would not stand the test. He agreed that the electrical prospects of the area were excellent for a flotation—probably second only to London—but in any district where there was a vigorous gas undertaking there was a limit beyond which the price of electricity could not go, whatever the need, and it had to be remembered that the cost of building a new station now was three times the pre-war cost, and the interest on capital was twice that of pre-war times, so that the annual cost of the new station would be about six times that of pre-war.

In answer to Mr. J. A. Greene (for the West Riding County Councils' Association, comprising 81 urban districts and 13 rural districts not members of the Conference), witness saw no justification for the rates of those districts being pledged as security for any part of the proposed undertaking. He agreed that these councils were justified in being distributors but not generators. The present was a bad time to spend capital, and postponement might be advisable. As to co-ordination without buying out the company, at one time Leeds had contemplated interlinking without the capital station, but the prospective demands indicated the coming need for such a station. A linking-up scheme would require more capital at present than the Leeds scheme, and linking-up would not serve very long or lead to much conservation of capital expenditure. He admitted that linking-up had much to commend it even now, and that councils would be more disposed to raise money for something of their own and linking-up than for either the Leeds or Conference scheme. Nobody could estimate with certainty the future demand, owing to the state of general commerce, but as things stood he favoured the Leeds scheme as being the most conservative estimate. In response to pressure by Sir Harry Haward as to the absence of provision for even a temporary deficiency in funds in the Leeds scheme, witness said such deficiency was meant to be carried forward until the time when growing business would pay it off. If the scheme failed to survive the test of avoiding rate aid from anybody, the Leeds Corporation would be well advised to drop it. They had not been asked to consider providing a clause under which a deficit might be a call upon the revenues of undertakings taking electricity, but personally he saw no objection to it provided that the price paid for the energy was not so hopeless as to make the thing provocative. The idea was that the deficiency, if any, should be capitalised for the time being and covered by the Ministry's advance.

Sir Harry said he did not consider that clause covered the point.—Mr. Collins, in answer to further questions, did not think Leeds would be prepared to proceed with its scheme on so low an advance as five years' period. As to the ability of the authorities to borrow the several millions involved, the secret of the whole thing was how far they would pledge their rates. Private enterprise alone might not get the money at less than 7½ per cent., private enterprise supported by local authorities without pledging rates at 6½ per cent., and if the rates were pledged the money might be obtained so low as 5½ per cent.

Mr. Wooll intimated that his case for Leeds was closed.

The Conference Case.

Shortly before the adjournment Mr. A. T. Miller, K.C., opened the case for the Bradford Conference scheme, which was resumed on Saturday morning. Mr. Miller said he recognised, as Mr. Wooll had mentioned, that agreement was really an essential of any proper and satisfactory future development in the area, but he by no means started with any feeling that agreement was not to be hoped for in favour of the most business-like and most profitable scheme for the district. Looking broadly at the present position in the West Riding, it was a problem differing essentially from those which had had to be solved in West Lancashire and North Wales and Chester. In all the cases the existence of a power company had had to be faced, and in the West Riding there was a large development of local-authority production of electricity. There were eight distinct methods of supply in the district at present, all intermixed and all within the Power Co.'s area. Furthermore, the Power Co. itself extended its operations on the north along a fringe of districts beyond the Aire and Calder District area. In that area there were districts taking entire supply and distribution from the company; other districts took only bulk supply and did their own distribution; there were districts for which provisional orders had been obtained which were not yet operative; districts depending wholly on their own generated current; others upon energy supplied by authorities other than the company; districts taking bulk supply from borough authorities and doing their own distribution; others taking part of their supply from the company in bulk and part from neighbouring borough authorities and doing their own distribution; and others which had not yet any system at all. He desired to emphasise the extreme complication of the position. There was a rich industrial area, providing a most important field for development; a district in which many active municipalities had their own electrical developments and which had had the advantage of the Yorkshire Power Co.'s operations in the past. All this complication led up to a position which was just that condition of affairs which the Electricity Act of 1919 was intended to enable the Commissioners to unravel, of course with the agreement of those interested. The three solutions before the inquiry appeared to him to be arranged somewhat in a rising scale of evolution. They started with the Power Co., which had proposals which seemed to be a sort of policy of despair. It wanted to be left to develop in its own way, and the most it could suggest was interlinking. Leeds proposed a Joint Authority to leave the Power Co. at any rate for the present; and the Conference scheme was for entire public ownership and control of the generating stations and main transmission lines throughout the district. The three proposals seemed to represent stages of the rising appreciation of the intentions of the Act.

Mr. Miller then dealt with the broad principles of the Conference scheme and the manner in which it came into being. He claimed that the Conference body was actually the direct descendant of the original conference called by Leeds on publication of the formal notice of the provisional determination of the area by the Commissioners, and that it was the Leeds authority which had fallen away some six months after the first conference. He suggested that the letter in which Mr. Hefford, the Leeds engineer, intimated the Leeds differences with the other bodies in the conference, indicated that he was willing to work in harmony with the other authorities so far as possible, and seemed as though he might be prepared to modify his views. In August last the Bradford town clerk, on behalf of the Conference, reported to the Yorkshire Electric Power Co. the decision of the conference in favour of a Joint Authority comprising only elected representatives of the people, and asking whether the company would be prepared to offer terms for the transfer of its undertaking. The company replied, not unnaturally perhaps, that it was not prepared to offer to sell out to an authority which did not yet exist, and whose constitution had not been settled. Mr. Miller contended that the tone of its letter indicated that it had not given a final and definite refusal to negotiate at any future time. In fact, it seemed to leave the way for negotiations open, thereby indicating that it had in mind the interests of the community at large. That gave him reason to hope that should the Commissioners direct that the interests of the public could best be served by public control, the company would be prepared to consider transfer of its private undertaking on proper and reasonable terms.

Though Mr. C. N. Hefford had had to leave the Conference engineers owing to the views of Leeds, he had given great help up to that time, and had continued to furnish any information required. The Conference engineers appreciated his co-operation. Proceeding with the history of the drafting of the Conference scheme and engineers' report, counsel said the original Conference Committee had invited the co-operation of local authorities which were distributors only, as well as those which were generators, and had secured support from some of them. He called attention to the comparative weight of electrical output by the authorities supporting the Conference scheme, as against that of the other sides to the inquiry. During the year ending March, 1920, Leeds had generated, roughly, 76,500,000 units, the power company 50,000,000 units, and the local authorities which had passed definite resolutions in support of the scheme some 120,000,000 units, or about 46 per cent. of the whole output. These authorities had an experience averaging since 1897, as against the Power Co.'s commencement only in 1904, and therefore not only had they the largest stake in the area, but also a record of achievement which augured well for public control in the future. The facts showed how strongly was the principle of public control held in the area. Any objection of the company to transfer was met by the proposal that the entire undertaking, including part outside the Aire and Calder area, should be bought, at a fair and full price by agreement, or, failing agreement, under the Arbitration Act.

Questions were raised by the Commissioners as to what was to happen to the portion of the company's undertaking outside of the Aire and Calder area, if the Joint Authority took the whole undertaking.—Mr. Miller held that though the situation depended on the passing of the No. 2 Bill, adjustments, and the settlement of the North-East Midlands District Joint Authority, the general policy of the Authority in the latter district indicated the probability that arrangements could be made for that Authority to take over the parts outside of the Aire and Calder district. This should not be a matter of difficulty, as there were no big generating stations in that outer portion. He agreed with Sir Harry Haward that the point was *ultra vires* except by consent, and said the scheme was not put forward with a view to asking for compulsion on the company; they wanted agreement, and every generating authority in the area, except Leeds, supported the scheme. Counsel contended that there were no special circumstances in the area which justified departure from the general rule, established by the opinion of the national coal conservation and electricity supply committees, that public control of generation and main transmission was desirable in the national interests. The Conference took the view that this principle was the best from the business point of view, the engineering point of view, and the point of view of development.

Dealing with the estimate of capital expenditure under the scheme, Mr. Miller called attention to a correction in the column of working capital brought forward in 1931 in the financial tables. The figure should be £260,000 instead of £170,000, thus altering the total to £8,983,994.

Sir John Snell suggested that the key to the whole scheme was missing—the actual capital commitment involved in the acquisition of the Power Co.'s undertaking. This was necessarily an unknown figure.—Mr. Miller admitted that, but said the Conference was confident on its figures, which had been accepted, that by the saving gained from co-ordination a cheap and good electricity supply could be secured and would leave a margin of profit which would meet the charges on the capital outlay. Excluding the sum necessary to buy out the Power Co., the figures of the Conference scheme showed a greater saving than either the Leeds scheme or the linking-up proposal. With reference to the proposed purchase, counsel said the Conference had taken as a basis a price of supply of 1d. per unit at the busbars at centres and sub-centres for high-pressure untransformed energy. There would be some little addition for subsidiary distribution to get at the actual price, but taking the 1d. as the estimated outlay, the working costs, excluding charges on the purchase price of the acquisition and the cost of authorised extensions by the company, left a surplus in the year 1926 of £280,170, which the promoters regarded as more than sufficient to meet the purchase charges, the latter being based on the capital of the company at the year ending December, 1920. In 1925 the Conference scheme showed a surplus, on 1d. price, after paying capital charges on the estimated purchase price, of £51,370, as against the Leeds tables showing a deficit, at 1d., of £603,930, and he believed Leeds proposed a higher price in order to meet the difference. He admitted that the figures were largely problematical, in view of the unknown expenditure on purchase. Concluding his opening of the Conference case, Mr. Miller drew attention to the technical differences between the Leeds and Conference schemes, particularly as to sites and times of erection of the new stations. The Conference regarded the proposed Leeds site as totally inadequate. The Conference scheme achieved a substantial estimated saving of coal by centralisation and the finance officers of all the authorities in the scheme had approved the financial clauses of the general provisions of the scheme.

Sir Harry Haward asked whether the principle of public control meant total exclusion of any representative of an electrical company, or would be satisfied with a controlling majority of elected public representatives.—Counsel said he felt that the clause as drawn up did not go so far as total exclusion. Any companies in the area were, of course, authorised undertakers.

The inquiry was then adjourned until Monday, May 23rd.

(To be continued.)

The Lower Severn Electricity District.

Joint Authority Scheme Abandoned.

A resolution that was passed unanimously at a meeting of the Organising Committee (of which Mr. H. Faraday Proctor, engineer and manager of the Bristol Corporation Electricity Department, is chairman) on February 3rd, 1921, stated that the Committee, whilst still desirous of proceeding with the scheme to set up a Joint Authority for the district, having regard to the almost insuperable difficulties of conforming to the requirements of the Commissioners (bearing in mind the limitations of the probable electrical requirements of various portions of the district) especially in relation to the impossibility of restricting representation to those who are willing to assume financial responsibility; and the necessity for the presentation of an engineering scheme of development embodying an undertaking that portions of such a scheme shall be carried out by dates to be determined, was of the opinion that it was unable to proceed with the scheme submitted so as to present it in accordance with the requirements before referred to.

Mr. Proctor explains that the sending out of the following information (which we received on May 26th) has been delayed, at the request of the Electricity Commissioners, to enable further endeavours to be made to secure such assurances from the Forest of Dean Colliery Owners' Association as would enable the scheme to be proceeded with on the original basis. The Association not being in a position to give the required assurances, it has been determined that no further action be now taken. He comments as follows, *inter alia*, upon the present position:—

The Organising Committee has always been of opinion that the district (with the exception of one portion specially dealt with) does not present features showing that a scheme of centralisation would result in very decided financial advantages in the near future. Practically the whole of the district is agricultural, there being few areas in which an industrial load or other substantial demand would arise; therefore, the most desirable course to be pursued in connection with the district, is to leave the engineering proposals for reorganisation in abeyance until the organisation for controlling supply and other matters is set up.

Since a complete scheme could not be adopted at present, as essential financial clauses are generally considered to be *ultra vires*, the inquiry * was deemed to be of an interim character.

The Organising Committee did not, therefore, deem it necessary to engage counsel, and the Commissioners were so advised on December 17th, 1920. Additional information was furnished to the Commissioners at their desire subsequent to the submission of the scheme. The Commission, on December 1st, 1920, stated: "You are correct in assuming that it is only the 'scheme' which need be available on application and not the additional technical information furnished by you in subsequent memoranda." But on the morning of the inquiry surprise was expressed that counsel had not been engaged, and that the "additional technical information" had not been circulated to all parties.

Mr. Proctor has good reason to believe that, unless financial responsibility is imposed upon all authorities and bodies represented on the Joint Electricity Authority, authorities of importance will decline to assume such responsibility, and it appears likely that as a result voluntary financial responsibility will disappear altogether. The chief object in requiring financial responsibility to be assumed *pro rata* with voting power, is to secure cheap money by giving the best security. If this is, as indicated above, impossible, an increase of not less than, say, 3 per cent. should be allowed for in the rate of interest on capital. Opinions have been expressed that the additional rate should be 4 or 5 per cent., and that money would not be forthcoming at any price.

The power to require "standardisation of systems" rests entirely with the Commissioners. The Joint Electricity Authority can only act by agreement or through the Commissioners as regards "methods of charge to consumers." If this reference is restricted to the charges to be made by authorised distributors as distinct from those to be made by the Joint Electricity Authority, the matter would not appear to be under the control of the Joint Electricity Authority. In Mr. Proctor's opinion no authorised undertaker or other consumer should be placed in either a better or worse position, as regards the price at which he is supplied, on account of the position selected for the location of any generating station, but a difference is justified according to the locality in which the supply is required as affected by other considerations, such as the total demand in the locality, the nature and density of the demand, and other considerations which might have affected the price of supply furnished from any other source than the Joint Electricity Authority. Thus, a demand arising in or near a purely rural area should be furnished on less favourable terms than a corresponding demand in or near an industrial area. This principle does not appear to be followed in the schemes put forward in respect of the Chester or the Mersey Districts wherein a uniform standard is advocated.

The Organising Committee decided that it was inadvisable to put forward engineering proposals other than those connected with the interim works to be carried out by the

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* Elec. Rev., Jan. 14th, 1921, p. 53.

Minister of Transport for the furnishing of a supply to the Forest of Dean, with transmission lines extending in the direction of Gloucester. The Commissioners, however, pressed for the submission of a scheme for connecting up Bristol, Bath, and Wiltshire towns, and Mr. Proctor informed the Electricity Commissioners, "I purposely refrained from dealing with the supply of considerable portions of the district on the lines of any centralised scheme, and particularly the district of Bath and other places beyond, as I have felt that there is very little that can be put forward in support of the same at the present time." However, on November 22nd, 1920, "additional information" was prepared, embracing detailed estimates dealing with capital and revenue, also tables of statistics and diagrams, &c. For a bulk supply to be given at Bristol, Bath, Bradford on-Avon, Melksham, Trowbridge, Frome, Radstock, and Pensford, the financial results ascertained show that no case can be made showing economies resulting from this section of the scheme (on the estimates of demand submitted), if an additional 3 per cent. be added to the annual charges on capital account due to the absence of the backing of the rates of local authorities.

If Bristol is considered separately, the result is not only a disappearance of the saving, but the creation of a direct loss, for instead of extending its existing generating station, Bristol would construct a new generating station, on the lines of the proposed capital station, to furnish its additional requirements. Mr. Proctor's figures suffice to indicate the attitude of the Organising Committee in not committing itself to any definite engineering programme, and indicate the probability that local authorities and others would decline to do so.

The Organising Committee much regrets that it is still of opinion, after having made further investigations, that it is unable to proceed with the scheme, so far as it relates to the supply of electricity, so as to present it in any different form from that in which it was originally deposited, but it is prepared to proceed with the original scheme on receiving satisfactory assurances from the coal owners in the Forest of Dean, which assurances it has not yet been able to obtain.

The results have throughout confirmed the views consistently held by the Committee that, apart from the northern section of the district (embracing the Forest of Dean, Stroud Valleys, Gloucester, and Cheltenham), whilst certain advantages might accrue from the formation of an organisation to "father" development within the area, with power to carry out developments as and when commercially practicable, if such is not permissible, no alternative can be suggested on a sound commercial basis at the present time.

THE PRESENT ECONOMIC POSITION OF THE ENGINEERING AND ALLIED INDUSTRIES.

(*Concluded from page* 695).

A Slander on the British Workman.

It is to be regretted that, in the persistent desire to "create atmosphere" and to put the fear of starvation into the workmen's minds, the employers' pamphleteer does not refrain from libelling the British engineer. "The great misfortune," we are told, "is that, at present, for a variety of reasons, the productivity of British labour is"—not merely "below its pre-war standard," which might be arguable and explicable, but also "below that of workmen in competing countries." Not the slightest evidence is adduced for this astounding libel on his fellow-countrymen. What can the writer mean? Probably all that he meant to express was that the British workman does not work continuously at as high speed as the employer thinks that he ought to do—to put it bluntly, that on time rates he does not give piecework intensity. This, let it be clearly understood, no workman ever contracts to do. But this misconception does not excuse the libel. Does the pamphleteer seriously contend that the average fitter or erector, turner, or toolmaker in Great Britain is less skilled than the Belgian or the German fitter or erector, turner, or toolmaker, or that, taking the year round, he produces less in quality and quantity? In which case, we would ask, why are British mechanics asked for by employers in other countries? and why are they constantly being tempted to go abroad to take situations at much more than the earnings of the local engineers? Even in the United States the British engineer is in demand. It used to be said that foreign mechanics worked longer hours than British. This, however, whatever it was worth, has ceased to be true. The eight-hour day has become practically universal. It may quite well be true that, on a repetition job, with foolproof machines, a far greater quantitative output may be got out of some Continental operatives, as was found when the Belgians were in this country. But the fact that no employer having engineering work of first-rate quality to do ever engages a foreign workman when he can get an English or Scottish engineer, with all his faults, indicates how little ground there is for this careless slander.

Wages and the Cost of Living.

The pamphlet states (pp. 22-3), actually enough, the rise in the cost of living, and the extent to which it has begun to decline. But again, the attempt is to "create atmosphere." It is predicted that the cost will rapidly fall—it is suggested to no more than 66 per cent. "above the pre-war level," a fall which any "decline in wage rates will accelerate." Now, if we take the money earnings of all grade of engineers as being now (April, 1921) at somewhere between 100 and 150 per cent. above pre-war level, the suggestion that we can confidently expect the cost of living to be, very shortly, no more than 66 per cent. above the pre-war level, means, once more, an insinuation closely resembling the one that *wages are to be halved*, which is almost exactly what the South Wales miners are being told! . . . .

The Export Trade.

Something like half the engineering industry works for export. Why is the foreign demand for engineering products so slack? Let us take the countries one by one.

To Russia we used, before the war, to sell some millions of pounds' worth of engineering products, an amount which at present prices would be at least double. Russia to-day is hungering for locomotive engines, for electrical plant, for agricultural implements, for machine tools, for motor-car components, for textile machinery, and, in fact, for nearly every kind of mechanical appliances. Surely the employers will not contend that any appreciable reduction of price would make any difference in this case? So urgently does Russia (which is badly off enough owing partly to our continued blockade) need these things, that the Soviet Government is prepared to buy them for gold and platinum paid down on shipment. For more than two years the British Government (which nearly all the engineering employers voted for, and still support in office) has actually forbidden this profitable trade, which would have kept thousands of British workmen in employment, and would now find them work for years to come. Even now obstacles are put in the way, legal proceedings are threatened, and trade with Russia is still a "wash-out."

To Germany we used also to sell annually millions of pounds' worth of engineering products, worth at present British prices at least double, and in German currency 24 times that sum. Is it suggested that it is the high prices quoted by the British engineering employers that have prevented exports to Germany? For over two years the British Government, dragged at the heels of the insane desire for vengeance of the French Government, has put every possible obstacle in the way of the restoration of prosperity of German industry. Nor is it only the British Government. Many a British employer has felt with the Right Hon. W. Runciman, late President of the Board of Trade, that "we have got Germany down, and we won't allow her to get her head up again," or words to that effect. However natural may be such primitive feelings, they do not make for a revival of international trade. We are members one of another. British industry cannot be restored to full prosperity unless other countries are prosperous. We do not gain by ruining our customers. The engineering employers themselves expatiate on the great difficulty created by the depreciation of the German mark. *This depreciation is being to-day increased by the action of the British Government*, still supported by practically all the representatives in the House of Commons of the Federation of British Industries (to which so many engineering employers belong) in endeavouring by extraordinary Customs duties to prevent the German export trade. How can engineering employers expect to see their own export trade to Germany revive so long as this extraordinary policy is persisted in?

To Poland and Bohemia, Austria and Hungary, the Balkans and Rumania, we used to sell every year many hundreds of thousands of pounds' worth of engineering products. These countries are to-day terribly in need of machinery of every kind. Their currencies are so depreciated that our British employers complain that export sales are rendered almost impossible. Will it make business easier to effect if the depreciation of the krone and the leu is actually increased by the practical prohibition of their exports to this country (and to as many of the countries of our Allies as we can induce to take the same suicidal course)? For this is what is involved in the proposed new British Customs duty of 33⅓ per cent. on imports from countries having depreciated currencies.

Now, the British engineering workmen do not believe that, so long as these evil *political* restrictions on trade are continued, any reductions in the price of British products will avail to restore our international trade. So long as trade is actually hampered by blockades and embargoes, 50 per cent. duties on exports from Germany, and 33⅓ per cent. duties on imports into Great Britain from nearly all the continent of Europe, *reductions in price are simply thrown away.*

When the employers ask the workmen to co-operate in effecting such a reduction in prices, it is obvious that the preliminary answer must be that the workmen would be fools to take any step in that direction until the British engineering employers first insist on the British Government adopting a policy of peace and free trade, with a sincere desire for the prompt restoration of prosperity of the whole European continent. *The only way to increase our foreign trade is by adopting a policy of peace, the restoration of Europe, and free trade.*

The Home Market.

But our foreign trade is, to the British engineering employers generally, only half their normal business. How can we give a fillip to that other half which is with the Home

Market? Clearly not by cutting down wages, the effect of which is, by exactly the amount of reduction, to restrict the home sales of British manufacturers generally. So long as British employers pursue this policy, in one industry after another (which is what the workmen mean by "a conspiracy to force down wages"), trade will get worse and worse, so far as the Home Market is concerned.

It may be that the British engineering employers are justified in believing that, if their cost of production could be reduced (and, *what does not always follow*, if they gave their customers the benefit of such a reduction by a corresponding fall in retail prices), more engineering products could be sold. It is their business to judge of such a fact. If motor-cars and bicycles, gramophones and agricultural implements were considerably cheaper, *without anybody's income being lessened*, more of them could be sold. If it cost less to put in new machinery and electrical plant *without any lowering of purchasing power*, more would be installed. But even on the employers' own showing the reduction in price must, to be effective, be substantial. Now, in the engineering establishments the wage bill is often reckoned at half the gross value of the output. On p. 20 of the employers' pamphlet it is incidentally given as no more than 27 per cent. of the gross value of the output. Taking the intermediate estimate of 40 per cent. of the gross value of the output, it would need a cut at engineering wages of no less than 50 per cent. in order to enable the product to be sold even 20 per cent. cheaper. Do the employers suggest that a cut of 50 per cent. in wages is going to leave the Home Market as large as before? Is it not evident that the very argument in favour of lower prices increasing demand depends on the assumption that purchasing power is not reduced? It may be desirable to bring about a reduction in the cost of production if it can be done without reducing income. But it is simply suicidal to seek to develop the home trade by reducing the incomes of the mass of the people.

Now, it is an extraordinary fact that from the beginning to end of the employers' pamphlet no possible means of reducing the cost of production is mentioned other than a reduction of wages.

Is this honest? Is it consistent with the claim (p. 25) to set before their workmen "a comprehensive and reasoned statement of the case"?

Lowering the Cost of Production.

How can British engineering employers reduce the cost of production without reducing anyone's income? First, they have to get their materials at the lowest possible cost. Will they be lowering their costs by allowing Mr. Lloyd George's Government to clap on 50 per cent. duties on all German exports, which ought to include (as they did before the war) iron and steel, timber, and various components? Will it make timber and leather, lubricating oil and platinum cheaper to the British engineering employer to permit Parliament, by a general import duty of 33⅓ per cent. to raise the price of all the raw materials and components that come from Russia, Poland, Germany, Austria, Czecho-Slovakia, Hungary, Rumania, and the Balkans—not to mention India, Belgium, and France—which is what is actually being proposed? The workmen have a right to raise such questions when they are asked (p. 25) to "co-operate" in reducing the cost of production. Are the British engineering employers taking all the necessary steps to prevent their cost of production being actually increased? *Or are they inviting the workmen to make up by still further reductions of wages for the increase in cost now being artificially produced?*

Reduction of Workshop Costs.

But apart from these extraordinary proposals to increase the British engineering employers' cost of production, against which it is to be hoped they are vigorously protesting, are there no steps to be taken in their own establishments by which unnecessary expense could be saved?

On this point it is difficult to speak without seeming to be impertinent, and without giving offence. But the employers ask, in effect (p. 25) for a "frank exchange of views," and it would be discourteous not to explain to them what the workmen feel on the matter. *The British engineering industry is, with few exceptions, badly organised from one end to the other.* And this is taking no ideal standard, or theoretical perfection. Compared with many American establishments, and even with the best in this country, the great majority of British engineering workshops are badly laid out, often badly lighted, inadequately equipped, and, many of them, wastefully managed, with the result that time and materials are not used to anything like the greatest advantage, and costs are (without advantage to the workmen or anybody else) unnecessarily raised.

What can the mere workman know about such things? Well, let us call in an authority in matters of engineering, whose capacity to judge no one will dispute—Mr. Michael Longridge, late President of the Institution of Mechanical Engineers. Speaking to the employers themselves and their managers no longer ago than April, 1917, he declared that: "Except in a few cases, workshop organisation here has not received the attention given to it in America or Germany. There are still shops without definite planning of the progress of the work, without adequate equipment of jigs and gauges, and without standard shapes of tools or a tool-room; where men drift about in search of tools or tackle, or wait in idleness for drawings and materials; where machinery is obsolete and lights so bad that good work cannot be done if the machinery is up to date. Such shops must go. They cannot compete in price or quality of work with those in which, what is known as 'scientific management,' or anything approaching it prevails; where the progress of every job is planned to the last detail before it is sent into the works; where machinery is so arranged that each piece passes through the whole series of operations to be performed in its pre-determined order and without pause, and is immediately succeeded by another piece to undergo the same cycle of operations; where labourers and tackle for fixing the work are ready the moment they are wanted; where drawing gauges, and tools properly ground to standard shapes come with the work; where cleanliness, light, and comfort reign, and where an endeavour is made to get the workman to regard his task more as a problem to be solved than as a task to be got through."*

Every employer who reads this very authoritative description of British engineering as a whole will probably resent it as a description of his own establishment. But let him reflect candidly on what he has seen in other engineering establishments, which he can judge with more impartiality, and we do not think he can deny the indictment of the President of the Institution of Mechanical Engineers. "Conscious as we are of each other's infirmities," he must admit that many of the engineering workshops that he has had occasion to visit fall far behind, in efficiency, those which he considers the best.

It is these defects and deficiencies in the manner in which the British engineering employers have laid out and equipped their workshops, and the state in which these are allowed to continue year after year, *that the workmen are now invited to make up for in reduction of wages.* The employers assert that what is hampering them is their high cost of production. *To seek to lower wages without first stopping the employers' waste is to make the workmen pay for that waste.*

The Waste of Fuel.

For an instance of faulty management not alluded to by Mr. Longridge, take the one item alone of coal consumption, which is a standing charge of no small magnitude. As recently as 1919 the very expert and highly practical Fuel Research Board reported that fuel was being wasted by British manufacturers to an almost incredible extent. "In the majority of industrial undertakings," it was declared, "a reduction of from 5 to 20 per cent. could be secured within a year at a relatively trifling expenditure on wages and small alterations of apparatus."

A reduction of 5 or 10 per cent. in the coal bill would be worth a great deal. Why not secure it?

Railway Rates.

Or consider how greatly the cost of production is at present increased by the heavy expense incurred by many engineering establishments, owing to their location, in the heavy charges for carriage on materials and coal inwards, and for carriage of their products outward, at railway rates extraordinarily high in comparison with what their American, Belgian, German, and French competitors are paying. Is it part of the claim of the British engineering employers that, because their works are badly located, or because they have failed to use their political power to get these railway rates reduced, or to secure the alternative of an efficient canal system, the engineering workmen are to make it up to them by accepting lower wages—a course which would be suicidal so far as the Home Market is concerned, because it would be restricting the very demand that it was intended to stimulate? Would it not be better to see what can be done to reduce the high railway charges by which, as employers themselves have often declared, British industry is handicapped?

The Burden of Tribute.

Finally, there is the delicate question of the extent to which British engineering industry is charged with rent, interest, profits, and managerial salaries. It is sometimes argued—indeed, it is implied in the very pamphlet under consideration (p. 20)—that "profits alone represented but a small percentage of turnover even though in the aggregate a large sum"; and that "two very large firms . . . . showed proportion of wages to profits of about 10 to 1 in one case and about 12 to 1 in the other." This is a very naive and simple error. What is intended to be implied is that the poor capitalist is getting next to nothing out of the business, and that nine-tenths or eleven-twelfths of all the net proceeds go to the workmen. The workmen, of course, know better—know, in fact, that according to the best available statistics, only about two-fifths of the national income goes in the wages of the manual workers, who constitute with their families more than four-fifths of the population. The fallacy of the other view lies in excluding from "profits" all rents and royalties; all interest on loans and debentures; all allocations to reserve for equalising dividends; all the various "hidden reserves" that are periodically distributed as bonus shares; and, finally, the sums paid to directors and managing partners. It is not contended, of course, that the directors and managers can be expected to work without a livelihood. It may even be necessary to remunerate people for the act of saving capital in order to invest it; though not necessarily to reward them with perpetual annuities for their original act! It is, of course, not practicable for any firm immediately to free itself from the burden of rent, &c. But it may well be that some particular establishment, or even the British engineering industry as a whole, finds itself saddled, by inheritance from the past, with a dead-weight burden of rents and royalties, or loan and debenture interest—even of "capital" watered by bonus shares which its present business is unable to bear. At any rate, it is plain that it would be necessary to make the amount of this "dead-weight burden" (for which the workmen clearly have no liability) a subject for statistical investigation, before the allegation that there was no profit, or every little profit, left for distribution as dividend to the ordinary shareholders could be accepted as having any bearing on the question of whether the industry could or could not continue to pay its present wages. It may be that the burden of the tribute which industry pays to ownership will have to be reduced. When a company finds itself "over-capitalised" it has to "reconstruct."

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* Mr. Michael Longridge (presidential address to the Institution of Mechanical Engineers, April 20th, 1917), quoted in "The Works Manager To-day," by Sidney Webb, 1918, pp. 134-5.

Conclusion.

Only one word need be added. It will be seen that, in the workmen's view, the employers' pamphlet is far from being the "comprehensive and reasoned statement" that it claims (p. 25) to be. It does not afford any of the statistical data necessary for the "frank exchange of views" that the employers invite. It gives neither the amount of their costs nor that of their sales, still less does it afford any analysis of the several items; so that it fails to present even the beginning of a case for any reduction of wages. The employers are invited, in reply, to put their cards on the table. If they claim that their industry is, at the existing rates of wages, actually insolvent, let the figures be produced and authenticated which prove this to be the case; and let some explanation then be given of the current Stock Exchange quotations for their shares.

When this is done the Conference could next inquire under what difficulties the export trade now suffers and by what means it could be increased—leading, it is suggested, to issues of foreign policy and fiscal changes, which it would be necessary to explore. The Home Market, which is of such great (and possibly growing) importance to the engineering industry, could then be considered, when the employers would doubtless afford the statistical material for an examination of the growth of the several branches of this trade, and would explore the hindrances to its further development.

In so far as it seemed useful, for the sake of increasing sales, to reduce the cost of production, inquiry could then be made how this could be done, without anything so suicidal as a reduction of wages. Such matters as the circumstances enhancing the price of materials and components; the wasteful consumption of fuel; the disadvantages of workshop location, equipment, lighting, and organisation; the burdens on the industry such as railway charges, local rates, rents, and interest, &c., would be relevant.

In a "frank exchange of views" on these subjects, the representatives of the workmen would gladly co-operate as invited.

NOTES ON ELECTRICITY IN SWITZERLAND.[*]

As is the case in England, Switzerland has suffered in the past from too great a variety in the systems adopted for the supply of electricity. During the great European war, however, great strides were made in the direction of standardisation in that country.

The new standard of distribution is three-phase with a periodicity of 50 cycles and the normal supply is at either 127 volts, 220 volts, or 381 volts, and in certain special cases 660 volts. For railway work, the single-phase system is standardised, with an overhead collector at 15,000 volts and a frequency of $16\frac{2}{3}$ cycles. For town and suburban tramways direct current is used at 600 or 1,200 volts; and 2,400 volts in the country extensions of the tramways.

The two-rate system of charging, with clockwork change-over meters, is almost universally employed. During the period of maximum demand the rate charged for domestic purposes is from 40 to 60 centimes per kWh. During the remainder of the day the charges vary from 15 to 25 centimes per kWh.

One of the first extra-high-pressure transmission systems in the country is now in course of erection. The system will be operated at 135,000 volts, and is intended chiefly for connecting up the large power stations, though, in addition, it is also proposed to export electric power to neighbouring countries. The principal electric power stations in Switzerland are the Nordost-Schweizerische Kraftwerke at Baden of about 120,000 installed turbine h.p. (not all available owing to lack of water) and the Bernische Kraftwerke at Berne of about 110,000 h.p.

It is an interesting feature, that the Swiss power stations have the most power available in the summer months and not in the winter. This is due to the fact that the water supply is obtained from the melting snow. More attractive rates are accordingly offered to summer customers, including farmers. Most of the power stations are in a very awkward position this year on account of the lack of snow during the past winter; river beds are drier than they have ever been in the recollection of the present generation; and lake levels have fallen to such an extent as to expose the remains of old-world villages and monuments. The power stations already have had to announce considerable restrictions in the supply to customers. In the lower part of the Engadine valley, steam locomotives are being used, owing to lack of power for the electric locomotives, which supplanted the steam engines a few years ago.

In agriculture, very great progress has been made in the various applications of electricity. This evidently has been the case in nearly all the non-belligerent countries during the great European war. Electric motors are used extensively in the farm buildings; as an illustration of this it may be mentioned that at the beginning of the war 250 electric motor installations were in use on farms around Lucerne—to-day over 1,000 farmers in the neighbourhood of the city are using electric motors. The size of the motor employed is chiefly 3-h.p., three-phase, 50 cycles; the normal range of sizes being from 2 to 3 h.p. This is much smaller than the average size of motor employed by Danish farmers, which is 10 h.p. These motors are usually of the portable type, in which case the starter is very neatly and compactly mounted on the top of the motor. The motor is connected to the source of supply by 12 metres of 4-core flexible cable, one of the cores being the earth wire. The motor is either fitted with a pair of metal stretcher bars to enable it to be transported by two men, or else it is mounted on a small truck. While each farmer owns his own electric motor, it seems quite a common practice for several farmers to combine to purchase the machines to be driven by these motors, such as root-pullers, chaff-cutters, and the like. This is contrary to custom in other countries, except in the case of large machines, such as thrashers. Some very important experimental work in connection with the drying of hay has been carried out by Herr Director Ringwald of the Central Schweizerische Kraftwerke, Lucerne. However, its adoption by farmers is only just commencing. It may be mentioned that the chief credit for the development of applications of electricity to farming in Switzerland may practically be all ascribed to the initiative and energy of Herr Director Ringwald. The possibility of obtaining a supply of electricity on the farms has caused a number of farmers to start up various rural industries, such as cider making. Some of the larger cider makers are employing electric vehicles for the transport of their cider and general farm produce. Very little has been done in Switzerland in connection with the application of electricity to agriculture for work outside the actual farm buildings. This is largely due to the fact that there are no very large farms in the country, in fact, the owner of a herd of 30 cows or of 100 hectares (250 acres) of land is considered to be a large farmer. Further, the practice of growing fruit trees out in the fields amidst the crops almost prohibits electro-mechanical ploughing and cultivation in many parts of the country.

Electro-culture of crops has only been carried out on a small experimental scale at Lucerne by the aid of a Tesla transformer operating at 20,000 and at 30,000 volts. Offers have been made to local farmers of a free trial installation, but so far nobody has been found enterprising enough to take up the matter, although the preliminary experiments were so successful. Electric pumps for the irrigation of fields and also for distributing liquid manure are in use on quite a number of farms. Electrically heated incubators have established themselves as successful pieces of apparatus, and there are at least two companies manufacturing them. Freehold pole rights are easily obtainable nowadays on payment of from 10 to 30 francs for ordinary poles, and about 50 to 100 francs for a tower.

Altogether Swiss electrical manufacturers report a very big business in the supply of electric motors and other apparatus specifically for use in agriculture. Of course coal and oil have been and are very expensive and difficult to obtain; but on the other hand, the prices charged for electricity to farmers —according to English ideas—are very high. The underlying secret of the success of electricity is very evident not its cheapness as a form of power supply, but rather the discovery by farmers, that it is so very much more convenient, economises labour, and accomplishes better work than any other method.

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[*] Written by R. Borlase Matthews, M.I.E.E., &c., for the E.D.A.

Chalk as Fuel.—Recent advertisements in the daily Press have drawn attention to a new fuel, of which the essential constituents appear to be chalk and cinders, blended with a "rich carbonaceous material," the invention consisting in certain secret processes. To engineers we need not say another word on the subject. We note, however, with a sense of relief, that the financial experts are giving a very cool reception to the prospectus, and are criticising the offer severely. While they do not touch the matter on the chemical side, they find ample scope for criticism in the prospectus itself, and after reading their comments, even the most ardent investor with money to burn will have only himself to blame if he cannot keep it in his pocket.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Reflex" Pendulum Control.

When unification of workmen's registers was first attempted, the electric clock maker proceeded to do so by substituting for the spring-driven clock work, an electrical step-by-step or impulse movement. Such a substitution avoids the necessity of winding, but introduces other troubles, because the comparatively low power of the impulse movement leaves little margin for stiff places which occur in the clock mechanism from time to time as the register is used.

The next step to overcome some of these possibilities was to "scape" the existing mechanism electrically. By this method the pendulum was removed, and an electrical scaping mechanism substituted, which, operating every half-minute by means of the time circuit, allowed the clock train to run on in half-minute intervals. This principle is sound and practical, but still it does not remove the possibility of a stoppage if the time circuit is interrupted.

In the "Reflex" pendulum control, made by Messrs. Gent & Co., Ltd., Faraday Works, Leicester, nothing is removed from the register, but an addition is made thereto in the form of the "Reflex" control mechanism. This consists of two main parts, one the "vibrator," which is clipped to the pendulum rod, no drilling or tooling being necessary. The other part, or "stator," is screwed to the woodwork of the register by wood screws or by nuts and bolts, as may be desirable. The register is "wound up" in the usual way. It operates by the clock work exactly as supplied by the maker, but by the "Reflex" movement, the pendulum is compelled to keep time with the transmitter controlling the time circuit of the factory and the other clocks in the circuit.

The pendulum should be so rated that the clock does not "gain." It must be given a slightly losing rate, but need not be set to lose more than two minutes per day of 24 hours. So effective is the "Reflex" control that, in a pendulum beating 88 per minute, as is the case with some of the best-known makes of recorders, it will effectively deal with a loss of as much as ten minutes per day.

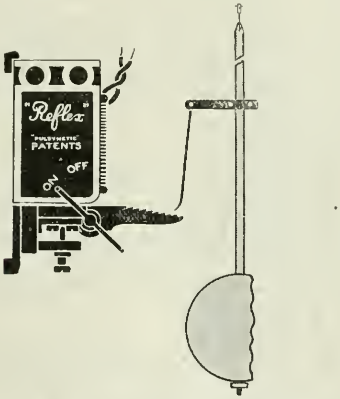

Fig. 1.—The "Reflex" Pendulum Control.

Among the advantages claimed for the device are that it can be removed entirely in five minutes, and if the electrical time circuit is thrown out of commission, the register does not stop, but carries on as a separate mechanical unit, and is not affected in any way except that it is no longer under electrical control, so that this does not materially interfere with the costing and checking system.

We are informed that many firms have already adopted the "Reflex" control on their existing time circuits.

A Corrosion-proof Switch.

There has always been great difficulty in designing a switch which will be efficient in operation, strong and so proof against corrosive atmosphere as to protect the ends of the cables and the working parts of the switch against damage.

A switch of an entirely novel design is now being marketed by the St. Helens Cable & Rubber Co., Ltd., of Warrington, for use in connection with their well-known C.T.S. wiring system in corrosive situations. This switch (fig. 2) consists of an outer box of cast-iron containing an ebonite bell-shaped cover, inside which is mounted an ordinary 5-A tumbler switch in an upside-down position. This means that instead of the switch being operated by moving a dolly or other lever handle, the circuit is made or broken by moving the switch itself (under the ebonite bell), whilst the dolly is fixed to the bottom of the outer box. When the switch is wired up and fixed in position a quantity of special sealing compound is poured into the box (to a height regulated by an overflow hole in the latter) which has the effect of forming an air-lock in the upper part of the ebonite cover and completely isolating the vital parts from the outer corrosive atmosphere.

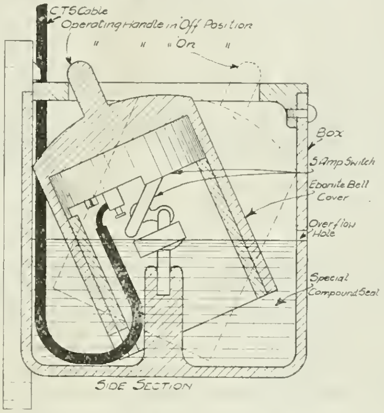

Fig. 2.—St. Helens Corrosion-proof Switch.

The switch is very strongly constructed to withstand the hard usage often encountered in the positions for which it has been devised, and this fixture, in conjunction with the soundness of the design, would appear to make it extremely suitable.

A New Wiring System.

We have received from Messrs. Faulkner & Co., 5, Market Street, Manchester, particulars of their Woods's wiring system for lead-covered cables. The system consists of 2-, 3-, and 4-way soft metal bonds for fixing behind ceiling roses or switches, and for junctions a neat cast aluminium box is made in 3 and 4 ways. The main feature of the bonding is that no screws or clips are used and, when fixed to awkward positions like ceilings, it reduces the time required for fixing, which is a great consideration. Its simplicity should commend it to all who are engaged on contracting for the new houses under the housing schemes.

A Bedside Tea Table.

Furniture designed especially to bear or contain domestic electrical appliances is too rarely seen having regard to the position electricity has attained. It is an inherent quality of electricity that it can be used with safety in all sorts of positions, it gives off no fumes, and is essentially clean.

With these points in mind it is pleasing to hear of a tea table for use in a bedroom. This piece of furniture is made by The Charment Co., Ltd., Bank Chambers, 109-111, New Oxford Street, W.C.1. It is a beautiful example of cabinet making, and is constructed in mahogany or oak. The front and top are hinged, and the top is supported by closing-in struts. The base of the inside is of white vitreous material and the sides bear hooks upon which cups may be hung. At the back of the cabinet is a tin-lined box, in which biscuits may be kept. The table is connected up to a lamp holder or wall plug by flex, which is led into a switch underneath the cabinet and therefore invisible. A kettle, toaster, or other appliance may be placed inside, and the whole when closed up is of very attractive appearance.

Electrical Installations in the United States.—*Electrical Merchandising* gives some interesting statistics relating to lighting installations in the U.S.A., from which we extract the following:—

Total number of residences	20,481.700
Residences using electric light in 1920	6,517,600
Residences using electric light in 1925 (estimated)	10,170,000
Business premises using electrical apparatus in 1920	1,675,900
Business premises using electrical apparatus in 1925 (estimated)	2,600,000
Number of farms in U.S.A.	6,362,502
Farms which are now using electric light and power	340,000
Number of electricity supply stations in the U.S.A.	5 726

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

13,681. "Primary and secondary batteries." J. F. Niblett. May 17th.

13,682. "Means for regulating current for electric welding apparatus." A C. Giles and Shipley Tank Co., Ltd. May 17th.

13,714. "Electric controlling devices." M. Walker. May 17th.

13,730. "Apparatus for heating forgings, &c., by electricity." Dagubert Timar & Co. May 17th. (Germany, December 22nd, 1920.)

13,731. "Electric rivet heaters." E. Schroder. May 17th.

13,761. "Electric energy control systems." H. J. Brearey. May 17th.

13,762. "Electric liquid-heating appliances." E. Richter. May 17th.

13,774. "Electric lighting of vehicles, &c." H. C. Crews. May 17th.

13,794. "Magnetic material for loading telephone and telegraph conductors." Western Electric Co., Ltd. (Western Electric Co., Inc.) May 17th.

13,804. "Electrically-controlled locks." H. France and E. G. Mitchell. May 17th.

13,809. "Stranded cables." R. W. Midgley, Sir C. A. Parsons, and J. Rosen. May 17th.

13,815. "Connecting additional transformers to a supply circuit." Siemens-Schuckertwerke. May 17th. (Germany. May 14th, 1920.)

13,816. "Vacuum rectifiers." Siemens-Schuckertwerke. May 17th. (Germany, May 15th, 1920.)

13,824. "Apparatus for starting synchronised non-synchronous motors." Compagnie Générale Electrique. May 17th. (France, October 6th, 1920.)

13,825. "Methods for parallel coupling of generators of polyphase current." Compagnie Générale Electrique. May 17th. (France, October 6th, 1920.)

13,831. "Automatic exchange telephone system." H. Baron (F. Aldendorff). May 17th.

13,865. "Transformer windings." F. Haberle and Sachsenwerk-Licht-und Kraft Akt.-Ges. May 17th. (Germany, May 25th, 1920.)

13,866. "Electric locomotives." W. S. Mundle and R. L. Stanbrook. May 17th.

13,877. "Telephone automatic burglar and fire alarm." T. H. White. May 18th.

13,909. "Variable vibratory contact devices for electric circuits." G. P. Ferreira and J. R. Quain. May 18th.

13,910. "Electric heating-elements." J. J. J. M. Kluijtmans and Phi-Kappa Syndicate, Ltd. May 18th.

13,932. "Indicator for electric circuits." J. Atkins. May 18th.

13,936. "Electric generators." J. R. Middleton and Watts, Williams and Co., Ltd. May 18th.

13,952. "Signal-receiving systems." British Thomson-Houston Co., Ltd. (General Electric Co.). May 18th.

13,953. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). May 18th.

13,954. "Commutators for dynamo-electric machines, &c." H. J. Curtis. May 18th.

13,958. "Electric bell pushes, &c." G. Wallace. May 18th.

13,961. "Electric butt-welding and tubing produced thereby." A. F. White (Elyria Iron & Steel Co.). May 18th.

13,971. "Means for limiting change of speed in alternating-current generators." T. F. Wall. May 18th.

13,977. "Thermionic devices." H. J. Round. May 18th.

13,997. "Chains for electroliers, &c." T. Hollis. May 19th.

14,029. "Electrical resistances." J. S. Stone. May 19th.

14,040. "Telephone transmitter mouth-pieces." L. van Rutten and Western Electric Co., Ltd. May 19th.

14,042. "Sparking plugs." H. A. Hands and J. Ward. May 19th.

14,052. "Thermionic valves for wireless signalling, &c." H. St. J. de A. Donisthorpe. May 19th.

14,060. "Single-phase short-circuited motors." P. R. Elnegaard. May 19th.

14,063. "Amplifying systems." British Thomson-Houston Co., Ltd. (General Electric Co.). May 19th.

14,065. "Means for ploughing with e'ectric tractor." P. Roulph. May 19th.

14,066. "Protective devices for electric circuits." Metropolitan-Vickers Electrical Co., Ltd. May 19th. (United States, June 9th, 1920.)

14,067. "Thermal relays." Metropolitan-Vickers Electrical Co., Ltd. May 19th. (United States, June 9th, 1920.)

14,079. "Submarine, &c., electric cables." H. W. Sullivan. May 19th.

14,085. "Electric switches." H. C. Gover. May 20th.

14,143. "Electron-discharge apparatos." British Thomson-Houston Co., Ltd. (General Electric Co.). May 20th.

14,144. "Incandescent electric lamps, &c." O. Oberlander. May 20th.

14,149. "Regeneration of spent electrical dry cells." H. E. Coley and W. H. Frampton. May 20th.

14,151. "Electric current regulating devices." W. H. Glaser and W. H. Glaser, Ltd. May 20th.

14,163. "Means for regolating speed of electrical machines." Ges fur Drahtlose Telegraphie. May 20th. (Germany, Augost 9th, 1920.)

14,194. "Miners' electric hand lamps." A. E. Angold and A. H. Railing. May 21st.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1914.

17,768. "Measuring of continooos electric current." Besag. August 20th, 1913.

1916.

5,524. "Arc light electrode with capillary passages." Planiawerke Akt.-Ges. fur Kohlen-Fabrikation. September 13th, 1915. (Addition to 16,364/15.) (101,471.)

1919.

23,722. "Incandescent electric lamps." L. A. de Becker. September 26th, 1919. (162,686.)

24,582. "Electric switches particularly applicable to alarm circoits." T. B. Harris. October 8th, 1919. (162,689.)

26,698. "Vacoum tobes." Siemens & Halske Aktiengesellschaft. October 30th, 1919. (Germany, June 21st, 1916.) (134,542.)

28,706. "Electricity meters." W. Lawson. November 19th, 1919. (162,702.)

30,062. "Windings of alternating current dynamo-electric machines." British Thomson-Houston Co., Ltd., F. H Clough, and H. W. Taylor. December 2nd, 1919. (162,707.)

30,161. "Thermionic devices for use as amplifiers, relays, detectors, and the like." J. Scott-Taggart. December 3rd, 1919 (162,710.)

30,295. "Block thermo-insolation material." T. B. Munroe. April 3rd, 1919. (141,322.)

30,604 "Ignition devices for internal combustion engines." Telegraph Condenser Co., Ltd., and W. J. Cole. December 6th, 1919. (162,711.)

32,450. "Electric heaters." L. M. Waterhouse, Simplex Conduits, Ltd., and H. F. McLoughlin. December 29th, 1919. (162,715.)

32,523. "Electro-magnetic impulse mechanism." C. L. Walker. December 29th, 1919. (162,716.)

32,532. "Dynamo-electric power plant." M. Harris. December 29th, 1919. (162,717.)

1920.

244 "Electro-magnetic devices for controlling alternating-current dynamo-electric machines." British Thomson-Houston Co., Ltd., and H. W. Taylor. January 3rd, 1920. (162,731.)

[illegible]85. "Anti-vibrators for incandescent electric lamps." E. Booth and N. R. Booth. January 6th, 1920. (162,735.)

1,541. "Electric heating element." H. J. Dean-Osgood. January 17th, 1920. (162,737.)

2,139. "Automatic telephone systems." Automatic Telephone Manufacturing Co., Ltd., and J. Savin. January 23rd, 1920. (162,739.)

2,305. "Apparatus for protecting metal-vapour rectifiers." Gleichrichter Akt.-Ges. March 3rd, 1919. (139,756.)

2,850. "Inter-commonication or like telephones." W. Stott and Telephone Manufacturing Co. (1920), Ltd. January 29th, 1920. (162,748.)

2,931 "Protective devices for alternating-current electric supply systems." Siemens-Schuckertwerke Ges. November 26th, 1918. (138,367.)

2,957. "Electrical systems of power transmission and regenerative braking." British Thomson-Houston Co., Ltd. (General Electric Co.). January 30th, 1920. (162,755.)

3,068. "Wireless transmitters." W. T. Ditcham. January 31st, 1920. (162,761.)

3,069. "Wireless transmitters." W. T. Ditcham. January 31st, 1920. (162,762.)

3,081. "Cooling arrangements for dynamo-electrical machinery." Siemens-Schuckertwerke Ges. October 7th, 1918. (138,613.)

3,218. "Reception of continuous waves in wireless telegraphy." A. K Macrorie and W. A. Appleton. February 2nd, 1920. (162,770.)

3,222. "Low-frequency amplification in electrical circuits for use in wireless telegraphy and telephony." A. K. Macrorie and S. H. Long. February 2nd, 1920. (162,771.)

3,223. "Holders for electric valves used in wireless telegraphy." A. K. Macrorie and H. Morris-Airey. February 2nd, 1920. (162,772.)

3,224. "Thermionic valves and their circuits for use in wireless telegraphy and telephony." A. K. Macrorie and H. Morris-Airey. February 2nd, 1920. (162,773.)

3,307. "Electrically-driven machines." E. H. Harman and E. Le Bas. February 3rd, 1920. (162,777.)

3,358. "Transmitters for wireless telephony." A. K. Macrorie and G. A. Irving. February 3rd, 1920. (162,781.)

3,462. " " Microphones." A. G. T. Cusins, W. S. Tucker, and E. T. Paris. February 4th, 1920. (162,791.)

3,498. "Electrical transformer arrangements." F. E. Berry. February 4th, 1920. (162,794.)

3,590. "Ignition systems for internal-combustion engines." Dayton Engineering Laboratories Co. November 11th, 1918. (138,646.)

3,627. "Electric couplings for sparking plugs and the like." J. E. Barrows. February 6th, 1920. (Cognate application 8,518/20.) (162,804.)

3,776. "Means for connecting electric light and power cables with junction boxes, distribution boxes, and the like." R. S. Wood. February 7th, 1920. (162,814.)

4,085. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). February 10th, 1920. (162,820.)

4,411. "Protective arrangement for electric distribution and transmission systems." Callender's Cable & Construction Co., Ltd., and P. V. Hunter. February 13th, 1920. (162,828.)

4,640. "Electrical switches." Midland Electric Manufacturing Co., Ltd., and H. E. Sutherland. February 16th, 1920. (162,83[illegible].)

4,661. "Electric lighting of motor cycle combinations." S. G. Muir. February 16th, 1920. (162,834.)

4,715. "Electric transformers." Hackbridge Cable Co., Ltd., and W. C. Kennett. February 16th, 1920. (162,836.)

5,127. "Sparking plugs for internal combustion engines." M. MacGregor. February 20th, 1920. (162,841.)

5,619. "Electric lamps." Efandem Co., Ltd., and A. H. Williams. February 25th, 1920. (162,848.)

6,082. "Electric switches." R. K. Damey and C. A. Damey. February 28th, 1920. (162,858.)

6,661. "Sparking plugs for internal-combustion engines." B. Hopps and A. M. Lodge. March 4th, 1920. (162,868.)

7,517. "Ignition devices for internal-combustion engines and the like." W. Pickard and D. R. Dobson. March 13th, 1920. (162,879.)

7,737. "Sparking plugs." G. Calvert. March 15th, 1920. (Cognate application No. 24,675/20.) (162,880.)

8,692. "Vehicular lamps, searchlights, and other lamps." V. F. Feeny (Wood Corporation). March 24th, 1920. (162,889.)

10,835. "Tungsten alloys particularly for electric lamp filaments." British Thomson-Houston Co., Ltd. (General Electric Co.). April 19th, 1920. (162,907.)

12,029. "Electric heating appliances." Thermos Akt.-Ges. December 5th, 1914. (142,506.)

12,104 "Electric power transmission systems." E. M. Fraser. September 19th, 1919. (151,580.)

12,549. "Protective apparatus for alternating current systems." A. H. Railing, C. C. Garrard, and A. E. McColl. May 6th, 1920. (162,919.)

12,599. "Method of driving electric centrifugal machines having mechanical unloaders." W. Hunt (S. S. Hepworth Co. and E. M. Mackintosh). May 6th, 1920. (162,920.)

13,212. "Glass reflecting globe for electric safety or similar lamps." A. G. Gullifrod. May 13th, 1920. (162,925.)

13,359. "Electric switches." E. T. R Morray and G. F. Shotter. May 14th, 1919. (143,263.)

13,410. "Electric lanterns or the like." Veritys, Ltd., and F. W. Thorpe. May 15th, 1920. (162,926.)

13,671. "Manufacture and production of a material suitable for use as an insulator for electrical porposes." H. Herrmann. November 7th, 1919. (153,884.)

13,841. "Tronk circuits more particularly for automatic or semi-automatic telephone systems." Automatic Telephone Manufacturing Co., Ltd. September 18th, 1919. (151,237.)

14,357. "Sound amplifier." P. R. Gonsky. May 26th, 1920. (162,939.)

15,180. "Electrically-nperated indicator or annunciator apparatus." Siemens Bros. & Co., Ltd., and L. de M. G. Ferreira. June 4th, 1920. (162,949.)

16,095. "Radio transmitters." Marconi's Wireless Telegraph Co., Ltd. June 14th, 1919. (145,040.)

16,747. "Electrical distribution and power transmission systems." Igranic Electric Co., Ltd. (Cutler Hammer Manufacturing Co.). June 21st, 1920. (162,961.)

17,591. "Thermally-controlled electric circuit interrupters." Igranic Electric Co., Ltd. (Cutler Hammer Manufacturing Co.). June 28th, 1920. (162,965.)

17,611. "Sparking plugs for internal-combostion engines." Soc. H. Trentelivres et Cie. May 28th, 1914. (146,262.)

17,843. "Electric generators." J. W. Torrance and J. M. Torrance. June 30th, 1920. (162,966.)

19,166. "Apparatus for the electrical long-distance control of the valve gear of a hydraulic gun-pointing gear." F. Krupp Akt.-Ges. December 4th, 1916. (Addition to 147,126.) (147,127.)

19,528. "Automatic starters for electric motors." F. Krupp Akt.-Ges. May 5th, 1919. (147,591.)

19,757. "Electrical high-frequency current transformers." Ges for Drahtlose Telegraphie. July 29th, 1915. (147,754.)

22,383. "Electric light sconce fittings." S. W. Hamlyn. July 27th, 1920. (162,980.)

22,563. "Electrn-magnetically operated controlling devices." Igranic Electric Co., Ltd. (Cutler Hammer Manufactoring Co.). July 29th, 1920. (162,981.)

24,942. "Means for operating constant voltage circuits from variable-speed dynamos." Edisoh Accumulators, Ltd., and J. F. Monnot. August 28th, 1920. (162,992.)

29,952. "Sparking plogs." C. Chollet and G. Lepape. October 22nd, 1919. (152,968.)

34,903. "Mercury switches for electrical apparatus." K. Kaisser. December 15th, 1919. (155,256.)

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ELECTRICITY SUPPLY PROBLEMS.

NEXT week the Electricity Commissioners will sit in London—appropriately at the Institution of Electrical Engineers—to deal with the biggest and most difficult problem that has yet come before them, namely, the electricity supply of the Metropolis itself. Until quite recently, it appeared that to thrash out the very complicated questions, of the gravest importance, that would be raised at this Inquiry would involve an enormous amount of labour and time, and that the sittings would extend over several weeks, but we have reason to suspect that the major questions will simply be shelved and that, instead of the comprehensive scheme originally put forward by the joint committee of engineers, a comparatively modest programme of linking-up and local extension will be submitted for consideration.

If this be the case, the proceedings will be greatly shortened, and the situation will not be materially changed from that which existed prior to the Act of 1919. That, apparently, is what always happens when the London problem is discussed, whether in Parliament or out of it—*plus ça change, plus c'est la même chose.* It is the line of least resistance, and it saves much trouble. That policy, however, does not carry us far on the road to reform and unification, nor does it for one moment delay the efflux of time, which is steadily marching on towards the fateful year 1931, when something will *have* to be done. Indeed, unless drastic steps are taken long before that date, the electricity supply of the greater part of London will sink into a deplorable state, for no company can afford to spend money on improvements and extensions from which no material return can be hoped for, in the face of the conditions of purchase which like the sword of Damocles hang over them.

With the power companies the case is different, and if it be true that an emasculated scheme is to be put forward, it is to be regretted that the County of London Co. was not permitted to proceed last year with the erection of the station at Barking, which, presumably, it will now be authorised to do.

Broadly reviewing the position of electricity supply throughout the country, it will be seen that with a few important exceptions, development has made but little progress since the Armistice. We all hoped for great things from the 1919 Act, and the establishment of a first-class Board of Electricity Commissioners, but the task set before them was too great to be accomplished within a few years; that is not the fault of the Commissioners, whose labours have been unceasing—it is the result of circumstances which hamper their efforts and tie their hands. Chief of these is the political element which has always entered so largely into the conduct of electricity supply in this country, and which is bound up with the individualism innate in the heart not only of every true Briton, but also of every British Community. These factors were very plainly manifest at the West Riding Inquiry, where Leeds would not act with Bradford and the Conference; the Conference would not act with the power company, though willing to swallow it; and the company saw no reason for immolating itself on the altar of municipalism, while quite a considerable number of minor local authorities held aloof from all the parties. But for the obstacle presented by the fetish of "public ownership," the West Riding problem could have been settled off-hand; and but for the individualism of the big towns, a far stronger case could have been presented for public ownership. As it is, the case for the power company, partly through its possession of the field, its admittedly high reputation for just dealing and public spirit, and its unity, partly through the dissensions of its rivals, their inability to produce the necessary capital, and their admissions that the company can quite readily do all that is needed, is so strong that, if the Commissioners do not entrust it with the work of development, the conclusion that political influences have been too powerful for them, and engineering and commercial considerations have had to be sacrificed, will be unavoidable.

Those who, in season and out of season, subordinate technical to political considerations and desire to perpetuate municipal ownership under the new régime, would do well to weigh the situation very carefully before they commit their protégés to heavy responsibilities. That the present and prospective demand (apart from strikes) for electricity supply is insistent and increasing is proved by reference to our reports from all sources, municipal and private; can it be better met by public ownership, or by private enterprise? We submit that the former is always handicapped. In the first place, the "directors" are not experts in the business, and even if they acquire a working knowledge of it in the course of time, they are always liable to be dismissed from office at elections. They are responsible for their actions to the localities from which they receive their mandates, and therefore have not a free hand to develop the business irrespective of persons and places; and as municipal representatives they have no more inducement to develop the less densely populated areas than a company would have.

A company, of course, must first of all provide a satisfactory return upon the capital invested by its shareholders; but so likewise must a public authority, which has to find the interest on the borrowed capital, and a sinking fund as well. Excessive dividends can easily be prevented in well-known ways, and in these days it would be nonsense to pretend that a great public company, subject to these restrictions, either would or could "exploit" the community for its own ends—such an attempt would court disaster. Private enterprise avoids all "risk of coming on the rates" (a bogy that is constantly being raised nowadays), and actually can raise capital more readily than big municipalities (for proof see our news columns during the past year); it is free from those jealousies which are the curse of all attempts at public co-operation, and it ensures continuity of management under the control of professional experts. It is, in fact, a "business proposition."

It seems to us that the most rational and beneficial system to adopt is on the following lines: To appoint a Joint Electricity Authority for each district, to exercise general supervision, and advise the Electricity Commissioners; to entrust the generation and main transmission to the existing power companies under suitable safeguards; and to leave the distribution of electricity in the hands of the local authorities, who already possess it in the great majority of cases.

By such a system the great objections which are constantly being raised by either side against the elaborate schemes that have been and are being put forward would be disposed of; rapid progress in the development of bulk supply would be assured; the work of the Commissioners would be lightened, and no risk would fall upon the rates—the fear of which, whether justified or not, is proving a serious obstacle to the formation of Joint Authorities with executive functions.

Engineering Wages.

We have placed before our readers during the last few weeks the statements issued by the Engineering Unions and the Employers' Federations respecting the state of the industry and the necessity for reductions in wages. During the past week matters have been carried further than the pamphleteering stage, meetings between representatives of both sides having taken place on Friday and Saturday last. Unfortunately, however, no settlement was reached, and at the time of writing, while the coal strike is still in progress, and widespread trouble threatens the textile industries of the nation, the engineering situation also looks very unpromising. It was stated in the Press on Monday that the employers had decided to post notices on Tuesday intimating the reduction which, as we have previously intimated, has been proposed to the unions. Their official announcement stated that they had been "compelled, in the interests of the industry, and with a view to reducing unemployment by being able to quote for contracts at a less cost of production," to post these notices. We read that on May 12th a meeting attended by over 200 trade-union representatives was held at York, at which employers, when intimating that they were willing to discuss with the unions the manner in which the reduction should be applied and the period over which it should be spread, proposed that 3s. to time-workers and 7½ per cent. to pieceworkers should be taken off in June, and a similar amount in July, and that the 12½ per cent. to timeworkers and 7½ per cent. to pieceworkers, Ministry of Munitions bonuses, should be taken off in September.

At last week's conferences, according to the *Daily Telegraph*, the unions suggested a modification of the employers' position, and the employers, having regard to the modifications which they had already made and with the desire to make the application of the reduction as easy as possible, asked the unions to agree in principle to discuss the manner in which the reduction should be applied. After consultation with the main body of their representatives, the unions replied that such a suggestion was not acceptable.

It is stated that over a million and a half skilled and semi-skilled workers throughout the United Kingdom are affected by the negotiations. The whole matter was reported to the Ministry of Labour, and Dr. Macnamara invited the employers to meet him on Monday, which they did.

On Tuesday, as foreshadowed, the notices were duly posted by the employers, but efforts to bring about agreement were continued, and Dr. Macnamara, having conferred with the representatives of both sides, was to meet the employés' delegates again on Wednesday. It is quite clear that reductions are inevitable, and we earnestly hope that they will be the subject of friendly agreement; unless the cost of production is diminished, the resulting lack of orders will bring about increased unemployment at a time when every effort should be made to recover from the effects of the miners' strike and of the other adverse factors which have so greatly hampered the work of reconstruction and the restoration of prosperity to the nation.

Industrial Diseases.

The problems associated with industrial diseases are now well recognised as an integral part of the work of our factory inspection organisation. Undoubtedly considerable progress has been made in combating industrial diseases during the past 25 or 30 years. In a large measure, however, if not entirely, our efforts have been devoted to curing diseases after they have manifested themselves rather than to eradicating the causes of them. The latter aspect of the matter is now taking a strong hold on the minds of medical men and others closely concerned with the industrial welfare of the nation. In a paper read before the Royal Society of Arts on May 30th, Sir Kenneth Goadby calls attention to it, not for the first time, although perhaps from a somewhat different point of view.

The electrical industry, of course, is concerned with more than one industrial disease likely to arise at one stage or other of the various processes involved in the course of the production of the finished machine or piece of apparatus. The outstanding one, perhaps, is lead poisoning in the accumulator industry, but there are others. The medical examination of fitness of young persons, or old ones, for that matter, for any particular industry has been suggested on more than one occasion. So far as young people are concerned, there is not likely to be much objection to it because at the start of life it is more easy to change from one occupation to another. With older workers the case is different, and that accounts for the opposition of workers in so many trades to periodical medical examination; they fear loss of position and the difficulty of securing other employment. Trade unions in general have supported this attitude, and from the human point of view it must receive sympathetic consideration. Such examinations hitherto have only paid regard to general physical fitness determined by the usual routine medical examination. Another type of examination of fitness for particular work has been suggested which covers the aptitude of the person for special kinds of operations demanding a special type of skill. The type of examination which Sir Kenneth Goadby now recommends, however, is of a totally different character. It has been found possible, by simple tests in many cases, to determine the susceptibility of people to various industrial diseases. Some people are naturally immune, others acquire an immunity after a short time, whilst others have a natural susceptibility which, in their own interests, and the interests of their co-workers, really calls for their exclusion from particular classes of work.

It is this type of examination which Sir Kenneth Goadby, with many years' experience as Specialist Medical Referee for Industrial Poisoning in London and the Home Counties, now suggests. The idea naturally does not appeal to some people, although for very different reasons. There are even highly educated people, not concerned as workers, who would thrust aside with impatience this perpetuation of official examinations of the individual whilst, of course, the workers themselves, in many cases, for the reason already stated, cannot be expected to welcome it with open arms. Between the two points of view comes the essentially logical one that workers must be protected against themselves, and it is undoubtedly the one sound opinion that can be put forward if we proceed on the basis only of curing people from these diseases or preventing their coming into contact with them. There is, however, the further point of eradicating the disease. In many cases, of course, certain diseases are inherent to the industry, and must be accepted as such. In other cases, it is more than probable that the cause of the disease can be eliminated. It thus follows that the investigation of industrial diseases will have to proceed on dual lines, always with the aim of removing the cause, if possible.

With the general scheme of preventing persons peculiarly susceptible, as shown by a simple test, to particular industrial diseases, from entering those industries, there can only be agreement. Industrial disease is inevitably a cause of unemployment, so that the fear of the workers of losing employment through periodical medical examination is not so strong as it might appear likely to be, because if they are allowed to continue, they will lose their employment through contracting disease, and constitute themselves a charge upon the nation in some form or other. To proceed on the lines indicated by Sir Kenneth Goadby would not only reduce the incidence of industrial poisoning in many cases, but might even render safe some trades now regarded as dangerous. The proposal comes solely from the development of medical science, the advantages of which to the nation as a whole in such a matter it would be worse than foolish to ignore.

Long-distance Wireless.

The interesting discussion which took place at the Wireless Sectional meeting of the I.E.E. on May 25th, if it did not educe any notable amount of information, at least served a good purpose by bringing into the forefront a problem of the utmost importance to wireless telegraph engineers. While the conditions of transmission over moderate distances have been pretty thoroughly explored, the case is very different when the distance is of the order of thousands of miles. Not only does great uncertainty exist as to the minimum power that must be collected by the receiving apparatus at any particular site in order to ensure the maintenance of communication throughout the year; even were this accurately known, an equal uncertainty would arise as to the power that must be put into a particular sending aerial in order to produce that given result.

This double uncertainty obviously creates a very serious embarrassment for the designer of a long-distance scheme to contend against; a little consideration will show that he is in a far worse position than the designer of a dynamo of 40 years ago, who at least could depend upon the lessons of experience for a tolerable estimate of the probable performance of his machine.

The reason why the case is so difficult to deal with is found in the fact that the atmospheric conditions play a most important part in the working of long-distance wireless. Not only does the effective range of a transmitting station vary enormously at different times of the day and year—the atmosphere itself is the seat of frequent electrical disturbances which produce oscillations similar to those transmitted by man, and which are also subject to wide and erratic variations. Consequently the receiving conditions are most complex; it is necessary to eliminate the atmospherics whilst preserving the highest possible sensitiveness to signals. The incidence of atmospherics is more marked at some places than others, so that the experience gained on one "circuit" may be of little value on another. Again, the question arises whether provision should be made to overcome the very worst conditions at all times; it may happen that if one or two days in the year are sacrificed, communication can be successfully maintained on every other day with one-tenth of the power that would have been required on those bad days. In this respect the problem is somewhat analogous to that of hydro-electric power—shall the output be restricted to that corresponding to the minimum flow observed on any day in ten years, or shall the supply be allowed to fail now and then, in order that a far larger output may be available at normal times?

It will be seen that the present state of this problem is very nebulous, and that accurate data obtained at a great number of localities all over the world are urgently needed. The discussion advanced the matter hardly at all. Just before the war the Radiotelegraphic Investigation Committee of the British Association was organising an international scheme for collecting data, and in April, 1914, the International Commission for Radiotelegraphic Research was constituted at Brussels, with the late Mr. W. Duddell as president, for the purpose of making just such observations as are now required. The war put an end to the collection of data, but some such organisation should again be established to carry out the necessary measurements. Only by accurate measurement, at frequent intervals, and over long periods, can the information be obtained.

SERVICE.

By MALCOLM B. MACDONALD, B.Sc., A.M.I.E.E.

The splendid article appearing in your issue of March 25th last, by Mr. J. W. Thomas, upon "The Function of Whitley Councils in the Electric Supply Industry" should be more than glanced through by all connected with the industry, or interested in the advancement of harmonious relationships in the industrial world. His remarks deserve to be studied and carefully digested, especially those calling for a recognition of "Service."

The call for "Service" is a demand made upon every organisation which opens its doors to minister to the wants of the community. To those embarked on the supply of electricity, this demand is perhaps more particularly insistent. Electrical energy has entered widely and deeply into our social existence; each day, each month, increases the roll of those who depend upon it, not only for their home comfort, but also for their daily bread. Electricity supply is essentially and pre-eminently a service. It is a service that cannot be given by one man, be he manager, engineer, jointer, or stoker, but is only rendered effectively by the combined effort of all engaged. Each by his own particular service to his organisation renders its service to the public more complete, and more efficient. We need, as Mr. Thomas remarks, an *esprit de corps* to animate all ranks. We have an honourable duty to discharge faithfully—there should be no necessity to cajole.

The foundation, development, and success of "Service" may be summed up in three words or expressions: Courtesy, readiness-to-serve, and genuineness. Courtesy to everyone is the first word of good service, in little things as well as big. Whether it is the meter-reader's quiet demeanour as he enters a house, or the superintendent's attention to a trivial and possibly unwarrantable complaint, made thoughtlessly, or as the legacy of some past feud with the organisation, it does not matter; courtesy is the first word, and it implies good intention. Courtesy, like all good things, comes from the Top; unless the manager shows the way to his assistants, it will not be possible for them, in their turn, to spread the idea among their subordinates, who, very likely, with indefinite and obscure notions of what is required of them, are the ones who most often come into working contact with the community. The second word in "Service" is readiness-to-serve. It is incompatible with good service for an organisation which assumes the roll of giver, not always and at any time to be prepared to yield that service. Furthermore, that presupposes a certain willingness, or cheerfulness, on the part of the giver to perform his duty. A service grudgingly given is no service at all, it is a nuisance, which many prefer to do without, or if that is impossible, accept it in an apathetic manner; who are then the losers? An electricity supply organisation should make its presence felt in the community that it serves, not only by its quarterly accounts, but by developing an agreeable habit of rendering assistance to manufacturers and others in order that they may obtain the best results possible from the energy supplied. There should even appear to be a degree of eagerness to help them should any difficulties arise that it is within the powers of the organisation to alleviate.

These are only some of the methods by which an organisation can increase, and round out its service to the community which it serves. So, too, within the organisation, good service to the organisation asks nothing more, and nothing less, than a cheerful readiness-to-serve. There is exactly the same need and demand for willing, cheerful service, from among the staff and workers, if the resultant service is to be completely satisfactory. Is there any necessity to emphasise what the results of good team work are like? Even the boy in the meter room can appreciate good combination when he sees it on a Saturday afternoon. A well-trained keen team, is as sure of success in business as on the athletic field. What is more dampening, or depressing, than to come on to the job in the morning to be greeted by cheerless or listless faces? The effect is to produce a veritable desire to escape it all, the task becomes irksome and heavier, culminating in a discontented, difficult-to-understand feeling that "things are not all right," and "never will be right," and "we had better have a rise in pay to make us feel better." This feeling is as far removed as the Pole Star from readiness-to-serve. There is too much of the capital "I" about.

Once that readiness-to-serve feeling could be disseminated throughout an organisation from top to toe, till it was saturated, then that first person "singular" would be replaced by a greater and more useful first person plural. Artificial aids are not to be despised towards increasing the efficiency of a body. From birth upwards human nature requires that some form of assistance be given before even the individual can perform the elementary action of taking a step. The giving of help, then, is part of the great "Service"; all aids in the right direction are beneficial. But once going, further action is dependent upon the person himself, unless he means to hang on crutches all his days. The feeling of courteous readiness-to-serve is a seed that requires to be developed by each man for himself, by each organisation for itself. Those who keep allotments, or rear chickens, know how carefully young "things" must be guarded from sudden and unseasonable frosts, and how they thrive under sunny conditions. The final tendency of this second word is in the direction of goodfellowship, and an understanding of the little difficulties of life. It affords the opportunity of giving mutual assistance, often very helpful to a fellow worker.

The last word in "Service" is genuineness, or, shall we say, "deliver-the-goods." This is the action following upon the desire to serve. By the action we can adjudge the intensity of the desire propelling, the direction of its course, and the ultimate objective. It may be argued that once a man has allowed himself to develop the feeling of willingness-to-serve, of course, he must be genuine. Perhaps! But the human mind is open to a host of assaults, some so subtle as to pass in the crowd unnoticed. Therefore, unless the desire is unmasked by action, and "the goods delivered" our man is an unknown quantity. Not everyone can deliver the same quality or quantity. But every person is capable of some development, and has a certain capacity. If the desire to serve by learning is coupled in a counterpart to another desiring to serve by giving, then that quality or quantity can very materially be augmented, with a general heightening of efficiency. Unfortunately it would neither be wise nor natural to expect that efficiency to rise to 100 per cent. Yet if the all-round efficiency were raised a point or so among the individuals of an organisation, the over-all efficiency attained by it would be sharply manifested in the improved quality of its service; furthermore, its value to the community would be enhanced.

Service is that which each soldier rendered to his country during the war, and it developed without doubt a splendid feeling of comradeship. It is because that same free sense of comradeship is lacking a trifle here and there to-day that things become a little difficult. The private obeyed his subaltern, as he in turn obeyed higher authority; each in his part in "the big show" did his best, and believed and relied on the other. Unless this spirit of service continues, social existence cannot continue. Machinery of the most costly and most perfect kind may be laid down, but it will be spoilt by bad or inefficient service; it may not even be worth laying down, as the expense of its upkeep may be prohibitive. It may be said that unless we pick ourselves up, and try to increase the value of our service to the community, we shall surely return to the neolithic age, in which the hammer was the great tool of social service.

THE VISIT OF DUTCH ENGINEERS TO ENGLAND.

By R. BORLASE MATTHEWS, Wh.Ex., A.M.Inst.C.E., M.I.E.E., F.R.Ae.S.

During the week before last the members of the Association of Managers of Dutch Electricity Supply Undertakings were the guests of the Institution of Electrical Engineers, jointly with the Cable Manufacturers' Association and the B.E.A.M.A. Owing to the prevailing labour difficulties, both here and in the Netherlands, uncertainty in steamship sailings, &c., the original programme had to be considerably modified and curtailed. Many of the works which it was proposed to visit were shut or shutting down for lack of coal, so it was decided to plan the trip so that the guests might obtain a good idea as to what England looked like at her best in the "Merrie Month of May." Accordingly, after the reception of the visitors in London, the party was taken in cars *via* Henley, Oxford, Ettington and Stratford-on-Avon to Hereford, and thence *via* Chester to Manchester, whence the return journey to London was accomplished by train.

Mr. Ll. B. Atkinson, President of the I.E.E., acted as the principal host on the tour, and was supported by Sir Tom Callender, Messrs. Rosling, Kibblewhite, Pollock and Borlase Matthews; each of these gentlemen provided a motor car for the transport of the party. Mr. R. H. Tree accompanied the party as an official of the I.E.E.

The visitors were met at Liverpool Street Station on arrival and driven to Tagg's Island, Hampton Court, for lunch. After lunch, a visit was paid to the residence of Mr. W. J. Crampton at Weybridge to inspect his wireless telephone equipment. He had arranged for a speech to be transmitted from The Hague by the President of the Dutch Radio Institute in Dutch, for the benefit of the visitors. Also the party was able to listen to a concert at The Hague. Unfortunately, owing to the very hot, dry day, atmospherics were in evidence, and occasionally Croydon (speaking by wireless 'phone to Folkestone) butted in, as the wave length was only slightly different. Still, the transmission of song, music, and speech was very clear. Mr. Crampton's apparatus was of special interest in that only three thermionic valves were employed, instead of the usual seven, an improvement which was made as recently as a couple of months ago.

On the following Monday morning the recently reoccupied buildings of the I.E.E. were viewed, and an idea was given as to the damage Government bureaucracy can inflict on buildings in its temporary occupation. Thence the party proceeded to the Lot's Road Power Station of the Underground Electric Railways, where it was met by the chairman of the directors, Lord Ashley, and the chief officials of the company. The chief items of interest that attracted attention were the oil burners now in use and in course of installation on the boilers. Two types are employed, the Thornycroft oil-pressure system and the "Scarab" steam injector. The officials stated that they found they could raise steam more quickly, and also that fuel oil at 90s. per ton compared favourably with coal at 54s. Many power-station engineers have talked glibly of utilising oil fuel under present circumstances, but have quite overlooked the necessity for large storage tanks. The Underground Railway officials have met this difficulty by borrowing two large oil tank lighters, into which they have led flexible steam pipes for heating and pumping the oil. A 25,000-kVA turbine set was in course of erection, and a 5,000-kW turbine, that had been running continuously since the opening of the station nearly sixteen years ago, was open for inspection. It was interesting to note what little wear had taken place during this long time.

The visitors were entertained at lunch at St. Stephen's Club by a large and representative party of electrical engineers, after which the first stage of the tour was commenced. The first stop was made at Henley, and after tea a trip was taken in a launch on the river. On the next day, Tuesday, the party motored to Hereford *via* Ettington and Stratford-on-Avon. At Oxford, the City Electrical Engineer, Mr. F. H. Francis, showed the party round the principal Colleges.

At Ettington Park the party was entertained to a sumptuous lunch by Mr. Robert Petersen, in his charming old-world mansion house, the original portions of which date back to before the days of William the Conquerer. The house contains a magnificent collection of pictures and antique furniture, including, to the special interest of the visitors, some excellent examples of Dutch art and workmanship. The detour through Stratford-on-Avon was made so that the guests might obtain an idea as to the appearance and characteristics of Shakespeare's country.

At Hereford the party was met by the Lord Mayor, the chairman of the Electricity Committee, and Mr. W. T. Kerr, the city electrical engineer. After dinner an inspection was made of the power station, and on the following morning a diversion was made from the direct route to Shrewsbury, to see the overhead distribution system for supplying farmers and outlying villages. Of all the engineering enterprises seen by the Dutch engineers on their visit to this country, that of Hereford made the deepest impression, partly probably because it was very akin to their own problems, and also on account of the uniqueness of finding such a large station in such a small country city of only some 25,000 population, whose per capita consumption is 122 kWh per annum, as compared with about 27 kWh in many other towns. All the more credit is due to the electricity staff, when it is borne in mind that Hereford is a farmer's market, and other industries are conspicuous by their absence. Ten electrical wiring contractors are kept busy, and find it difficult to retain any stock of electric cookers and heaters in their showrooms, so great is the demand. A normal farm equipment in the neighbourhood of Hereford comprises electric light and cookers for the farm-house, and a 15-h.p. motor and electric light for the barns. Mr. Kerr also demonstrated some of his electroculture experiments.

At Chester the party was met by Mr. S. E. Britton, the city electrical engineer, who showed the visitors the sights of the city. Arrangements have just been completed for the lease of the Government Munition Factory generating plant at Queen's Ferry. Only those who have had experience of the difficulties of negotiating with irresponsible Government departments will fully appreciate what this means; hence Mr. Britton is to be congratulated upon his success. For the time being, Mr. Britton's electroculture experiments on crops without manure have been suspended; it is to be hoped, however, that he will be able to find time soon to continue his investigations.

At Manchester a visit was paid to the Stuart Street generating station, and to the site of the new Barton power station, which is to be equipped with three 25,000-kVA turbine sets (maximum load of station 90,000 kVA). The foundations are well in hand, and a commencement has been made with the erection of the buildings. After this a demonstration was given of the operation of the Barton barge canal bridge. This structure is the only one of its kind in the world. It forms a channel for the passage of barges over the Manchester Ship Canal, and when ships wish to pass in the latter, locks are closed at the ends of the canal and its junction with the canal bridge. Similar locks are closed on the canal bridge, which is then swung aside, clear of the ship canal. The water contents of the canal bridge amount to about 1,400 tons. This engineering achievement greatly impressed the visitors from the land of canals. After this the party was entertained at lunch by the Metropolitan-Vickers Co., and then proceeded to inspect the works of the firm. Particularly noticeable, as indicative of the progress of electricity in the world, was the large number of large-sized turbo-alternators in the course of construction. In fact, it would appear that a central station ought to be ashamed of itself, if it had not on order a set of at least 5,000 kVA.

The official visit terminated with a dinner given by the Lord Mayor of Manchester, and the guests proceeded to London on the Friday, so as to catch Saturday's steamer.

Such a visit undoubtedly does much to promote the *entente cordiale* between nations, and in the present world's crisis, what is wanted, above all things, is a restoration of international credit which is based on mutual understandings. It was interesting to note the views of Dutchmen on the coal strike, as they are watching events very closely; they have so many patched-up affairs in their country, which are still smouldering, and both men and masters are taking their cue from England.

LONG-DISTANCE WIRELESS TRANSMISSION.

At a meeting of the Wireless Section of the Institution of Electrical Engineers on May 25th, Mr. C. F. Elwell opened a discussion on "Long-distance Wireless Transmission."

Mr. Elwell said that in planning a radiotelegraphic service over long distances the first consideration was the value of the power required in the receiving aerial or coil to operate satisfactorily the various receiving devices. The value selected must be obtainable under the worst possible circumstances, *i.e.*, it must represent the minimum value for the year. It had been shown that audibility as between two long-distance stations might vary from a minimum of 200 to occasionally 50,000. Opinions on this subject varied considerably. Dr. L. W. Austin considered that a minimum of 6×10^{-10} watt was necessary for good all-the-year-round communication in the Washington region. The Nauen station produced signals of this strength in American aerials, while Bordeaux with its 1,000-kW arc transmitter and 250-metre towers produced 20×10^{-10} watt. Professor Howe had worked out a figure corresponding to 400×10^{-10} watt as a suitable figure. Professor Vallauri measured signals received at Leghorn from Annapolis, and obtained values from 0.1×10^{-10} to 1×10^{-10} watt. A transmission formula for long distances was lacking. The short distances, from 20 to 50 miles, were covered by a formula based upon mathematical analysis. For longer distances the magnetic field would be less, but this could be corrected by the addition of a factor which took care of the curvature of the earth's surface and absorption of energy. This was then known as the Austin-Cohen formula. Dr. Fuller and Sommerfeld had suggested other values for the constant used in the Austin-Cohen formula. Prof. Howe had used the formula in calculating the power required for transmission over various distances up to 6,000 miles. The number of kilowatts thus obtained was in some cases quite unreasonable, but upon subsequent revision according to the Fuller formula the results were much more reasonable. It had been proved by Prof. Vallauri that the Austin-Cohen formula was not so reliable as the Fuller formula over distances of 4,000 miles. Other experiments reduced this distance to 2,200 miles. The speaker advocated international co-ordination and a special arrangement of the formula to differentiate between overland and oversea transmission. He thought that the inexpensive nature of the apparatus for measuring received currents would permit amateurs to aid in the collection of data. The Radio Research Board might be induced to coordinate the data thus obtained; a standard method of carrying out the measurements might be developed, and printed forms might be distributed to those willing to assist. After all, it was quite possible that no formula could be evolved either mathematically or empirically, because there was no reason to suppose that the distribution of the field due to a given transmission was symmetrical. It might become necessary to trace polar diagrams around wireless centres or certain countries.

Admiral-of-the-Fleet Sir Henry Jackson, speaking as chairman of the Radio Research Board, welcomed Mr. Elwell's remarks, and expressed the readiness of the Board to collate data if it could be assured that such data would be generally accepted. A specially-trained and qualified observer was required for the work.

Mr. A. Gray said that 18 or 19 years ago the Marconi Co. had evolved a formula for the calculation of the value of received energy, based upon the cube-root of the power and the effective height of the aerial. This company was still working on the question. He reminded his audience that occasional ranges had to be taken into consideration.

Capt. H. J. Round said that Mr. Elwell had commented upon the fact that values were exceeded during the night and winter. American night signals were only 1/5 or 1/6 of the strength of day signals. The best seasons of the year seemed to be spring and autumn. At present the value of power received from New Brunswick and other trans-Atlantic stations was about 16×10^{-10} watt measured near London, but the figure would have to be larger. Referring to the measurement of signal strength in watts, the speaker thought that the size of the receiving aerial should come in, and suggested microvolts per metre of aerial or ether as a better method of measurement. He did not recommend the measurement of signals by amateurs; it was a difficult job, and accuracy was essential. The N.P.L. might give data regarding the value of effective heights of aerials. He thought that audibility methods were dangerous for this purpose.

Prof. Fortescue said that the variety of formulæ on the subject suggested an examination of their bases to find which was the most accurate. The formula given by Mr. Elwell was probably the most satisfactory, and it had been proved to hold good for short distances. He then proceeded to explain the functions of the symbols given in the Austin-Cohen formula. The curvature of the earth required careful consideration. Pure refraction of the waves could not explain the reception of signals round one-half of the earth's circumference; the theory was that it was due to what was known as the "Heaviside layer," which kept the waves to a path following the curvature of the earth.

Capt. L. B. Turner said that with the present-day means of amplification weak signals could be increased to any desirable strength. The height of the antenna was not a serious consideration. A big point was the selection of a suitable wave length. The longer the wave length the more violent were atmospheric disturbances; it was necessary, therefore, to select a wave length which would give the greatest ratio between the power which it was desired to receive and that which was *not* desired. He showed by a table the results obtained over a distance of 5,000 km. which indicated the falling-off of the ratio with increased wave-length. At 1 km. the ratio was 0.39; at 2.2 km. 1.0, and this fell until at 10 km. it was only 0.11, showing that 2.2 km. was the length to employ.

Prof. E. W. Marchant also thought that signal strength was of minor importance with good amplifying apparatus. The figure 1×10^{-10} quoted by Mr. Elwell was rather high. He hoped that more care would be taken to state the aerial current in each individual case considered. Tests by means of shunted telephones had not been satisfactory; far more accurate results had been obtained by means of galvanometers and valves. The series of observations and co-ordination suggested was certainly desirable.

Capt. Trench said that in considering these questions fascinating side issues had to be avoided by engineers. He suggested two or three ways in which the Austin-Cohen formula might be simplified. Modifying factors had to be applied for various conditions. The formula had been used for trans-Atlantic transmission; over the Pacific Ocean conditions might be entirely different. He did not think the aid of amateurs could be relied upon for the collection of data.

Mr. Eckersley showed some slides on which were plotted the results obtained during 24 hours. The stations concerned were Marion and Chelmsford, and the figures given were the actual voltages induced in the Chelmsford aerial working with a current of 380 A. It was seen that while the average during the daytime was 517 mV, at night the value fell to as low as 200 mV. The ratio between the measured values and those obtained by the Austin-Cohen formula worked out between 1.82 and 1.89. The speaker said that if the assumed height of the Heaviside layer was correct the distance at which reflection and refraction of a wave became effective was 250 km.

Mr. Lunnon displayed lantern slides showing the apparatus used in obtaining the results mentioned by the previous speaker. This was something similar to that used by Prof. Vallauri in his experiments.

Major A. C. Fuller thought the first step to be taken was the standardisation of the power required for any particular type of aerial. He also suggested a standard apparatus with a tape recorder for measuring values of received power. The value of current received would vary with the geographical position of each station; the results obtained could be plotted and co-ordinated.

Mr. Reed considered that field strength rather than watts should be sought for; the measurement of the power in watts was often misleading. He thought the best method of measurement was by means of a tuned loop as antenna, and amplifiers.

Prof. G. W. O. Howe said that Mr. Elwell had referred to his figure of 400×10^{-10} this was the strength of the field required for good all round working, and the factor of safety allowed was not too large. When the Austin-Cohen formula was used the number of kilowatts sometimes seemed too large.

Dr. W. H. Eccles said that the fundamental law governing the received portion of the power transmitted was the law of inverse squares; the formula merely showed what the factors were. Bending round the earth and absorption in the medium both took place, and these were put into one exponential term in the Austin-Cohen formula. The correctness of the formula for daylight measurements was really miraculous.

Mr. Elwell said that he would make a written reply.

ELECTRIC LIGHT WIRING SYSTEMS.

At a meeting of the National Association of Supervising Electricians, held on May 10th, Mr. F. T. Alldread read a paper on the above subject, which we abstract below, together with the discussion. The paper was written chiefly to cover the conditions and difficulties met with by supervisors and foremen in the contracting industry, especially in those cases where clients do not engage the services of consulting engineers.

Great attention is being paid nowadays in the preparation of lighting schemes to endeavouring to obtain a uniform degree of light throughout the whole area at a predetermined intensity on the principle of daylight instead of locally lighting the actual areas where a high intensity of light is required. The writer is strongly of the opinion that, before applying the apparently ideal system, the whole of the conditions of each proposed installation should be very carefully considered; otherwise it will be found to be both inefficient and extravagant.

Where operations have to be carried out over a large area, or where operators have to move about very much, uniform illumination is much the best, but in all cases where the actual working points are fixed and of small area, local lighting with small units adequately reflected and screened from the eyes is much the best and most economical method.

With regard to the system of wiring, in situations where the wiring is likely to be subjected to mechanical damage, or where it is desired to bury it under the plaster of walls and ceilings, &c., *heavy gauge screwed conduit* is the most suitable, but in other cases it is an open question which system will be the most satisfactory.

The chief advantages of the screwed conduit system are :—(1) Good mechanical protection to the wire, and very suitable for burying in walls and ceilings, &c. (2) The wire can be easily drawn out when faulty and replaced without disturbing the decorations. (3) Can be made practically watertight, and (4) gives complete protection from fire, due to electrical causes, except at the fittings and switches.

The disadvantages are :—(1) The wire being encased in a conductor at earth potential (usually at the same difference of potential as the supply voltage) is always under electrical stress which tends to break down the insulation, and is usually quite successful in doing so wherever it is weak, even though not low enough to be dangerous. (2) Being watertight (at any rate wherever dips without joints are made) any moisture that is collected is held, which corrodes the conduit, causing chemical action to take place in the insulation of the wire. (3) Where there is an excess of moisture in the air, the conduit will very quickly corrode and thus attack the insulation as before mentioned, or if lead-covered wire is used, electrolytic action will occur between the lead and steel, thus causing the steel to be eaten away, this action being greatly accentuated in places where the air is charged with damp salt or acid. (4) Very expensive to install and cannot be used on the surface where appearance is of consideration.

Steel conduit with continuity grip couplings makes a fairly good substitute, with the advantage that it is somewhat cheaper, but cannot be made watertight. The advantages and disadvantages are about the same as with screwed conduit, but the writer much prefers screwed conduit, and has found that, if properly installed by conscientious and reliable workmen, there is very little difference in cost of the two systems.

Steel Conduit with Plain "Push On" Couplings.—The Institution of Electrical Engineers and most of the fire offices have condemned this system, although it is still being used very largely in the cheapest class of work.

Wood casing and capping, where installed on the surface in dry buildings and not subject to mechanical damage, especially if well shellaced on all sides before erection, is as good as any system to be at present found. The wire being encased in a non-conductor, the insulation is subject to very little electrical stress and, therefore, breakdowns are extremely rare. There is no danger from electrical shock and very little, if any, with regard to fire from electrical causes; in fact, provided that the wires are not disturbed, the installation will be quite efficient long after the insulation has perished. The casing can also be made to form part of the decorations where desired.

The chief disadvantages are :—(1) Should the casings be subjected to damp, they become partial conductors, the insulation of the wire is electrically stressed, and, if weak, faults will occur. If the precaution is taken, in damp places, of fixing the casing off the surface by means of porcelain packing pieces and well shellacing the casing before erection, very little (if any) trouble will be found due to this cause. (2) Not suitable for places where subject to mechanical damage. (3) First cost is fairly high, being practically the same as that of screwed conduit. (4) Efficient labour is difficult to obtain, the average wireman usually having very little skill in this direction, and it is not practical to let carpenters do the casing work and wiremen the rest on small installations.

Lead or alloy-covered wire fixed direct forms an efficient and durable installation if installed under suitable conditions, and generally is found to be considerably cheaper than either screwed conduit or casing.

The chief advantages and disadvantages are :—All these systems are more or less subject to mechanical damage, and in practice the harder the alloy, the more difficult and expensive it will be to install. There is greater risk of kinks being formed, as well as sharp edges where the alloy is removed at fitting or switch points, both of which will damage the insulation. Where fixed on the surface, more especially with plain lead or the softer alloys, the wires are very liable to sag on horizontal runs, even though the fixings be provided at very short intervals, and therefore is apt to be unsightly. Although the wires when fixed may fit the surfaces perfectly, sagging will gradually occur, sometimes taking several months. The system can easily be made watertight. One great advantage is that if the ends are properly protected, the wires are immune from damage by impurities or damp in the surrounding air. Where salt or acids are present, the writer suggests that plain lead be used as some of the alloys are subject to electrolytic or chemical action under these conditions. In cases where it is desired to conceal the wires, they should be drawn into conduit where embedded in cement or plaster, but can be run without further protection under wooden floors and down hollow partitions, &c.

Hard Rubber-cased V.I.R. Wiring.—The rubber casing has a tendency to crack and open where the wires have been bent to a very sharp angle, this cracking only occurring at some considerable period after installation, thus exposing the V.I.R. insulation to any damp or corrosion that may be present. The wiring is more or less ragged and unsightly where installed on the surface, as a certain amount of sagging on horizontal runs is unavoidable.

V.I.R. cleat wiring systems form very serviceable and cheap installations. Extra protection must be given where the wires are liable to mechanical damage, and where within ordinary reach. This system is rather unsightly when on the surface. Very successful results have been obtained in installations where the V.I.R. wires have been cleated under wood joist floors and vertical runs on the walls, the wires being enclosed in conduit or wood casing. There is, however, a risk of the insulation of the wires under the floors being attacked by vermin, but the writer considers that if the wires are separately cleated under the floors and separate fibre conduits (which can be sunk behind the plaster) for each wire are used down the walls, the danger is practically nil. This system being then free from mechanical damage, and not affected by damp or condensation, is probably the cheapest and best that can be installed in buildings so constructed, more especially the smaller type of private residences. The insulation of the wires being really only of a secondary nature, especially on voltages of 100 volts and lower, the cheaper grades of wire can be used, and once installed can generally be relied upon to last a great number of years after the insulation itself has perished. The writer does not, however, advise this system for places where there is a strong chemical or salt-laden surrounding air, unless the very highest grade of rubber-insulated wire is used.

Bare Copper Wire on Insulators.—In buildings which have lofty roofs or ceilings, and appearance is not of great consideration, successful use may be made of bare copper or aluminium wires stretched tightly and bound to suitable porcelain insulators. A combination of V.I.R. cleat wiring and bare conductors forming the cheapest class of installation in suitable buildings will generally be found to be very durable and free from faults. In cases where chemically or salt-laden air is present, bare conductors are not recommended, owing to the liability of electrolysis acting between the conductors across the insulators where the latter are fixed to metal work. The system of running flexible insulated wires on button insulators has been very much used on the Continent, and there is a lot to be said for it.

Discussion.

Mr. Garrett, referring to a suggestion that some of the faults of screwed conduit could be got over by galvanising, asked how the threads were to be galvanised and what advantage there would be if they were? He did not think galvanising would be any assistance in preventing condensation. As to the comparative cost of wood casing and screwed conduit, he was surprised to hear that they were about the same. A serious difficulty he had found with "Cab Tire" cable was in the ends, especially when it was used in connection with, say, printing machinery where the cable had not only to withstand rough usage, but also the risk of contamination with printer's ink; he had never yet seen any system which looked after the ends, which too often were exposed to the elements. He had noticed that on some jobs something like 50 wires were bunched together outside and exposed to the weather. What happened when water got between the individual wires?

Mr. Crowdy said that where the threads were galvanised it impeded the continuity. It was difficult for the ordinary man to tell aluminium paint from galvanising, and it was a splendid conductor, and was often used. The present high cost of wages rather helped to justify the author's suggestion that wood casing was as expensive as screwed conduit, but thanks to the work of the Trades Training Schools some very good young wiremen were being turned out who were doing very much better work with wood casing than some of their forerunners did. There had recently been a big discussion by the

Institution of Electrical Engineers Wiring Rules Committee, upon which he represented the Association, about the advisability of putting two wires in wood casing without an intervening fillet. He could hardly believe his own ears when the suggestion was made, but 22 of them discussed the matter for four hours, and eventually a majority, apart from the Fire Office authorities, agreed that it was safer to run two wires of opposite polarity in one groove than to run them in separate grooves. The reason put forward was that more fires had occurred through the wood fillet than from any other cause. At a subsequent discussion, however, that decision was reversed. In the course of other discussions by the Wiring Rules Committee, he found that some consulting engineers and fire office authorities objected to running "Stannos," Henley's or "Cab Tire" cable under floors, but he, personally, did not see the difference between those systems and wood casing under floors. The objection, however, appeared to be that there was a possibility of the metal sheathing getting a kink in it, with the result that eventually there was a blow out in the twin cable, which was usually used. It was the fact that many cases had occurred of that kind with lead-covered twin cable, and fires had resulted. "Cab Tire" cable was funny stuff, and opinions differed about where it should be used and where it should not. In a case at Hampstead, the local supply authority refused to allow "Stannos" cable to be used for some heaters (the customer not wishing the walls or floors to be interfered with), but accepted "Cab Tire" cable. On another occasion he could not get the people concerned to accept the latter on any account. The end of "Cab Tire" cable was really a serious matter, and he made it a rule that it should be gripped by a suitable grip fitting. If they connected "Cab Tire" cable to an ordinary switch or holder, they would find that in, say, a week or two, the sheathing had appreciably shrunk and left an inch or so of unprotected wire.

Mr. Revell was prejudiced in favour of V.I.R. cleat wiring protected down walls with wood casing. He had had considerable experience in the use of this system; an earth seldom occurred, and a fire was unknown. A considerable quantity of that wiring was carried along under the open eaves, in which snow collected in the winter time, whilst the eaves were almost filled with birds' nests, which provided plenty of material for a fire, but nothing of that sort had happened. In some places also the insulation had been gnawed off by rats, but as long as the wires were kept apart, nothing occurred. On the other hand, with conduit there was a great incentive to slackness of work and there were all possible chances of breakdown. On those grounds he contended that there was nothing to beat the cleat system for safety and efficiency. Moreover, the structure of the building was not appreciably weakened, as it was with conduit, only the minimum amount of material being taken out to accommodate the wires. A case had come under his notice in the City of London, and, curiously enough, it was a fire insurance office building, in which the floors had dropped two inches through too much cutting away underneath to take the conduit. In spite of the criticisms that had been made of "Cab Tire" cable, there were circumstances in which no other type would stand up so well. In a sewer in Manchester a "Cab Tire" cable had been used for many years without trouble in circumstances in which many people would not undertake to put in an ordinary cable.

Mr. Crowdy asked what was the best system of wiring for the use of heaters in bath rooms? The difficulty with apparatus of that kind was that the frame must be earthed, and if they put in a 3-pin plug and an earthing wire for a radiator in a bathroom, then it was necessary to put in similar plugs all over the house, because very often the same radiator was used in the bathroom as was previously used in the bedroom. Difficulties also arose in connection with shaving pots, &c., which were used with d.c. adapters, and had led to several nasty accidents. The obvious thing was to do without radiators, but people would have them.

Mr. Stiling explained that no trouble should be experienced with the ends of "Cab Tire" cable if they were clamped.

Mr. Wright said his experience was that the cost of wood casing was about half that of screwed conduit in dry situations.

Mr. Whitley thought that the manufacturers of "Cab Tire" cable made a great mistake in recommending it for any and every purpose. For certain purposes it was extremely useful, but there were circumstances in which it should not be used.

Mr. Alan Kirk had recently got out estimates for various systems of wiring working-men's houses, and he found that the saving obtained by using lead-covered wire was so small compared with screwed conduit that it was decided to go ahead with the screwed conduit. The chief thing in all installation work just now was the cost of labour, which had gone up out of all proportion to anything else. In 1913-14 it was about 25 per cent. of the total cost, but now it was 60 per cent.

Mr. Goringe said that a good method to prevent condensation was to ventilate the conduit as much as possible.

Mr. Crowdy pointed out that with a three-wire system often quite an appreciable potential difference would be found between the neutral and earth: a recent test which he had made showed between 50 and 65 volts.

Mr. Alldread, in a brief reply to the discussion, said that prices which he had recently got out for wood casing and screwed conduit showed that the latter could be installed as cheaply as wood casing. As to galvanising, if the threads were tightly screwed up, galvanising was not necessary. He did not believe in aluminium paint, which was made of aluminum and varnish. Galvanising was resorted to in order to give protection from condensation and subsequent chemical action, and he agreed that if condensation could be avoided by ventilation, it should certainly be done. He had had no experience of "Cab Tire" cable, and would not, therefore, say anything about it. At the same time, he thought that if the ends of the cable were gripped efficiently that was all that was necessary. As to bunching wires outside, he saw no reason why the water should have any harmful effect upon the hard rubber insulation. The whole object in wiring was to provide the job at the cheapest possible cost, and not at the top cost which it was thought the customer could afford to pay. He agreed with Mr. Crowdy that present-day apprentices were making good workmen, and also that the two wires should not be put close together in wood casing without the centre fillet. There was no doubt that cleat wiring was one of the best systems, but there was no one system which satisfactorily met all conditions. As to wages, he would be inclined to put the present percentage of the total cost at even a higher figure than that mentioned by Mr. Kirk. His experience was that wages were now three to four times as high as they were in 1913-14.

ELECTROSTATIC ADHESION.

Great interest has been aroused by the remarkable demonstration of Messrs. Alfred Johnsen and Knud Rahbek at the Institution of Electrical Engineers, and the correspondence which has followed relating to earlier work in the same field. In our last issue we drew attention to the discovery of Elisha Gray in 1873, which was recorded in our pages, and we have now traced the matter further.

As Mr. Rollo Appleyard points out in a letter in this issue, whether Edison's chalk-cylinder loud-speaking telephone depended on the Johnsen-Rahbek electrostatic phenomenon, or upon electrolytic action, is somewhat in doubt. In The Telegraphic Journal (now Electrical Review) of April 1st, 1879, a detailed illustrated description of "Edison's New Telephone Receiver" was printed, from which we reproduce an extract:

"In fig. 1, *d d*, is a mica disk about four inches in diameter, held at its edge by suitable frame work; *c c* is a cylinder which can be revolved continuously in the direction of the arrows, and which is composed of precipitated chalk mixed with potassium hydrate and mercuric acetate, upon a metallic axle (shown by the shaded lines). This cylinder is kept slightly wetted with water. One end of a metal bar is fixed to the centre of the mica disk, and to the other end is fixed a small platinum point *p*, which presses upon the circumference of the chalk cylinder. The circuit between line and earth is made from this metal bar, through the chalk cylinder. As the cylinder is rotated either by hand or other power, the friction between the metal bar and the chalk cylinder is very considerable, and the diaphragm is drawn or bowed outward toward the cylinder. This operation is purely mechanical and local. When the electric waves are transmitted from the distant station by the speaker (who uses Edison's carbon transmitter connected in circuit with the induction coil A in the usual manner) over the wire to the receiver, each wave as it passes through the chalk cylinder effects by electro-chemical decomposition more or less neutralisation of the friction between the bar and the cylinder according as the wave may be a strong or weak one. The resultant effect of each wave is the freeing of the diaphragm, permitting it to regain its normal position. Thus a series of electric waves, with the alternate space between, effects a vibration of the diaphragm in perfect accord with the voice of the speaker, the action being solely electrical and chemical. The element of time is not a factor as in the electro-magnetic instrument of Professor Bell, where, as is well known, a perceptible degree of time is requisite for a charge and discharge. In this new telephone apparatus Edison dispenses entirely with the electro-magnet, heretofore used in all telephone receivers, substituting the above electro-chemical principle. This, by its greater delicacy and power, is made to vibrate a very much larger diaphragm than is possible with the electro-magnet, thus giving greater volume of sound and obviating the necessity for holding the telephone to the ear. By it the voice of the speaker is transmitted to the distant station

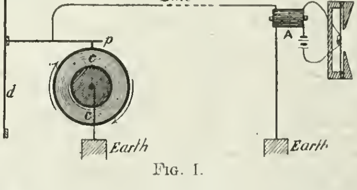

Fig. I.

without the loss of volume. In fact, at times, with a very considerable increase, the telephone speaks louder than the person talking at the transmitting station. It also produces the highest musical notes with the same perfection as the lower ones, something that was found impossible in the old machine. These points of superiority over the electro-magnet are due to the fact that while in the electro-magnet the electric waves constitute the force which vibrates the diaphragm of the receiver, in the new machine they only control it, the force used being strictly local, either the power of hand or clockwork."

It will be seen that the action of the instrument is ascribed to the *diminution* of friction when the telephone current passed between the chalk cylinder and the platinum contact—precisely the opposite effect to that observed by Messrs. Johnsen and Rahbek, as well as by Elisha Gray, Prof. Barrett, and Mr. Appleyard. The Edison effect is attributed to electrolytic decomposition, and it is interesting to note that the cylinder had to be kept moist with water. Whether this explanation was correct or no was the subject of discussion at the Physical Society on March 14th, 1880, reported in The Telegraphic Journal of April 1st. Mr. Shelford Bidwell showed experiments supporting the electrolytic theory, and Prof. Ayrton apparently held the same view.

Further particulars of an improved form of the Edison telephone were given in The Telegraphic Journal of October 15th, 1879, and we may add that hundreds of these instruments were put into use by the British Telephone Co.

In "The Speaking Telephone," by G. B. Prescott, published in 1879, Chapter V gives a full account of the researches of Elisha Gray, originally communicated to the American Electrical Society on March 17th, 1875, and quoted by Mr. Appleyard in our "Correspondence" columns to-day. The author points out that in experiments with the bath tub success was attained only when his finger was dry. Continuing his experiments, Gray constructed a cylindrical sounding-box with a metal cover, the box being mounted on a spindle to which a crank was attached. The metal cover was connected to earth through the spindle, and the operator held one end of the telephone line in his hand. On rotating the box and pressing the fingers against the cover, while the telephone current was flowing, he says, "the tune that is being played at the other end of the line becomes distinctly audible, and may be heard throughout a large audience room." Discussing the cause of the phenomenon, Gray proved that the effect was due to electrostatic attraction. Whilst we have not space to quote further from this exceedingly interesting article, we may mention that Gray applied himself to the transmission of "composite" signals and to their analysis at the receiving end, with a view to producing "a multiple Morse, a fast printing, an autographic and other systems," and succeeded with the aid of resonators. He says: "Many signals may, in this way, be transmitted over the same wire at the same time, and many dispatches sent simultaneously to as many stations. All this may be done, too, without affecting the line for its ordinary use." On one occasion, when he had been sending tunes over a short line, using one of the batteries of the North-Western Telegraph Co. at Milwaukee, he was surprised to learn that the tunes were reproduced by the relays in the various offices along the line. "Some of the operators being ignorant of the invention of the telephone at that time, were very much amazed at this new exhibition of the musical powers of their instruments, and I am told that one gentleman, sixty miles from Milwaukee, closed his office that night much earlier than he was accustomed to do." It will be remembered that America had not then become "dry."

REVIEWS.

The Electric Lamp Industry. By G. A. Percival. Pp. xxi + 112, figs. 26. London: Sir I. Pitman & Sons, Ltd. Price 3s. net.

This little book is one of a series dealing with common commodities and industries. It is not intended as a technical treatise, but rather to give a general description of the methods employed in the manufacture of electric lamps in a modern factory.

The book opens with a brief but interesting account of the development of the industry from the experiments of Sir Humphrey Davy down to the present date. The manipulation of glass and the pumping equipment are next dealt with, and the operation of several kinds of vacuum pump is described. Some figures are given to show that the molecular pump is much superior to others, but no attempt is made to describe it. The manufacture of carbon-filament lamps occupies rather more space than is justified, seeing that these lamps now only form about one-tenth of the world's output.

It will come as a surprise to most people outside the lamp-making industry to observe what a high degree of specialised chemical knowledge is required for the production of a commercial tungsten lamp, first in the reduction of the ore and preparation of the pure metal for drawing into wire, and later in the use of chemicals in the completed lamp to prevent blackening and assist in producing a good vacuum.

In the chapter on gasfilled lamps, the methods of preparing argon are briefly described, and the reasons for using a coiled filament are stated, but, unfortunately, there appears to be an omission of some kind in this chapter, and the argument is hardly intelligible.

The author gives a warning to users of inferior gasfilled lamps that sagging of the filament and the consequent opening out of the spiral may result in the efficiency being lower than that of the ordinary vacuum lamp.

The most interesting part of the chapter on arc lamps is the description of the Pointolite lamp, in which an arc is formed between a rod of rare earths and a tungsten ball in a sealed bulb, the result being a highly concentrated source of light of high efficiency.

There is an excellent chapter on vapour lamps of the arc and glow discharge types. Considerable advances have been made in the design of these lamps recently, and it may well be that they are destined ultimately to supersede the filament lamp. Certainly the lamps in which the light is obtained by a discharge through a rarefied gas approach more nearly to the ideal of a cold source of light, whereas the tendency with the filament lamp is to obtain higher luminous efficiency by increasing the temperature at which the filament is run. Obviously we must be approaching the limit of improvement in this direction, and the vapour lamps offer possibilities of research along quite different lines.

It is a pity that more care was not taken in correcting the text of this book. There are a number of errors, some of them slight, but others, as indicated above, affecting the sense of passages in which they occur, and these mar what is otherwise an extremely interesting and readable little book.

Fundamental Principles of Electric and Magnetic Circuits. By F. A. Fish, M.E. in E.E. Pp. xi+194; 106 figs. London: McGraw Hill Book Co. Price 16s. 6d. net.

This book has been written with a view to giving undergraduates a foundation for their studies of practical electrical engineering.

The author follows the method which has always been used in British universities, and sticks closely to fundamental principles; he makes reference to instruments and machines only when it is absolutely necessary to do so.

There is no great novelty in the method of treatment of the subject, but the explanations are so clear and accurate that the book should become very popular.

The chapter headings convey an idea of the ground touched on. They are, fundamentals, electricity and magnetism, electric circuits, electromagnetism, electrostatics, sine wave, alternating currents, non-harmonic waves and polyphase currents. The allocation of space and care to the different chapters has been very well done, and a private student with a knowledge of elementary trigonometry and calculus should have very little difficulty in working through the book without help.

The reviewer did not come across any original matter in the book, but he was greatly impressed by the very able manner in which some of the difficult points were explained. The treatment of hysteresis is very clear, and the derivation of the $B^2A/8$ formula for an electromagnet is very convincing.

Several examples on the calculation of currents in networks of conductors are fully worked out, but the introduction of the delta-star transformation would have been a decided improvement. This transformation which is useful in both d.c. and a.c. calculations is widely used in German practice, and deserves wider publicity in British and American text books.

The method of harmonic analysis adopted by the author is very interesting, although a professional mathematician would probably be dissatisfied with it. This subject could be taken up with advantage by some of the standardisation committees as it is of great importance, and students are liable to be mixed up by the multiplicity of methods given by various authors.

The final chapter on polyphase currents contains a brief treatment of Kirchhoff's laws applied to alternating currents, and gives an introduction to the calculation of currents in unbalanced circuits. This type of problem is generally carefully neglected by writers on alternating currents, although its importance must be obvious to everyone.

The use of pounds and inches as standard units is unfortunate, and the reviewer is of the opinion that the book would have been improved by the addition of a few unsolved problems at the end of each chapter, but apart from this, he can thoroughly recommend the work to university and technical college students who are beginning the subject of electrical engineering.

The printing and reproduction of the diagrams are of the usual high standard of the McGraw Hill Co.

The Electrical Handling of Materials. Volume I. Electrical Equipment. By H. H. Broughton, M.I.M.E., M.I.E.E. Pp. xiv+200; 231 figs. London: Benn Brothers, Ltd. Price 25s. net.

This review is concerned only with the first of the four volumes of which the work is composed.

The three remaining volumes deal with structural steelwork and mechanical equipment, cranes and crane mechanisms, and machinery and methods of handling and storing material.

The present work is a revised edition of the author's book on electric cranes and hoists, and has been almost entirely rewritten.

It is intended both for the user and the designer, and contains a number of typical specifications as a guide to the former in selecting appliances for his purposes, whilst the latter is provided with a large amount of information in the shape of drawings and particulars of machines and the principles underlying their design.

In his introduction the author lays stress on the evils of the system of casual labour at the docks and the social advantages of replacing this casual labour by mechanical methods of handling material. Although it would appear to be true that the introduction of what the author calls "labour-aiding appliances" does not, in the long run, adversely affect the amount of employment available, it is very difficult to convince the dock labourer that the use of a machine which does the work of twenty men is to his advantage.

We suspect that the economic aspect of the case is usually the deciding factor. The high rate of wages now paid for unskilled work, and the necessity for quicker clearing of cargoes, are all in favour of mechanical methods, and this work should prove particularly valuable at the present time.

In the chapter on electric motors, the types which are suitable for use under various conditions are described with reference to their operating characteristics.

Performance curves and general equations are given, from which the theory of speed regulation is developed in a clear and convincing manner. In describing the electric braking of a series motor by the method in which the field is separately excited, however, the author quotes what he describes as a lucid description from the *Elektrotechnische Zeitschrift*. This may have been lucid in the original, but is certainly not so in the translation.

Although no attempt is made to deal with the design of motors, the essential requirements for this work are outlined, and weights, speeds, and ratings for various standard lines of motors are given.

The author wisely insists on the need for standardisation and interchangeability of parts, and gives some striking figures of the saving that can be effected in maintenance costs by proper consideration of these points.

In the chapter on intermittent rating, it is shown from first principles that the rating of a motor should be based on the load factor, and examples are given to illustrate the differences obtained in actual cases between this method of rating and the more common one of a time basis.

In applying the theory for the heating of a homogeneous body to the complicated structure of a motor, considerable assumptions have to be made, but the author makes a strong case for load factor rating, and it is certainly less empirical than the older method of time rating.

A large number of types of controller are described and illustrated. The operation and wiring diagrams in this section are exceedingly good, well chosen, and well reproduced, the latter point being particularly important in the case of the more complicated diagrams of connections.

The dynamical theory of rotating bodies is given with sufficient fulness to show how the power required can be calculated in any given case, and also tables and examples which will in many instances enable such calculations to be dispensed with.

Numerous references are given to other literature on the subjects dealt with, and there is a useful index.

It is evident that much care and thought have been expended to make this work complete in all the details of the electric handling of materials, and it will prove to be a very valuable addition to the literature of the subject.

LEGAL.

Jones v. Greenling Electric Supplies, Ltd.

In the King's Bench Division on June 3rd, Mr. Justice Bailhache heard an action brought by Mr. S. G. Jones, carrying on business at Audrey House, Ely Place, London, against Greenling Electric Supplies, Ltd., of High Holborn, to recover £116, the value of certain flush type ammeters and voltmeters supplied to the defendants on September 23rd, 1920.

Plaintiff said the contract was for a gross of each, and defendants had failed to take delivery of all the goods. They said it was agreed that the time for delivery, viz., seven days, should be extended, but in breach of the agreement the plaintiff had failed to deliver within the agreed time, and they accordingly cancelled the order and accepted the failure to deliver as a repudiation of the contract.

His Lordship held that the defendants were bound to pay for the goods, and gave judgment for the plaintiff for the amount claimed.

Re Bastian Electric Co., Ltd.

The petition of W. F. N. May and Another for an order for the compulsory liquidation of the above company was again before Mr. Justice P. O. Lawrence in the Companies Winding-up Court on Tuesday, last week.

Mr. Schwabe, K.C., for the company, opposed a winding-up order, saying that the company was solvent, but it had not been able to pay that particular debt because it had not sufficient cash in hand. But it had large contracts for the supply of parts for electric heating apparatus. He alleged that Messrs. May & Padmore, who were concerned in the affairs of the company, had broken an agreement with regard to trading, and were trying to spoil the company's trade, which had improved considerably of late.

This was denied by Mr. D. Pollock, and his Lordship adjourned the petition for another 14 days.

Contraventions of Power Restriction Orders.

At Bristol, on May 30th, Henry Jones, a patent flour manufacturer, was charged with non-compliance with the provisions of the Coal Emergency Directions, 1921, in that he failed to restrict the use of electricity in his works to 50 per cent. of the average consumption prior to April last. The prosecution stated that defendant had been notified of the restrictions, but had announced his intention of applying for a permit to use full power as a food manufacturer. He was informed, however, that no permit would be issued as flour could be used for food without special treatment. Defendant said that although he had not paid particular attention to his power consumption, he had introduced shorter working hours for his employés. A fine of 7 guineas was inflicted.

A similar charge was preferred against Herbert Masters, a wholesale clothier. For the prosecution it was stated that defendant had used 69 per cent. above the power permitted to be used. Defendant pleaded ignorance of the local Restrictions Order, but stated that he had complied with it upon becoming cognisant of it. It was urged, in reply, that the warning circular had received the widest publicity. Defendant was fined 5 guineas.

Sedition Charge.

The hearing of the case against Frederick Newington, district secretary of the Wandsworth Branch of the Electrical Trades Union, for committing an act calculated to cause disaffection amongst H.M. Forces (Elec. Rev., May 20th, p. 618), was resumed on June 2nd at Bow Street. It was reported that a letter had been received from the Solicitor of the Union stating that branches had been informed that the fact that a member joined the Defence Force was not a sufficient reason to bring about his expulsion from the Union unless he ceased to pay his contributions. The action of Newington and his branch was apparently taken in error. The men who had been expelled had been informed that the resolution expelling them had been rescinded and annulled. The object of the prosecution having been attained, counsel withdrew the summons.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Electricity Supply Bill.

Your leading article in the issue of June 3rd contains several pertinent points upon which, with your kind permission, I should like to make a few remarks.

I plead guilty to referring almost entirely to the London Area, and for the reason that, not having had the advantage of being present at any of the Provincial inquiries and hearing all the evidence, I am unable to express a fair opinion. Judging by what I have heard and read, however, it would appear that many of the conclusions I have arrived at with respect to the London Area Scheme apply equally to those of the Provinces, and I believe I am correct in stating that the financial expert engaged upon the London Scheme is also engaged upon at least some of the Provincial schemes, and that his conclusions are similar.

Your reference to Mr. Leslie Gordon's report to the Executive Committee of the London Conference is somewhat unfortunate, for the reason that, I believe, that report referred to the complete scheme originally proposed, which included the erection of super-stations. These super-stations could not have been erected without a Joint Electricity Authority having financial powers under the Bill. That part of the scheme (super-stations) has now been abandoned, or at least deferred for several years, and a scheme for linking-up and developing the existing undertakings substituted, and I shall be surprised if many of the Provincial Areas do not ultimately adopt a similar scheme, as they could probably all do so with advantage. It could be carried out under the control of the Electricity Commissioners, and far more effectively, they being experts, than would be the case under a Joint Electricity Authority composed entirely of laymen with no special knowledge of the subject.

These circumstances considerably strengthen my contention that the Bill should be dropped, or the financial clauses removed and the protective clauses referred to in my article inserted.

In your leading article you say:—

"Failing the Bill what is the alternative? To perpetuate the existing chaos, and to make the best of the situation by linking-up the present generating stations and installing new plant in them where possible."

I venture to say that "the existing chaos" exists more in the minds of numbers of people as an obsession, than in reality. The various systems are undoubtedly inconvenient, but I very much doubt that they have materially checked the progress of the electricity supply business. It is a question whether the great cost of standardising would be justified, unless spread over a great many years.

In addition to the cost of new generating and transforming plant and distributing mains, every consumer who possessed motors or other appliances not suitable for the standard system would have to be compensated.

The latter portion of your statement is disposed of by the fact that the linking-up and development of the existing undertakings, which you criticise so severely, has been found to be the only scheme possible for some years.

In the last paragraph of your article you say: "With regard to the two amendments suggested, the first would appear to wreck the whole scheme." By this I presume you mean also the Bill, as it would not affect the London Scheme now proposed, nor any similar scheme, if carried out under the control of the Commissioners.

The insertion of the proposed clause should not affect the passing of the Bill, *if its supporters are confident that the formation and operation of the Joint Electricity Authorities will not necessitate a charge upon the rates.*

The Writer of the Article.

June 4th, 1921.

[Mr. Leslie Gordon's memorandum from which we quoted was dated May 7th, 1921, for the meeting of the Executive Committee of the Conference on May 10th.

If part of the scheme to which he referred has been abandoned, including the proposal to establish a Joint Electricity Authority, the change must have been made at or after that meeting (May 10th); and if our correspondent is basing his remarks on a modified scheme without a Joint Authority, which has not yet been made public, while we are dealing with the original complete scheme as published, it is obvious that we are at cross-purposes, and cannot arrive at agreement.

Towards the end of the letter the same impression is given by the statement that linking-up and development of the existing undertakings "has been found to be the only scheme possible for some years," and "it would not affect the London Scheme now proposed." Under the circumstances we must await the revelation of the modified scheme which, we gather, is to be placed before the Commissioners without prior publication.—Eds. Elec. Rev.]

Screwed v. Grip System.

In an interesting and practical paper read by Mr. F. D. Alldread before the National Association of Supervising Electricians, he states that there is very little difference between the cost of an installation carried out on the screwed system as compared with one carried out on the grip system.

A case that occurred the other day in a factory not a hundred miles from Birmingham furnishes a good illustration to the contrary.

Some motors had to be installed to run on the 440-volt supply, and several motors had to be installed on the 220-volt supply. It was arranged that the 440-volt circuits should be run in screwed tubing, and the 220-volt should be wired on the Walsall grip system. The most experienced man of the two men employed was given the job of carrying out the screwed work, and a man of less experience carried out the work of the grip system. The runs in both cases were almost identical, but it was found that it was possible for the less experienced man to wire up three motors in the time that it took to wire up one motor on the screwed system. The man doing the screwed work was taxed with being somewhat slow, and retorted that he would guarantee to wire up at least four motors on the grip system while one was being wired up on the screwed system.

Mr. Alldread in his paper did not sufficiently emphasise that although the grip fittings are practically equivalent in cost to screwed fittings, the tubing necessary is very much cheaper, and the saving in labour on most installations is very considerable indeed.

We all agree that in some circumstances a screwed installation is absolutely the best, but I contend that a great deal of money is often wasted in installing screwed work where an installation with the Walsall grip system would give equally good results.

With regard to the electrical continuity of the sheathing, Mr. Alldread emphasises the necessity of seeing that the enamel is always removed from the tubing before insertion into the fittings, but I should like to know if he has ever taken any tests for continuity even if this removal of the enamel is omitted. While I agree that it is advisable to insist upon the removal of enamel being carried out, it is certainly surprising what heavy currents can be carried without any overheating of the joints by a run of tubing and fittings, even if the removal of the enamel is omitted.

D. G. Brooks.

Birmingham.
May 24th, 1921.

Converting 50-cycle, 1,500-volt Alternating to Direct Current.

In your issue of May 20th appears an abstract of the report of a committee which was formed to report to the Electricity Commission, on the requirements of electricity supply in Kent.

In the section dealing with the electrification of the S.E. and C. Railway the conclusion is reached that 50-cycle, 1,500-V rotaries are unreliable and motor generators or 750-V rotaries in series too costly (presumably in both first cost and efficiency).

Is this not a clear case for the adoption of motor-converters? and have they not been overlooked?

K. W.

June 1st, 1921.

Cables for Hot Situations.

The conditions mentioned by your correspondent as to the use of cables in continuous high temperatures are not so severe, and provided that the temperature is maintained fairly constant, C.T.S. will prove satisfactory.

I have tried almost every conceivable method of wiring drying rooms at temperatures up to 150 deg. F. and with very high humidity, and I can say that the only really successful installations have been carried out with asbestos sheathed wires mounted on porcelain insulators away from the ceilings and walls.

The asbestos is not a good electrical insulator, and merely serves as a non-inflammable protection to the bare wires, and where the switch wires are carried through the walls into switches outside the rooms in question, the wires should be led in separate porcelain leading-in tubes and never bunched together.

Will your correspondent notify your readers at a later stage as to the "life" of the lamps running under the conditions he now details?—as he will certainly have some curious data without any reasonable explanation for the "variables."

Is it impossible to illuminate the rooms in question from the outside? There are several ways of doing this without loss of heat.

E. G. Phillips.

Nottingham.
May 31st, 1921.

Copper Losses in a Three-phase Motor Stator.

In reply to Mr. Voorhoeve's letter regarding this subject, may I state that I quite appreciate his remarks to the effect that in the actual machine the stator copper losses would be slightly higher than those obtained by the method outlined.

The importance of the correcting factor would, however, depend upon the degree of accuracy required, and also upon the ratio of the stator copper loss to the actual losses. Usually, this ratio is somewhere about 1 : 3, and if we assume an efficiency of 85 per cent., the reduced efficiency obtained by increasing the copper losses with the factor suggested, namely, 1.15, would amount to less than 1 per cent. This reduction would generally be less as the size of the machine increased, and therefore would not be of material importance.

I must admit, however, to Mr. Voorhoeve that in some cases it might be desirable to increase to a slight extent the stator copper losses calculated by the method described, in order to compensate for the increased resistance, but, as stated, the actual factor to employ would depend principally on the type and size of machine. At the same time probably no great error is introduced by neglecting this correcting factor altogether, although perhaps this will be more a matter of personal opinion.

A. Nash.

Manchester.
May 31st, 1921.

Coal Shortage and Oil Fuel.

I see that the good old discussion about Diesel engines is being revived, as a consequence of the miners' strike. Of course, it is ridiculous from a scientific point of view to burn under a boiler any fuel which will work in a gas producer, of anything like normal design, or still more, which will burn in a Diesel engine cylinder. Actually we use about three times as much oil under boilers as we do under the cylinder cover of a Diesel engine, both being in good order, with an average load factor. We will suppose that the turbo-alternators are absolutely reliable, that is, the cost and trouble of running them are zero.

If the boilers are capable of supplying 2,000 kW each, and for the sake of comparison, the Diesel engines are capable of supplying 2,000 kW each, will the gain due to the decreased consumption of oil be worth the trouble and expense of Diesel engines? Of course, I would say yes, but then I have used both. Let everyone figure it out for his own case (and then subtract any trouble he may have had with a turbine, if still in doubt).

In a boiler we may have decreased production of steam, due to burst tubes, either in the boiler or economiser, or even in the condenser. It will take, say, 20 minutes to get a boiler on the range, to help or replace a "dud." It will take 20 seconds, say half a minute, to put a Diesel set on load; of course, if you miss synchronising as the speed is rising you may have to operate the governor gear, and that will take longer, say three-quarters of a minute. (You couldn't miss paralleling.) A Diesel engine will require approximately as much attention as a boiler, both being oil-fired. The main difference is that an overloaded boiler will burst tubes, and an overloaded Diesel engine will (if of ancient manufacture), break crankshafts.

Of course (I admit this serious drawback), in the event of a strike, there is every chance that the Diesel station could be run, either by the chief, or by the Indian engine-room crews of any ships lying in our ports, or by casual labour (engineering students), provided that the plant was in good order. I claim that there is an advantage, however, which balances this, namely: It would be quite possible to lay down remote controlled sub-stations, with cheap plant, say, old submarine engines and old bipolar machines. These stations could be started up quite successfully if a microphone was fitted, and would supply, say, d.c. lighting and traction current, during the awkward few hours which some stations have occasionally.

No doubt the best solution to almost every problem is part turbo, part Diesel.

I hope that the demand for really reliable Diesel engines will encourage sufficient orders in the future to make the British Diesels as reliable as the special engines made in Germany, Switzerland, and Belgium.

One Junior Charge Engineer.

June 4th, 1921.

C.T.S. Cable in Iron Pipes.

Having considerable experience in the use of C.T.S. cable for wiring, particularly in situations detrimental to various classes of cable, I venture to gve my conclusions in reply to the letter of Mr. B. W. Goddard contained in your issue of the 3rd inst.

I have recently tested several installations where C.T.S. wire has been drawn through disconnected gas piping which originally carried gas to outlying buildings. When electricity superseded gas it was decided to risk using the piping laid underground for both the radiator and lighting mains.

Twin C.T.S. cable was employed (in one instance nine years ago) and the test proved the cable to be in excellent condition. Where no gas piping exists I have used enamelled screwed conduit sunk in the ground with highly satisfactory results.

Frequently I have sunk C.T.S. wire direct in the ground, placing sand on top to the depth of about 3 in. Over this sand narrow boards of creosoted wood were placed and the trench filled or levelled up with the original soil. The shortage of conduit during the war period prompted this procedure, and I have yet to learn of a fault. In one instance a zealous inspector insisted upon the sheathing being earthed—until he was convinced that it was not metal.

In conclusion, I would indicate that a London municipal electricity supply department whose system of distribution is alternating current, single phase, and which is renowned for its stringent adherence to wiring rules, has very recently specified C.T.S. wiring throughout for the dust destructor establishment and public baths and wash-houses. Needless to say, these installations have to withstand various destructive elements, including condensation, rust and wide temperature variations.

W. Ellerd-Styles.

Leytonstone, E. 11.
June 6th, 1921.

The Grading of Mains Engineers.

It is somewhat difficult to imagine what useful purpose can possibly be served by indulgence in the type of argument used by some of your correspondents relative to the grading under the E.P.E.A. Schedule. Instead of confining the discussion to what I quite agree is the grotesquely unjust treatment meted out to him, the charge engineer proceeds to belittle the status and requisite ability of the mains engineer, whereupon the latter retorts with an equally complimentary opinion of his colleagues in the power station. Such mutual disparagement does not assist in any way towards a redress of the grievance caused by the glaring anomaly in the schedule, while it is distinctly unedifying.

I am one of the unhappy "Grade 8's," but I do not in the least begrudge the mains engineer his good fortune. Were I to find myself floundering in a quagmire, it would not afford me any solace to bespatter with mud those who had succeeded in finding solid ground, however prone I might be to contrast my unenviable lot with theirs. Rather would I look to them to reach out a helping hand, so that I might extricate my feet and presently join them on the bank. To pursue the metaphor, my quarrel would be, not with my dry-shod fellows, but with those who were responsible for putting us in our respective positions.

The mains engineers were fortunate enough to be well represented on the Negotiating Committee, and they were well served by their representatives; that's all. The charge engineers were badly represented, and who are more to blame for this than they themselves? So long as they continue to vote almost exclusively for "day men" candidates for election to section committees, just so long will they find their special claims overlooked and neglected. I do not accuse "day men" of deliberately or intentionally slighting their colleagues on shift work, but it has been my experience that after a man has secured a day job his memory of the disadvantages of working round the clock and at week-ends, &c., rapidly fades and his sympathy, warm at the beginning, cools off in a very brief space of time. It is human nature, not callousness. For this reason, a strong leavening of shift men ought to be elected on the committees, and shift members of the Association have the remedy for their present plight in their own hands.

In conclusion, I regard it as questionable whether the airing of these domestic squabbles in your hospitable columns is calculated to discover a panacea for the ills complained of. At any rate, I agree with "A. B." that criticism should be constructive and not destructive.

"Grade 8."

June 6th, 1921.

Retentive Force, and a Tale of a Tub.

It is to be hoped that the valuable suggestions of Mr. A. A. Campbell Swinton and of Sir William Barrett, referred to in your issue of June 3rd, will lead some of your readers to repeat those experiments of the 1870-1880 period, and to elucidate the question of the extent to which they have a bearing upon the brilliant results recently obtained by Mr. Alfred Johnsen and Mr. Knud Rahbek. Unfortunately, the events of the last six years have deprived me of access to the necessary apparatus, but I venture to indicate a line of research.

Sir William Barrett has put forward the view that Edison's loud-speaking or chalk-cylinder telephone depends upon the adhesion that occurs when an electric current is maintained across the contact-surface of a badly conducting materal and a metal. Mr. Campbell Swinton has reminded us that Elisha Gray attributed the action of "a speaking telephone" to electrostatic attraction, and that consequently Elisha Gray's apparatus was an early exemplification of the principle now being discussed. The evidence in favour of Elisha Gray's apparatus appears to me to be convincing; but with regard to Edison's chalk-cylinder there is a doubt—just such a doubt as suggests a fascinating investigation.

The literature relating to these two instruments is somewhat difficult to trace, but I have succeeded in finding definite information concerning both of them. In the *Proceedings* of the Royal Dublin Society there is an entry that on January 19th, 1880, Sir William Barrett laid before the Section on Physical and Experimental Science a communication on "Edison's Loud-speaking Telephone, and the Theory of its Action"; but, so far as I can trace, the *Proceedings* contain no account of that communication. The official report appears to be the summary on p. 483 of *Nature* for March 18th, 1880. The curious thing is that this report describes not electrostatic attractions, but exactly the reverse effects: a "diminution of friction," a "reduction of 'stiction,'" a "repulsive action," an "electrodynamic action" between the rotating cylinder and the platinum-faced arm. Before pronouncing judgment, the whole report should be read—it is easily accessible, and quite short—and an appeal should be made to experiment to prove whether these effects are to be attributed to retentive forces or to electrolytic actions producing the equivalent of lubrication. Elisha Gray's apparatus has a most enchanting history. He described it himself in a delightful paper on the "Transmission of Musical Tones Telegraphically" in the *Journal* of the American Electrical Society of March 17th, 1875. He showed the instrument to Tyndall in 1874, and he invented it probably in 1873. His son was playing with a Ruhmkorff coal and had connected one of the secondary terminals to a dry zinc bath. Elisha Gray noticed that when his son's dry hand touched the zinc, the bath emitted the same note as the coil. He then made a rotary sound-box with a metal flange, which he could rub instead of rubbing the bath, and thus he produced notes of various pitches according to the rate of interruption of the coil. The whole of this marvellous tale of a tub deserves to be reprinted. Elisha Gray definitely states that "we have here the conditions of a static charge," and that "the sensation when the sound was produced was as though my finger had suddenly adhered to the plate, and then as suddenly let go, producing a sound." Tyndall preferred to rub with bacon rind.

By good fortune I found a pamphlet in the Patent Office Library containing an illustrated report of a lecture delivered at Norwich, December 29th, 1877, on "Telephones Old and New," by Sir William Barrett. This also deserves to be reprinted, for it contains an account of Elisha Gray's apparatus and of a good deal besides that ought to be better known.

Rollo Appleyard.

London.
June 6th, 1921.

[We refer to this subject on p. 744 in this issue.—Eds. Elec Rev.]

New Canadian Electric Steel Plant.—An electric steel foundry plant, the first of its kind east of Montreal, has just been established at New Glasgow, by the J. W. Cummings Manufacturing Co., Ltd. The plant will turn out electric steel castings, and will cater for the trade of the Maritime Provinces and Newfoundland.—*Reuter's Trade Service* (Halifax, N.S.).

BUSINESS NOTES.

Bankruptcy Proceedings.—William Wheatcroft, 162, Freeman Street, Great Grimsby, electrician.—The public examination of this debtor was held on June 2nd, at the Town Hall, Great Grimsby. The statement of affairs disclosed liabilities of £753, and there was a deficiency of £737. It appeared that after being demobilised from the Army, the debtor commenced business as an electrician in March, 1919, with £100 which he borrowed from a relative. He discontinued the business in 1920. He attributed his present position to bad trade. The examination was adjourned.

H. E. Carr, electrical contractor, Goole.—Trustee (Mr. C. R. Townend, Carlisle Chambers, Goole), appointed May 31st.

J. S. Denley (Denley & Co.), electrician and cycle dealer, 69, Regent Street, Cheltenham.—First and final dividend of 3s. in the £, payable June 9th, at the Official Receiver's office, 26, Baldwin Street, Bristol.

R. P. Baker and F. C. Stubbs (Sheffield Electric Construction Co.), electrical engineers, Sheffield.—First meeting, June 14th. Public examination, July 7th, both at Sheffield.

Company Liquidations. — Amalgamated Electric Works, Ltd., 32, St. Mary Axe, London, E.C.—The creditors interested herein were called together on May 31st, at Winchester House, E.C. Mr. P. Houstoun, of the British Traders' Association, was elected to the chair. Mr. J. L. Mahon, chartered accountant, of Windsor House, Kingsway, W.C., who had been appointed to act as the liquidator in the voluntary liquidation of the company, presented a statement of affairs which showed liabilities of £1,301. Of that amount £901 was due to the trade, while Mr. J. A. Bower was a cash creditor for £400. After allowing £74 for preferential claims, the assets were estimated to realise £672, or a deficiency of £629. The company was registered on September 26th, 1919, with a nominal capital of £5,000 in £1 shares. Only 102 shares had been issued, but they were allotted for cash. About three months ago a balance-sheet was prepared, and it showed a profit of about £75. The present position had been brought about very largely by the fall in prices. The company had suffered through the slump in trade, and it appeared that recently goods had been sold at cost prices in order to obtain money. The directors of the company were Messrs. J. A. Bower and A. S. Richards. No directors' fees had ever been paid. Mr. Bower had never drawn anything from the company, while Mr. Richards received a nominal salary. In answer to a question, one of the directors stated that goods had been sold recently at cost, and under, in order to get money to meet pressing creditors. The goods so sold comprised old stock, principally cut-outs and bells. The latter came from Belgium. Dissatisfaction was expressed at the position disclosed, and the representative of the Newman Electric Co. proposed a resolution in favour of an application being made to the Court for the appointment of Mr. T. J. Wilson, of Messrs. Wilson, Hunter and Co., chartered accountants, 59-60, Old Bailey, E.C., as the liquidator of the company. The representative of Messrs. William Geipel & Co., Ltd , seconded the motion, which was carried. The following are creditors :—

Green, Albert, Ltd.	£29	Newman Electric Co.	£127
Cheadle & Waltho	16	Electrical Components, Ltd.	20
Ward & Goldstone	12	Fillery Frères et Cie.	40
Leach, S. G., & Co., Ltd.	23	Boonella Bros.	90
Clark, E. E., & Son	46	Singleton, Benda, & Co.	96
Froy, Wm., & Sons	87	Davies, Kent & Stewart	11
International Electric Co.	21	Engineering Works, Ltd.	30
Geipel & Co., Ltd.	79		

Stoneycroft Electrical Works, Ltd.—Winding up voluntarily. Liquidator, Mr. E. Chetter, 26, North John Street, Liverpool. A meeting of creditors is called for June 17th at Liverpool.

Dissolution of Partnership.—Bass & Co., electrical engineers, 402, Essex Road, Islington, N.—Mr. W. S. Bass and Mr. R. A. Jones have dissolved partnership. Debts will be attended to by Mr. R. A. Jones, who will continue the business.

Trade Announcements.—The Consolidated Pneumatic Tool Co., Ltd., of London, has opened a branch office at 8, Clive Street, Calcutta, under the management of Captain E. Grigg. A stock of air compressors, oil engines, and portable tools, both pneumatic and electric, together with all necessary spare parts and accessories is kept there, and particulars of the erection and operation of the company's Giant semi-Diesel oil engines can also be obtained from Captain Grigg. Messrs. G. & A. Angus, of Rangoon, and the United Engineers, Ltd., of Singapore, have been appointed agents for Burma and the East Indies respectively, and they will carry stocks of the manufactures of the Consolidated Pneumatic Tool Co., Ltd.

Messrs. H. E. Ashdown (Birmingham), Ltd., have taken possession of their new and larger works at Aldridge Road, Perry Ba . Birmingham, where they have better facilities for meeting the increasing demand for their various mica insulating materials for electrical purposes, and land available for further developments as required.

The Premier Electrical Co. is removing to larger premises, and its address on and after June 25th will be 48, Grosvenor Road, Tunbridge Wells.

Messrs. Albert Lee & Co., Ltd., are circularising the trade with reference to their large stocks of electrical accessories.

The address of the Publicity Organisation of the General Electric Co., Ltd., will remain as at present 92-4, Queen Victoria Street, E.C. 4, but its telephone numbers will be "Central 2604 and 2605," instead of "London Wall 3600" as heretofore.

Catalogues and Lists.—The A.E.F. Manufacturing Co., 2, Clarendon Road, Turnpike Lane, Hornsey, N. 8. A price-list of standard accumulators and motor-car lighting sets.

Messrs. Ruston & Hornsby, Ltd., Lincoln.—Catalogue 4,078 (32 pages).—A well-illustrated brochure dealing with "Ruston" cold-starting oil engines. Full particulars and details of tests are given, and views of a number of installations are included in the catalogue.

The Macfarlane Engineering Co., Ltd., Netherlee Road, Cathcart.—Five price-lists of motors, dealing respectively with d.c., 50-cycle slip-ring, 50-cycle squirrel-cage, 25-cycle slip-ring, and 25-cycle squirrel-cage types. Also a list of users and terms of sale.

British Insulated and Helsby Cables, Ltd, Prescot, Lancashire. — Publication H 90, dealing with Helsby "Ozone-proof" cables, with an illustration and full particulars of various sizes. Publication No. P 170, describing various insulating varnishes and giving particulars of tests.

Electrical Utilities, Ltd., 1-3, Shelgate Road, Battersea Rise, S.W. 11.—Leaflet H 1, giving illustrations and very full particulars of the "Lightning" oven. Also a sheet giving details of the results of tests carried out with this appliance.

Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C. 2.—List No. 331, a priced and illustrated booklet dealing with many types of electric fans, and also with small d.c. motors ranging from $\frac{1}{30}$ to $\frac{1}{4}$ h.p.

Messrs. Aland & Co., 203, Great Dover Street, S.E. 1.—Two illustrated and priced leaflets dealing respectively with the "Boro" fan forge in various sizes and "Aland" improved exhaust fans.

Messrs. Superlamp, Ltd., 111, Great Eastern Street, E.C. 2.—Priced leaflet relating to electrical accessories.

The General Electric Co , Ltd , Magnet House, Kingsway, W.C. 2.—Installation Leaflet No. P 2,453. This illustrates and describes a 4,500-kVA Fraser & Chalmers-G.E.C. turbo-alternator set, and 400-kW motor-generator sets, installed in the East Station of the Newport Corporation.

Catalogues Wanted.—Mr. H. J. Davey, who has taken over the business of H. C. Robinson & Co., electric light and power engineers, 377, New North Road, London, N. 1, desires to receive catalogues from manufacturers, &c.

Adjudication Annulled. — W. H. Pease, electrical engineer, late of the Royal Hotel Shops, Scarborough and Doncaster. Adjudication annulled June 2nd, the debts having been paid in full.

Safeguarding of Industries Bill.—This Bill was under discussion in the House of Commons on Monday, when the motion had been moved for its second reading. It is described as "A Bill to impose duties of Customs on certain goods with a view to the safeguarding of certain special industries and the safeguarding of employment in industries in the United Kingdom against the effects of the depreciation of foreign currencies and the disposal of imported goods at prices below the cost of production, and for purposes connected therewith." It is in three parts :—(1) Safeguarding of Key Industries; (2) Prevention of Dumping; (3) General. Copies may be obtained at H.M. Stationery Office, price 2d. net.

Sir D. Maclean moved the rejection of the measure. He said that the proposals were against the tide of authoritative opinion, and quoted from the Bankers' Manifesto. Mr. Baldwin, President of the Board of Trade, replied, and in referring to the bankers' views, said he did not believe that any experts in the City or elsewhere could say what the course of foreign trade was going to be during the next two or three years. There were men of great experience who believed that in the near future we should have to meet fiercer competition from Germany than we had yet had, and no Government could neglect to take some steps to protect employment at a time so full of doubt and uncertainty. He said that the Government was only taking such steps as it believed to be necessary when the employment of our own people was likely to be seriously affected. The Bill was presented as an honest and *bonâ-fide* attempt to do something in a time of emergency. They knew that it would lead to criticism from many of their own friends, but they believed the Bill to be necessary, and they would do their best to secure its becoming an Act of Parliament. The debate was continued.

On Tuesday the Bill passed the second reading by a majority of 312 to 92 votes.

Electricians' Wages.—We have received from the General Secretary of the N.F.E.A. a letter showing that the previously-arranged wage reductions in the contracting and shipbuilding branches of the electrical industry have now been confirmed by both parties.

The Australian 44-Hours' Week.—The *Sydney Morning Herald* says that Judge Beeby, sitting as a special tribunal under the Eight Hours' Amendment Act, decided, in April, that a 44 hour week should be observed in the following and many other trades :—Boiler-makers engineers, electrical fitters, iron and steel-makers, joiners, moulders, machinists, pattern-makers, turners, wire-netting workers. His Honour in each case recommended that the 44 hours should be worked on $5\frac{1}{2}$ days, and in case of agreement between the parties he recommended that the 44-hour week be worked on five days, each of 8 hours 48 minutes, without liability on the employer for overtime.

The Tenders for the Morwell Power Scheme.—The *Melbourne Age* of April 7th says that according to the Electricity Commissioners, preference to Australian manufacturers, "whenever possible," will be the policy of the Commissioners when dealing with the tenders for the supply of equipment for the extensive Morwell power scheme. The value of this assurance to Australian manufacturers depends mainly on the spirit in which the qualification "whenever possible" is interpreted. In an article in *The Age* yesterday reference was made to a suggestion that influences had been at work with the object of furthering the interests of certain American tenderers. It was pointed out that the tenders for the equipment required for Morwell would amount to about £1,500,000, and that with the vast expansion of industrial activity locally, almost every class of electrical apparatus and machinery could be supplied, provided that local industries were given the encouragement they had the right to expect. Sir John Monash said it had always been the intention of the Electricity Commissioners to give every encouragement to Australian manufacturers. Whenever possible, the supply of boilers, condensers, and electrical plant would be placed in the hands of local firms. Australian firms had been given a share of the installation of Newport railway power equipment, and in the case of the Morwell scheme the Commissioners would see that local manufacturers got consideration, with due attention to the strides made in local manufacture during recent years. But the Morwell scheme was of such an extensive nature that provision from time to time would have to be made for the supply of certain special plant which could not be produced locally—or even in England. It would be necessary, for example, to obtain certain special gear with which only Americans had so far had experience. Instances such as this, however, would not mean that the Electricity Commissioners were ignoring local industry which, on the contrary, the Commissioners desired should have every facility for development.

Our contemporary on April 6th said:—

"Few people except those who are in direct touch with Australian manufacturers are aware of the vast expansion of industrial activity which has taken place during the past few years. But it is undoubted that almost every class of machinery and electrical apparatus and equipment can now be produced locally. On the Electricity Commissioners falls a heavy responsibility. The era of electrical power in industrial life is really just commencing in Australia, and with the inauguration of huge hydro-electric schemes in practically all the States there will be an ever-increasing demand for plant and equipment, both in the early stages and later on for renewals and extensions. If, therefore, Australian electrical plant manufacturers are given substantial orders for the Morwell works they will be encouraged to build up establishments which will be of inestimable value in years to come."

E.D.A. Activities.—The British Electrical Development Association has sent us another bunch of booklets and leaflets, some of which we have seen before. Among these publications is an artistically-produced booklet, "An Electric Home" (E.D.A. 77), describing a complete installation of appliances for lighting, cooking, heating, and cleaning. "Make it a rule to use electricity" is the advice printed on a cardboard slip marked off in inches (E.D.A. 128). The reverse bears small pictures illustrative of the ease with which various domestic jobs may be performed electrically. A leaflet (E.D.A. 156) exhorts the housewife to "clean and wash the easy way," and illustrates a washing machine and a vacuum cleaner in operation. The others, which are, for the most part, reprints of matter previously published, present in a very attractive manner various phases of the use of electricity in the home.

Mr. Beauchamp, the director and secretary, tells us that the Association has recently added a considerable number of interesting and up-to-date views to its collection of lantern slides dealing with the uses of electricity on the farm.

Rubber Exhibition.—The fifth International Exhibition of Rubber and Other Tropical Products and Allied Industries was opened at the Agricultural Hall on June 3rd. Its predecessors were devoted exclusively to the exhibition of rubber and its products, with the exception of that held in 1914, to which cotton manufactures were admitted. Although rubber is still predominant in the present show the scope has been considerably enlarged, permitting the display of such widely separated articles as carvings and metal work executed by natives of the tropics, and cocoa, chocolate, and soap.

Rubber in its many forms appears on the majority of stands, and rubber goods of all descriptions are to be seen. The application of rubber as an insulator is not given very great prominence. Several firms show rubber gloves, washers, and small articles. Messrs. Pirelli, Ltd., have a few samples of insulated wires and cables, including a section of a 1,000 sq. mm. power cable similar to one supplied to the Admiralty. A number of rubber tapes of various sizes are exhibited as well as a variety of small telephone parts in vulcanite, including mouth and ear pieces, hand grips, &c. Another firm showing telephone parts is the North British Rubber Co., Ltd., which also displays rubber belting, insulating gloves, &c. Several firms exhibit machinery used in the production of rubber. Messrs. Joseph Baker, Sons & Perkins, Ltd., have on their stand rubber washers, masticators, mixers, and patent mixing and kneading machines for the production of gutta-percha and rubber compounds. Messrs. James Carter (Stalybridge), Ltd., show a complete rubber mixing and sheeting unit, comprising a double-geared two-speed mixer-sheeting machine with chilled cast-iron rollers 36 in. long and 16 in. in diameter. This is driven by a 50-b.h.p. motor, by the Electric Construction Co., Ltd., through a vertical type double helical reducing gear, bringing the speed down from 500 to 50 r.p.m. This firm also shows washing plant and forcing or tubing machines. Messrs. Barrow, Hepburn and Gale, Ltd., have an exhibit consisting of Balata belting and conveyors made from Balata gum from British Guiana in combination with Lancashire cotton belting duck. Similar materials are displayed by Messrs. John Bright & Bros., Ltd. The exhibition remains open until June 13th.

The Coal Dispute.—Negotiations and subsequent "breakdowns" are still in progress between coal owners and miners, and in the meantime the unemployment list continues to grow. The *Morning Post*, quoting from an official source, gives the total on May 27th as 2,126,800, an increase during the week of 49.078. There were in addition to these about 1,194,200 working shorter hours. The effect of this has been the depletion of the Unemployment Insurance Fund, and special Treasury grants are to be made, "doles" are to be reduced and the contributions to the fund by employers, employed, and State are to be increased. Dr. Macnamara stated recently, in reply to questions regarding fraudulent drawing of out-of-work benefits, that 90,000 doubtful cases had been referred to the chief insurance officer, who had disallowed over 60,000 of them. Similar action had been taken by local Employment Committees, disclosing 41,000 persons who were not entitled to the money.

The installation of oil fuel burning apparatus has resulted in the relaxation of restrictions in many towns, and the chief improvement has occurred in connection with tramways, particularly in Leeds, where the normal services have practically been restored.

Large quantities of foreign coal are coming into the country, the lifting of the "embargo" by the trade unions having facilitated importation. In spite of oil and foreign coal, however, many towns have found it necessary to impose further restrictions, notably Keighley, which has decided to shut down the station from 12.30 a.m. to 5.30 a.m. daily, thus saving about 50 tons of coal a week. Strange expedients are being adopted by some undertakings. At Bradford old transformer oil and sewage grease have been used; Hereford is utilising coke-oven breeze.

The Economic Causes of the Coal Crisis.—Through the courtesy of Mr. D. A. Bremner, M.Inst.E.E., Director of the British Engineers' Association, we have received a pamphlet under the above title prepared by the Association. It is brief and to the point. It states that the tonnage of coal raised per person employed in the quarter ending March, 1921, was only 68.6 per cent. of the corresponding figure for the year 1913 and 55.3 per cent. of the average for the ten years 1883-1892. The number of persons employed in the first quarter of this year was 99,700, or 8.9 per cent., in excess of the average for 1913, and the yearly earnings per person £232, as compared with £82 in 1913, an increase of 183 per cent., as against an increased cost of living of 152 per cent. The average wages cost increased from 6s. 4d. per ton in 1913 to 26s. 2.71d. in the first quarter of this year, an increase of 314 per cent. The average selling price of coal rose from 10 shillings 1.5 pence in 1913 to 37 shillings and 4.9 pence in 1921. Our coal exports fell 60 per cent. Besides all this the direct loss on the industry (taken from the pockets of other citizen taxpayers) in the month of March, 1921, was £5,259,209. After allowing for depreciation, debenture interest, and owners' profits, a direct loss on the working of the coal industry of £85,000,000 a year is to be deduced from the March figures. The stoppage of the entire industry at the end of last March has already involved a loss in wages to the workers of about £33,000,000. The total loss to the country, direct and indirect, is of course colossal.

All these appalling facts are stated clearly and without embellishment, but they are supported by carefully prepared tables giving chapter and verse. We are told in high quarters that the country is apathetic about the strike and its results.

The apathy is, we think, more apparent than real, and Mr. Garvin's simile in the *Observer* of a fortnight ago, in our opinion, gives a truer insight into the situation. He remarked that a bomb appears apathetic until it goes off. But certainly the patience and calm of the British nation under all its afflictions are a marvellous asset.

Freezor Fans.—Acting in co-operation with the trade, the General Electric Co., Ltd., has in progress a Freezor Fan Publicity Campaign. New price lists and folders have been especially prepared, also coloured showcards measuring 19½ in. × 14½ in., and quantities of folders overprinted with the retailer's name and address are offered, as also are adhesive stamps. The G.E.C. Publicity Department (92-4, Queen Victoria Street, E.C. 4), is also prepared to assist traders in preparing advertisement designs to appear in the local Press, and to loan blocks suitable for this purpose.

Wages in the Iron and Steel Trade.—Under the sliding scale based on the selling price of manufactured iron and steel the wages of the men employed by firms affiliated to the Board of Conciliation and Arbitration for the manufactured iron and steel trade of the North of England are to be reduced 30 per cent., making a total drop of 60 per cent since the end of January. Wages are still 170 per cent. above the standard.—*The Times.*

The A.E.G. in Danzig.—The A.E.G. Electricity Works Co., of Danzig, as a "neutral" working organisation, with repairing business, and having branches in Posen, Bromberg, and Kattowitz, is reported to have considerably extended its activity in 1920. Although net profits of only 92,000 marks are disclosed on nominal capital of 300,000 marks, the credit balance has increased to 29,250,000 marks through the increase in creditors, on the one hand, to 28,840,000 marks, and, on the other, through the goods account having risen to 13,780,000 marks and the debtors to 15,140,000 marks. The taxes paid amounted to 205,000 marks.

Swiss Industry.—Switzerland, like many other lands, is at the present time passing through a very severe industrial crisis. Discharges are of daily occurrence from manufacturing works, and the outlay by the Federal authorities in relief of unemployment is constantly increasing. The Association Suisse des Electriciens is advising its members to buy their raw material from home firms, as the crisis in the country is due to the sale of foreign products; the middle-men, considering only their profits, buy from the agents of German firms. It points out that the Germans make the Swiss pay more for the raw materials (porcelain, steatite, ebonite, galalith, &c.) required in Swiss industries, than they do their own firms, as a consequence of which, they are able to sell the manufactured article at a less price than the raw material costs to be worked up in Switzerland.

Book Notices.—"The Magnet Magazine." Vol. VII. No. 24. April, 1921. 96 pp. London: General Electric Co., Ltd. Price 1s. net. First place is given in this issue to an illustrated description of the company's new headquarters, Magnet House, Kingsway, W.C. 2. A description, with views, of the new switchgear works at Witton is also included. The articles published include "The Selection of the Right Type of Small Motor," by T. C. Freeth; "Stonework Cubicles," by P. H. Ccales; and "Steel: Its Manufacture and Application," by James Calderwood. The social side of the firm is also given plenty of space.

"The Faraday House Journal." Vol. IX. No. 3. Summer Term, 1921.—This issue contains articles by T. R. Warren, "The Uniflow Steam Engine"; and Leopold Romero, "A.c. Over-pressures to Earth on d.c. Systems caused by Earth Faults on Armatures." A list of examination results is given, as well as details of transfers and elections to the various grades of membership of the I.E.E.

"The Manchester Steam Users' Association Memorandum for the Year 1920." By the Chief Engineer. (51 pp.) Manchester: The Association.—This memorandum deals with a number of subjects which are of great interest to manufacturers at the present day, when the high prices of all commodities make it desirable to reduce both coal and water charges. The advantage of using waste steam for heating purposes, and especially the production of power at a merely nominal cost by passing heating steam through an engine, are fully explained. A list of about 150 analyses of public water supplies all over the kingdom, together with instructions as to treatment for boiler purposes, is included. Under the heading "Advice to Boiler Attendants," fuel economy and related subjects are simply and carefully explained. The most important item in the memorandum is unquestionably the painstaking analyses of all reported boiler explosions which can throw light on the vexed engineering question as to the value of hydraulic tests in preventing boiler explosions. It is interesting to find that, contrary to a very popular belief, many explosions of boilers have occurred shortly after they had successfully withstood hydraulic tests at much higher pressures.

"The Municipal Year-Book, 1921-22." London: "Municipal Journal," Ltd. 21s. net; post free, 22s.—Besides this being a directory of the members and officers of local authorities, this is an encyclopædia of municipal activity throughout the United Kingdom. In addition to summaries of the work of the numerous borough and urban districts, it contains separate sections giving statistics of revenue and expenditure for the year 1919-20, in respect of the municipal water, gas, electricity, tramway, and motor-'bus undertakings, and also of markets, slaughter-houses, baths and wash-houses. The edition now before us includes tabulated particulars of a number of post-war housing schemes, giving the class of the accommodation provided, the system of construction, cost of erection, and the rent charged. Such information should interest others who are engaged either in the preparation or the carrying out of schemes. It also contains a census of municipal motor-vehicles, giving the number in use in the various departments, the purposes for which they are used, and the makes of the vehicles. Special articles are devoted to the work of the Ministry of Transport, recent progress in housing, the latest developments in the work of refuse collection and street cleansing, and the use of motor-vehicles in the municipal service.

"The *Journal* of the South African Institute of Engineers." Vol. XIX, No. 10. May, 1920. The paper included in this record of proceedings is "The Handling of South African Timber," and discussions on "Rubber Manufacture in S.A.," and fatigue in mines are also reported.

Patent Application.—Messrs. F. Forbes and F. W. Collett have applied for restoration of Patent No. 108,392 of 1916 for "Improvements in, or relating to therapeutic arc lamps."

French Moulded Insulation.—Among many other exhibits of interest on view at the French Chamber of Commerce, 153, Queen Victoria Street, E.C. 4, are a number of examples of moulded articles made from various kinds of insulating material by the Manufacture d'Isolants et Objets Moulés, a subsidiary of La Compagnie Générale d'Electricité.

Six classes of material are shown, each having its particular application. Four of these varieties are suitable for electrical purposes; these are "gummite," "roburine," "cegeite," and "infusite." "Gummite" is a black substance capable of withstanding the action of alkalis and acids, but vulnerable to oils. It may be used for accumulator containers, and several examples of these appear among the exhibits. One box shown is an example of many supplied during the war to the British Admiralty for installation in submarines. This is of large dimensions, measuring about 4 ft. × 1·5 ft. × 1·75 ft., and was produced with one pressing, there being no joints in it whatever. Several smaller containers are also to be seen, down to a small "pocket" size. A peculiar advantage of gummite is its ability to be "soldered" by means of a powder of the same substance and a hot iron. "Roburine" is divided into five classes. "A" is suitable for the manufacture of telephone parts, joint or terminal-box separators, insulated handles, &c. "B" possesses oil-resisting qualities, and can be used in a wide number of positions where it is likely to come into contact with oil. "C" is suitable for low-pressure work. "D" may be used for positions in which tensile strains are applied. "E" is especially applicable to X-ray work, it being opaque to the rays. "Cegeite" has a high thermal resistance, and on this account is suitable for use in heating apparatus, and also as high-pressure insulation. "Infusite" is also a heat-resisting material, but is only workable in plates or in other simple forms; it is infusible and incombustible.

The outstanding feature of all the parts shown is the absolute definition of details; every sample is clean cut, and a high polish is obtained during the moulding.

The British agents for this insulation are Messrs. E. H. Bissell and Co., 212a, Shaftesbury Avenue, W.C. 2.

Exhibition at Riga.—An International Agricultural and Industrial Exhibition is to be held at Riga (Latvia), from July 31st to August 28th this year. Exhibits will be admitted free of duty, unless sold. It is considered that the event will afford a useful means of promoting trade with Russia and the Baltic Provinces. Further particulars can be obtained from the British and Russian Transport Co., Ltd., 6, Lloyds Avenue, E.C. 3.

Social Event.—On Saturday, June 4th, the staff of Tredegars, Ltd., decorators and electrical engineers, of Brook Street, W. 1, entertained the directors of the firm to a motor drive through Surrey, proceeding *via* Ewell to Box Hill. Tea was taken at the Star and Garter, the journey being continued to Shere.

The Austin Motor Co., Ltd.—In the Chancery Division on 6th inst., in the debenture-holders' action of the Eagle, Star and British Dominions Insurance Co. against the Austin Motor Co., Ltd., on a motion for judgment in default of defence, judgment was entered for the plaintiff company.

Copper and Lead Prices.—Messrs. F. Smith & Co., and Messrs. James & Shakespeare report June 7th:—"No change in last week's quotations."

Greenwich Dispute Ended.—*The Times* says that the dispute at the Greenwich power station has been settled. The 200 men will be gradually reinstated as a result of negotiations between Trade Union representatives and the Highways Committee of the L.C.C.

Nottingham as an Industrial Centre.—A pamphlet of about 100 pages has been issued by the Industrial Development Committee of the Nottingham City Council, describing the varied nature of the industries of Nottingham, and of its resources. The transport, river, and canal facilities, water, gas, electric, and tramway services, the public buildings, and the lace, hosiery, engineering, and other industries are described, and a list of representative firms, together with a brief story of their operations, is included. Copies of the handbook, and any further particulars that may be required, can be obtained from the Industrial Development Officer, Guildhall, Nottingham.

Welsh National Exhibition, 1922.—Application is being made to the Board of Trade for a licence for the Welsh National Exhibition (Incorporated), which is to be an exhibition of trade manufactures and products, machinery and appliances, at Cardiff in 1922, to be registered with limited liability without the addition of the word "limited" to its title.

Armstrong, Whitworth's in South America.—Mr. John Noble director of Sir W. G. Armstrong, Whitworth & Co., who has been visiting Chile and Argentina on important business, interviewed by *La Nacion*, the Buenos Ayres newspaper, is reported to have said he had established relations with subsidiary companies up to a point of acquiring several mines, and that Armstrong, Whitworth's needed close association with concerns interested in South American mineral industries. Mr Noble enthusiastically referred to Argentina's natural resources.—*Financial Times.*

For Sale.—Holmfirth Urban District Council Electricity Department invites offers for one 60-kW, 460-V generator; and two 2½-h.p. motors. Messrs. D. Page & Sons will sell by auction at Graham Road, Derby, on June 15th and 16th, the entire plant; stock-in-trade, &c., of an electric lamp manufacturing company. For full particulars, see our advertisement pages to-day.

LIGHTING AND POWER NOTES.

Bangor.—Year's Working.—The total revenue accruing to the electricity works during the year ended March 31st last was £7,326, as against £5,930 in the previous period. Working expenses totalled £6,618, as compared with £4,873, leaving a gross surplus of £708 (£1,057). The capital charges absorbed £2,188, as against £2,215, causing a net deficit of £1,480, as compared with £1,158.

Birmingham.—Year's Working.—The accounts of the city's electricity undertaking for the year ended March 31st last show a total revenue of £1,293,521, as compared with £1,068,826 in the previous period. Working expenses amounted to £993,734, as against £776,291, leaving a gross profit of £299,787 (£292,535). After providing for all capital charges, including £137,935 for redemption of debt, a net balance of £68,161 remained. This is lower than last year's net profit, which was £75,324. The number of kWh sold rose from 127,938,924 to 136,921,417. The decrease in profit, in spite of increased revenue, is attributed partly to coal charges, which were 20 per cent. higher during the year, partly to increased local rates, which now absorb over £100,000 per annum, and partly to increased income-tax. It has been decided to transfer £53,000 of the net surplus to the renewals and special expenditure account, and the balance has been allotted to the reserve fund account.

Proposed Conversion of Station.—The Electric Supply Committee has been advised that it would be economical to operate Chester Street generating station as a sub-station, and the installation of a 1,500-kW motor-generator at a cost of £15,000 is recommended.

Blackpool.—Year's Working.—The annual report upon the Corporation electricity undertaking for the year ending March 31st last records a total income of £112,206, as compared with £80,259 for 1919-20. Working expenses totalled £83,321, as against £54,913, leaving a gross surplus of £28,885 (£25,346). Interest and other charges absorbed £20,705 (£20,077), resulting in a net profit of £8,180, which was double the estimate, and £2,811 more than the previous year.

Bootle.—Extensions.—The Electric Power and Lighting Committee has decided that, in view of the heavy expenditure which the Corporation may be called upon to meet, and the Committee being of the opinion that the consumers of electricity in the Bootle area would be better served by the extension of the borough's electricity undertaking as proposed in the year 1917 than by their inclusion in the scheme of the Merseyside electricity authorities to constitute a joint authority of the various authorised undertakers in the district, it was resolved that the Council should be recommended to again apply for the approval of the Electricity Commissioners to these extensions.

Bradford.—Loan.—Subject to sanction by the Ministry of Health, the Board of Guardians intends to obtain loans for various works, at an estimated cost of £15,168, including £2,000 for electric lighting at St. Luke's Hospital.

Fuel Expedients.—Oil fuel has not been adopted on any great scale at the Corporation electricity works, as the Electricity Committee feels that the advantages of oil over coal are not sufficient to justify the expense which would be involved. The engineer and staff have, however, rendered possible the raising of a certain amount of steam at the works by atomising a considerable accumulation of old transformer oil, and burning it in conjunction with coal. Air control is a handicap in burning oil and coal together, but the method adopted satisfies the need of the moment, though it is not looked upon as good enough to warrant the purchase of oil for fuel. An experiment was also made in the use of grease extracted from the Corporation sewage at Esholt. The Bradford sewage contains a great deal of grease, owing to wool trade operations and the sewage works are specially adapted to its extraction.

Burton-upon-Trent.—Year's Working.—The annual report upon the Corporation electricity undertaking for the year ended March 31st last records a total revenue of £74,582, as against £53,524 in 1919-20. Working expenses amounted to £47,203, as compared with £36,971 in the previous year, leaving a gross profit of £27,379 (£10,826). After payment of loan interest and other charges, the result was a net profit of £12,612, of which £1,000 was allocated to rate relief and the balance was transferred to the renewals fund. The profit in the previous period was £1,428. The total number of kWh sold rose by 1,131,143 to 7,132,045. The report shows great activity in the sphere of small domestic electrical appliances, and the engineer comments upon the success achieved by the showrooms opened six years ago.

Loan Sanctioned.—The Electricity Committee has decided to purchase from the Disposal Board the transmission line to the Machine Gun Factory for £4,500. The town clerk reported that the Electricity Commissioners had sanctioned the borrowing of £10,000 for the purchase of second-hand generating plant, and the sum of £5,000 for switchgear for the electricity works.

Canterbury.—Year's Working.—The report upon the electricity works for the year ended March 31st last shows that the income amounted to £20,579, as compared with £16,465 in the previous year. The expenditure totalled £15,160, as against £11,451, leaving a gross profit of £5,519 (£5,014). Loan interest and other charges amounted to £4,475, making the result a net profit of £1,044. The number of kWh sold rose from 870,058 to 1,021,883.

Chile. — New Hydro-electric Undertaking. — A company has been formed at Santiago de Chile, with the object of building a hydro-electric station on the River Colorado, estimated to produce 18,000 h.p., with which it is intended to supply electricity to the tramways of Santiago and Valparaiso, and for industrial purposes. The capital is 3,250,000 pesos, and the concession is a perpetual one; hitherto concessions have varied between periods of 30 and 50 years.

Continental. — Belgium. — La Société des Centrales Electriques des Flandres, which has secured contracts for the supply of electrical energy for lighting and power purposes to a number of small towns and villages along the two banks of the Ghent-Terneuzen maritime canal, is establishing a generating station at Langerbrugge, near Ghent, with a capacity of 17,000 kW.

Portugal.—Notwithstanding her small area, Portugal possesses relatively large water-power resources both in the north and in the midlands. The falls on the river Douro are estimated to be capable of yielding 350,000 h.p. Exact statistics are lacking, but it is estimated that all the resources total at least 600,000 h.p. In the south the rivers are very large, but the falls are unimportant, and there is a great loss from evaporation, so much so that development works are out of the question. At present there exist 36 hydraulic stations, ranging from 15 h.p. upwards, of a total capacity of 8,500 h.p.; 17 of these works have a capacity of 100 h.p. The most important is the Empreza Hydroelectrica da Serra da Estrella, which utilises a fall on the river Alva, also another on the Vaas Comprida, the height of the fall being 170 metres, and the output 1,800 h.p. It supplies power to the Gouvels factories and several towns.

Deal.—Time Extension.—The Town Council has consented to a further extension of time of one year to the Deal and Walmer Electricity Co., for carrying out the compulsory works included in the Order of 1914.

Derby.—Oil Fuel.—The chairman of the Electricity Committee recently stated that it was hoped to continue the "cheap and adequate" supply of electricity which had been maintained during the coal dispute. With reference to oil fuel, he said that the cost of carriage would neutralise any economy effected by its use, and he did not think it desirable to convert the boiler furnaces for the purpose. The lowest price at which oil could be delivered in Derby was £6 per ton. Two tons of coal slack was about equivalent to a ton of oil, and slack could be purchased at £3 per ton.

Dundalk.—Loan Sanctioned.—The Electricity Commissioners have sanctioned a loan of £2,000 for electric lighting improvements in Dundalk. At an interview with the Urban Council's Electricity Committee regarding supply to the Great Northern Railway (Ireland) Co.'s works, Col. G. T. Glover, the company's locomotive engineer, intimated that, in the event of a new flat rate charge per unit being proposed, and not meeting with approval, the company would probably install generating plant of its own.

Ellesmere Port. — Electric Lighting Order.—In response to overtures on the part of the Urban District Council, the Electricity Commissioners have stated that the Order granted to the Council must either be revoked or transferred to the Mersey Power Co. If a transfer was effected the terms would arrange for the reimbursement of the expenses incurred by the Council in securing the Order. The Council failed to arrive at a decision at its meeting, but the Electricity Commissioners are being asked for their reasons in giving, as an alternative to revocation, directions for the transference of the Order to the Power Co.

Exeter.—Progress of Extensions.—The electrical engineer recently reported on the new plant for the power station. The contractors for the foundations had been somewhat delayed by difficulty in removing the old concrete. Construction of the new piers could be begun. Excavations for the condensing water-mains were also in progress. The main contractors, Metropolitan-Vickers, Ltd., reported that they expected to dispatch the turbo-alternator, condenser, &c., well within the estimated time for delivery. The following plant was due for delivery from June to September:—Steel girder frame for turbine and condensing water pipes; steam turbine and condenser, alternator and air cooler, switchboard extension panels and connections, transformers, circulating water screen and accessories. If the dates could be adhered to, there was a good prospect of completion in time for use with next winter's load.

Felixstowe.—Strike.—The *East Anglian Daily Times* reports that the employés of the East Anglian Electricity, Ltd., ceased work on May 31st, as a protest against an immediate reduction of 12½ per cent. in their wages, and a further decrease of 12½ per cent. at a later date. It was hoped that terms would be arrived at at a meeting between the men's Union and the company.

Henley-on-Thames. — Proposed Water Power.—The Town Council recently rejected a recommendation that consultants be engaged, at a fee of 100 guineas, to submit a comprehensive report on the alternative schemes for water and engine power for providing an electricity supply for the town.

Horsham.—Extensions Approved.—The Electricity Commissioners have approved the extension of the electricity works as proposed by the electrical engineer.

India.—Calcutta.—The Municipal Council has decided that the question of granting a concession to the Calcutta Electric Supply Corporation, Ltd., in the matter of the extension of the period of option for the purchase of the undertaking be referred to a special committee consisting of eight members and a chairman to consider the whole question with particular reference to the following points:—(1) Abolition of monopoly and promotion of competition; (2) the necessity of having a local board of directors in Calcutta; (3) reservation of the right of the Corporation to examine the regulations and by-laws of the company dealing with applications from the public for electric connections and supply and any complaint arising therefrom; (4) reservation of the right of the Corporation to examine the schedule of rates every three years; (5) levy of charge for underground cables in public streets; (6) framing of regulations for opening up streets with the previous permission of the Corporation and restoration thereof; (7) the terms and conditions under which the company should be bound to supply electricity for street lighting and municipal institution from time to time; (8) and any other points which may arise affecting the public interests.

Jamaica.—Water-Power Development.—Representing commercial interests in Jamaica, a deputation interviewed elected members of the Legislative Council early in May, urging development of water power in the colony. It was stated that the electrification of the railway system was of prime necessity. The deputation expressed the fear that owing to the disparity of at least £1,000,000 between the estimates of British and American experts, the contract, if the Government should decide to take up the project, would go to the United States.—*Times Trade Supplement.*

Kingston-upon-Thames. — Sale of Undertaking Urged.—At a recent meeting of the Council, a member, referring to the losses incurred by the electricity undertaking, urged its sale to a private company. He was informed that a report upon the matter was shortly to be presented to the Council.

Liverpool. — Electricity for Houses.— The City Council has confirmed a proposal of the Housing Committee "that in consideration of the Tramways and Electric Power and Lighting Committee undertaking the capital expenditure in connection with the laying of the electric mains on the various housing areas, the Housing Committee will pay to that Committee annually a sum equivalent to the amount of interest and sinking fund contribution on such capital expenditure."

London.—Stoke Newington.—It was stated at a meeting of the Borough Council that the Ministry of Health had refused to sanction the installation of both gas and electricity in the new Lordship Grove flats. The action of the Ministry was severely criticised by many speakers who emphasised the importance of electricity in modern dwellings. It was resolved to install electricity whatever decision was arrived at by the Ministry of Health.

The Barking Station.—The Parliamentary Committee of the L.C.C. reports that in order to satisfy the Select Committee of the House of Lords appointed to deal with the matter, the promoters of the County of London Electric Supply Co. Bill (which provides for the erection of a large station at Barking) inserted a clause enabling the Joint Electricity Authority for the district to purchase the undertaking if such an authority was constituted within seven years from July 30th, 1918. The Select Committee finally approved this clause, but the L.C.C. Parliamentary Committee has given instructions for the opposition to the Bill to be continued.

Manorhamilton (Co. Leitrim).—New Plant. — The Electric Lighting Co. is installing new plant, at a cost of over £1,400, with the object of developing its operations and supplying the needs of districts outside the town.

Newcastle-on-Tyne.—Temporary Price Increase.—The Newcastle and District Electric Lighting Co., Ltd., has issued a notice to its consumers that, in consequence of the prolonged dispute in the coal trade, it has become necessary to resort to the use of oil fuel to maintain the supply of electricity, and that in consequence of the additional cost of production, the charges for electrical energy for both power and lighting purposes are to be increased. The charge for the latter is to be 6d. per Board of Trade unit.

Newcastle (Staffs.).—Erratum.—The report of the year's working under the heading "Newcastle (Staffs.)," in our issue of May 27th, related to the Stafford undertaking, and not to that of Newcastle.

Loan.—The Electricity Committee has decided to apply to the Electricity Commissioners for sanction to borrow £1,000 in respect of the work of laying a main along Friarswood Road, Cemetery Road, Hitherland to Drayton Street.

Siam.—New Plant.—A new 2,000-2,800-kW turbo-generator is to be added to the power station in Bangkok of the Siam Electricity Co.

Smethwick. — Oil Fuel. — The *Birmingham Gazette* says that it has not been necessary to impose any restrictions upon the supply of electricity at Smethwick, as the power company supplying the district has been using oil fuel as an adjunct to coal for the past 12 months.

Watford.—Loan Sanctioned. — The Urban District Council has received sanction to a loan of £23,200 for electricity purposes.

Wallasey.—Report on Breakdowns.— Consideration of the report by a Special Committee on the frequent breakdowns of plant some months ago, has been delayed, and it is now proposed to appoint a Sub-Committee of eight persons to render a further report. A section of the Council urges the formation of an entirely new Electricity Committee.

West Bromwich.—Loan Sanctioned.—The Town Council has received sanction to a loan of £29,040 for electricity purposes.

TRAMWAY AND RAILWAY NOTES.

Blackpool.—Year's Working.—The revenue accruing to the Corporation tramways during the year ended March 31st last was £279,661, as against £186,475 during the previous period. Working expenses amounted to £235,338, as against £147,770, leaving a gross profit of £44,323 (£38,705). After payment of capital charges the net profit remaining was £144, as against a profit of £15,583 in 1919-20.

Remedies for Losses.—Remedies suggested for the falling-off in profits on the tramways are the abolition of discount tickets, 50 per cent. increase in contract tickets, increased fare on Layton route, and a revision of fares between Blackpool and Fleetwood. Contracts costing £3 will be raised to £4 10s.

Burnley.—Track Renewals.—The tramway manager reports that 1,050 yards of single line have been re-laid, at an estimated cost of £6,300. To complete the re-laying to Queensgate there are 660 yards single (£3,960), making a total of £10,260. There are important reductions in the cost of material and wages, viz., 2d. per hour on wages, pitch 6s. per ton less, and cement £1 3s. per ton less. It has been decided that as more than half the sum produced by a 5d. rate has already been expended, the Tramways Committee be recommended to carry out only the re-laying of such portions as may be found most dangerous, as the Finance Committee cannot recommend the Council to provide more money during the present financial year.

Continental.—Spain.—A *Reuter* message, dated June 3rd, stated that the employés of the electric tramways were on strike.

Exeter.—Position of Undertaking.—The question of the future of the tramways came before the City Council, on May 31st, when Alderman H. J. Munro moved that the Tramways Committee should review the wages of the staff generally, and also the charges for electricity, with a view to reductions, and, failing its obtaining reasonable concessions, should consider the expediency of closing the undertaking, and report thereon to the Council. He reported that a £4,000 deficiency on the tramways had been included in the estimates. In discussion reference was made to previous consideration of the question of selling the undertaking to a company; this had been negatived. Mr. Percy Gayton, a Labour member, said last year the undertaking paid in rates and contributions to other departments £1,484, and the present estimate was £1,771. If they closed down they would still have to pay loan charges, which would exceed £4,000. Mr. J. S. Steele Perkins proposed increased fares, to lay the cost of the undertaking on the users. The motion for an inquiry was carried.

Halifax.—New Car.—The first railless trolley-car to be put into use at Halifax was given a trial run on June 3rd, in order to give the prospective drivers experience of the handling of the car. It was a more or less unofficial run over the Pellon and Wainstalls Road. The official run for inspection, prior to commencement of the service, has not yet been fixed.

Japan.—Railway Electrification.—The first part of the programme drawn up for the electrification of the Government railways, which is to be begun during this fiscal year, is said to embrace 203 miles of railways, and to cover the various routes in the neighbourhood of Tokio and Osaka. The work is to be completed by 1926 or 1927, and the amount of power required will be 70,000 kW, all of which will be obtained from power stations erected by the Government. A station of 15,000 kW is now being built in the suburbs of Tokio, and a plan is on foot to harness the Shinano River to the extent of 65,000 kW.—*Reuter's Trade Service* (Tokio).

London.—Westminster.—The inconvenience caused by the "dead ends" of tramways has become so pronounced that the City Council is considering a scheme for linking-up separate lines by means of motor-'bus services.

New Zealand.—Dunedin Extensions.—According to the *Otago Daily Times* of Dunedin (N.Z.), the Dunedin City Council is about to embark on considerable extensions to the present tramway system, and also intends to add to the present equipment. An estimated sum of £110,000 is to be expended on extending present lines. One of the extensions will take the form of a railless trolley 'bus capable of seating 70 persons. It will draw its motive power from the present type of overhead equipment, and is to maintain a service from an existing terminus. In addition to the proposed extra lines, 12 new cars are to be acquired, at an estimated cost of £52,000, and also six trailers, at a cost of £10,200. Two other cars are to be built at the Council's works and it is considered that these will absorb £8,000. Altogether, £135,000 is to be spent in this direction, including £47,000 on extensions to the car depôt and in the purchase of tools, &c. The grand total cost of the Council's project is £246,000.—*Reuter's Trade Service* (Melbourne).

Oldham.—Application for Time Extension. — The Corporation and the Chadderton Urban District Council have given public notice that an application is to be made to the Minister of Transport for an order under Section 18 of the Tramways Act of 1870 to extend the time for the completion of certain tramways authorised by the Oldham and Chadderton Tramways Order, 1919.

Taunton.—Undertaking Shuts Down.—On May 28th the undertaking of the Taunton Electric Tramways Co. was forced to close down owing to the cutting-off of the power supply by the Town Council. This was the outcome of non-acceptance of higher charges for power put forward by the Council. The existing agreement provided power at a fraction over 1d. per kWh, with a maximum of £600 per annum. The Council wished to increase the charge per kWh by 100 per cent., and the maximum payment to £1,000. The company pointed out that losses were already being incurred by the tramways, and during their 20 years' running, only one dividend had been paid—*viz.*, 1 per cent. in 1906. The Corporation recently declined to pay £7,000 for the undertaking, although the capital expenditure on it amounted to £30,000.

Torquay.—Fire at Depôt.—It is supposed that the blowing up of a petrol tank caused a fire at the tramway depôt on June 3rd, causing damage estimated at £20,000. During the dinner-hour, when only a few men were on duty, flames quickly spread to all parts of the shed. Some of the tramcars and other vehicles at the depôt were safely removed. Three tramway employés were injured by the fire. The damage is covered by insurance, and the manager hopes to replace the whole of the rolling stock within a month, with a view to dealing with the summer traffic of the resort.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—Shortage of Telephones.—The annual report of the Postmaster-General emphasises the acute shortage of telephones and material which continues to be experienced. The report states :—"Telephones connected in the Commonwealth increased from 205,272 on June 30th, 1919, to 224,000 on June 30th, 1920, a net increase of 18,728 during the year. This constitutes a record in the number of telephones added to the service in any one year since the inception of the Commonwealth, and the increase would have been probably 25,000 if the department had been in a position to meet the demand for telephone service. Approximately 11,000 applicants are now awaiting telephone service. Over £1 000,000 worth of material is on order, and tenders are about to be invited for additional material to the value of approximately £500,000. When this material is obtained and installed, it will considerably relieve the congestion that exists."—*Reuter's Trade Service* (Melbourne).

Wireless Telegraphy.—In his annual report, submitted to Parliament recently, the Postmaster-General (Mr. Wise) states that the total number of messages handled for the year ended June 30th, 1920, was 131,898, producing a revenue of £17,457. With the transfer of the radio service from the Navy to the Postal department immediate action was taken to extend its uses both for inland and trans-ocean public requirements. The regulations were amended so as to permit of any person obtaining a licence to erect and operate his own station in remote localities where land-line facilities were unobtainable. Where such private stations were erected to the department's satisfaction and the financial position was sound, the department undertook to transact business with the stations so as to provide the owners with communication with the land-line system. In furtherance of this policy, stations were about to be erected at Powell's Creek and Camooweal to act as collecting stations, and certain pastoralists had been informed that licences would be issued to them for the erection and maintenance of their own private wireless stations to work in with the collecting stations. Apparatus had been ordered to permit of trials being made in fast speed radio-telegraphy with a view to assisting over-loaded telegraph lines between selected localities. It was intended that Australia should be represented at the International Radio Convention, to be held this year, by an officer of the department.—*Industrial Australian and Mining Standard.*

Continental Wireless Services.—Mr. Kellaway, the Postmaster-General, in reply to an inquiry in the House of Commons last week, said that in the event of an agreement being reached between the Government and the Marconi Co. in connection with wireless services with the Continent, the agreement would be laid before Parliament. He was advised that as no charge would be thrown upon public funds, confirmation by a resolution of the House was not required ; but if there was a general desire for discussion, he would consult the Leader of the House about the possibility of meeting it.

India.—Cable Delays.—During the last few weeks the delay on cablegrams exchanged with India and the Far East has caused serious interference with the business of the community at large. An official of the Eastern Telegraph Co. states that the delay has been due to the temporary interruption necessitated by large renewal work carried out on the company's Red Sea cables. This work is being undertaken so as to increase the carrying capacity of these cables, and when it is completed the service with India and the Far East will be vastly improved. It is hoped that this improvement will be effected in the course of a few weeks. Unfortunately one of the Pacific cables belonging to another company was interrupted while the Red Sea operations were being carried out. Thus the whole of the traffic between the United States and the Far East was thrown on the Eastern Co.'s system, and the delay was thereby increased.—*Reuter's Trade Service.*

Magnetic Storm.—On June 4th, just three weeks after the recent magnetic disturbance, there was again some interference with the wireless telegraph system on the Continental "airways" owing to electrical disturbance of the atmosphere. The theory is that the sunspots to which the last storm was attributed are still in existence, having been carried round by the rotation of the sun so as to again influence the atmosphere of the earth, but in a milder form than on the previous occasion.

The Telephone Service.—Telegraph and Telephone Wires Cut.—More outrages, attributed to Sinn Fein, took place on Thursday last week at Liverpool. Fifty main telephone wires were cut down on the Leeds and Liverpool Canal, near Ford, Seaforth. Poles were sawn through on two telephone routes connecting the north and south of England at Roby. Thirty wires were cut on the telephone route to the North at Knowsley, and poles by the side of the railway were cut down at Mossley Hill and Hunts Cross. Three hundred telephone circuits are affected, says *The Times.*

Men said to have been found cutting telegraph wires at Gateacre, Liverpool, shortly before midnight on Tuesday, opened fire on the police when challenged, and the police returned the fire. Early on Wednesday morning it was reported that wires at Hayes, Middlesex, which connected with London, had been cut. An extensive wire-cutting raid seems to have been made in the neighbourhood of the Metropolis that night, probably by Sinn Feiners, and with the intention of isolating London by severing all telegraphic and telephonic communication. Many wires were cut and poles sawn through along the main arteries in Hertford, Kent, Middlesex, and Surrey. Among those affected were a Continental line, and the main telegraph line to Ireland ; signal wires on the G.W. Railway were also tampered with. Military patrols were at once posted.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia. — Melbourne. — August 10th. Victorian Railways. 250 core-type impedance bonds for power signalling, with a capacity of 1,000 amperes per rail ; also 50 miles of solid insulated copper wire, No. 14 Brown & Sharpe gauge, and 50 miles of solid insulated copper wire, 16 standard gauge.

July 27th. Victorian Railways. Incandescent lamps for electric car lighting : 24,000 metal filament, 46 W, 116 V ; 4,000 carbon filament, 32 W, 140 V. 5-h.p. electric motor, controller and resistances, or, alternatively, 5-h.p. electric motor and equipment.*

August 15th. Electricity Commissioners. Steelwork for power station buildings, roof covering, &c. ; water-tube boilers, stokers, fans, &c. ; platforms and ladders, steel chimneys, flues and dampers, sooting and dust extraction equipment, ash handling plant. (June 4th.)

August 17th. 3,000 sets of renewals for caustic soda primary cells.

August 30th. Board of Works. Four electrical centrifugal pumps, each with a capacity of twelve million gallons daily.

September 7th. Victorian Railways. Sixteen sets of air-brake equipment, 450 to 600 V., d.c., for single-deck tramcars.—*Reuter's Trade Service* (Melbourne).

Tasmania.—P.M G.'s Department. July 11th. Switchboard material (Schedule T. 317). (June 4th.)

Belgium.—Antwerp.—July 26th. Municipal authorities. Plant for the electric driving of the exhaust pumps at the Hattendyk dry docks. Particulars (3 francs) from the Hotel de Ville, Antwerp.

Brandon.—No date. Electric light installation for housing schemes for Brandon and Byshottles Urban District Council. Particulars from Mr. J. A. Robson, architect, Langley Moor.

Edinburgh.—June 22nd. Corporation. Electric lighting installations for houses under Gorgie housing scheme. Specifications from Burgh Engineer.

France.—Marseilles.—June 15th. The Commissariat General de l'Exposition Coloniale, 32, Rue Paradis, Marseilles. H.p. distribution system and a number of transformer posts at the forthcoming Colonial Exhibition.

Kirk Sandall.—June 22nd. Installation of electric light at the temporary Council School. Specifications from West Riding Education Architect, County Hall, Wakefield.

Leytonstone.—June 16th. West Ham Union. Three months' supply of electrical fittings. Mr. T. Smith, Clerk, Board Room, Union Road, Leytonstone, E.11.

Llandaff and Dinas Powis.—June 22nd. Rural District Council. E.h.p. feeder, with switchgear sub-station equipment complete. (See this issue.)

London.—Islington.—July 4th. Electricity Committee. H.p. switchgear. flame carbons. (June 4th.)

L.C.C.—July 11th. One 8,000-kW steam turbo-alternator and exciter, condensing plant, &c.; seven 1,000-kW rotary converters, static transformers and accessories. (See this issue.)

Manchester. — June 17th. Electricity Committee. Twelve months' supply of static transformers. Mr. F. E. Hughes, secretary, Electricity Department, Town Hall.

New Zealand. — Wellington. — June 28th. Public Works Department. Ten s.p. oil-filled transformers for the conversion of three-phase energy at 50 cycles, the voltage ratio being 50,000/11,000, for Waikato power scheme.*

June 28th. Supply and delivery at Lyttelton of two 50-kVA, two 100-kVA, and two 200-kVA condensers in connection with the Lake Coleridge electric power supply (Section 116).*

July 31st. Wairoa Electric Power Board. (*a*) Transformers, four 200-kVA, 11,000/1,900 single-phase units; (*b*) Insulators, 11,000 V and 3,000 V; (*c*) Air-break switches, 11,000 V and 3,000 V; (*d*) Fuses, 11,000 V and 3,000 V; (*e*) Lightning arresters and choke coils, 11,000 V and 3,000 V; (*f*) Accessories as per schedule. Tenders to the office of Messrs. Hay & Vickerman, Wellington.*

August 9th. Public Works Department. Suspension-type porcelain insulators for the Waikato power scheme.*

Nottingham. — June 16th. Electricity Committee. Twelve months' supply of general stores. (June 4th.)

South Africa.—July 5th. Electrification of Capetown-Simonstown and Durban-Maritzburg railway lines.

Rhodesia. — Bulawayo. — August 3rd. Municipal Council. Electric light and power plant. (May 27th.)

With reference to the "Official Notice" of the Bulawayo Municipality, published in our issue of May 27th, it should be noted that additional copies of the specifications, &c., can be obtained at 10s. per copy, not 20s., as printed in the advertisement.

Transvaal.—Rand Water Board. September 9th. Erection of a complete installation of mechanical or other filters capable of filtering 5½ million gallons of water per 24 hours at the Vereeniging main pumping Station (Contract No. 232). Copies of the contract documents may be obtained from the Chief Engineer, Rand Water Board, Johannesburg, upon a deposit of three guineas.*

Sudan.— June 30th. Sudan Government. Pumping machinery, consisting of Diesel or semi-Diesel engines and direct-coupled centrifugal pumps, capable of lifting 1,200 litres of water per second against a static head varying between 2·5 and 8 metres. Machinery must be delivered at Khartoum North by February 28th, 1922. Specifications, drawings, and conditions of tender may be seen at the office of the Sudan Agent, War Office, Cairo, Egypt. Tenders to Superintending Engineer, Department of Agriculture, Sudan Government, Atbara.—*Reuter's Trade Service.*

Trimdon.—June 11th. Electric light extension from Trimdon Grange to Trimdon Village, including the lighting of Trimdon Village with electricity. Specification, Mr. T. W. Wilkinson, Clerk to the Council, 24, South View, Trimdon Grange, S.O. Deposit, £2 2s. (returnable).

Uruguay.—Monte Video.—August 18th. State Electricity Works. Steel petroleum tank, Worthington duplex steam pump for oil, 250 metres steel tubing.*

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Australia. — The Victorian Electricity Commissioners have accepted the Metropolitan-Vickers's tender of £294,000 for the generating plant for the Morwell power-house. Out of this amount, £123,000 will be spent locally and the remainder in Great Britain.—*Reuter's Trade Service* (Melbourne).

Barrow.—Health Committee. Accepted :—

Two "Orwell" electric tipping wagons, £3,147.—Pollen & Crisp.

Belfast.—Tramways Committee. Recommended :—

Reconstruction of the first section of tramway track, £200,644.—Consolidated Construction Co., Ltd.

Belgium.—Nine concerns submitted tenders recently to the Limbourg Provincial authorities at Hasselt for the establishment of an electricity distribution system in the Genck-Hasselt district, the lowest being 1,484,050 francs by the Société d'Electricité de Genck.

Blackburn.—Town Council :—

Installation of e.h.p. switchgear at Jubilee generating station.—Met.-Vickers Electrical Co., Ltd.
Erection of two rotary converters and switchgear.—English Electric Co. Ltd.

Bradford.—Board of Guardians :—

Erection of boiler-house, heating, lighting and general completion of huts at Bowling Institution, £190.—C. Bell.

Liverpool.—Electric Power and Lighting Committee. Recommended :—

One 1,500-kW rotary converter.—Metro.-Vickers Electrical Co., Ltd.
Ash-handling plant.—Robert Dempsters & Sons, Ltd.

London.—L.C.C. Highways Committee :—

Supply of track rails and fastenings (about 5,400 tons).

Dorman, Long & Co., Ltd. (accepted)	**£85,556**
Anglo-American Improvements Corporation	86,738
Barrow Hæmatite Co., Ltd.	93,507
Walter Scott, Ltd.	96,163
P. & W. MacLellan, Ltd.	96,572
E. Risch	102,218
Bolckow, Vaughan & Co., Ltd.	103,191
Johnsons (Liverpool), Ltd.	112,210

Should the Committee require all or some of the new rails to be manufactured according to the new standard section lately issued by the Engineering Standards Association, Messrs. Dorman, Long and Co.'s tender would be increased by £675, the cost of the new rolls required.

St. Marylebone.—Electric Supply Committee :—

Renewal of two commutators of the 1,000-kW armatures of the Parsons' d.c. generators, £1,000.—C. A. Parsons & Co., Ltd. (recommended).
Seven new diaphragms for one of the 3,500-kW turbo-alternators, £1,025.—Ateliers de Construction Oerlikon Co. (recommended).

Stepney.—Electricity Supply Committee :—

Erection of Mile End sub-station, £12,473.—J. Jarvis & Sons, Ltd. (accepted).
Six feeder and six sub-feeder boxes, £306.—Universal Electrical Manufacturing Co. (recommended).
Steam flow meter, £130.—J. Downton & Co., Ltd. (recommended).

Manchester.—Tramways Committee. Accepted :—

H.d. copper trolley wire.—F. Smith & Co., Ltd.

Education Committee. Accepted :—

Electric installation, Ardwick Central School.—R. Seddon & Sons.
Do., Cheetham Central School. - Hall Bros.
Do., Ducie Avenue Central School.—Direct Electric Service Co.

Electricity Committee. Accepted :—

Cable.—Macintosh Cable Co., Ltd.; Western Electric Co., Ltd.
Two 7½-ton electrically-driven coal cranes.—J. M. Henderson & Co., Ltd.
One 7½-ton hand-power travelling crane and one 10-ton do.—H. Wharton, Ltd.
H.p. steam and water pipes.—Babcock & Wilcox, Ltd.
H.p. valves.—J. Hopkinson & Co., Ltd.
Three boiler feed pumps.—G. & J. Weir, Ltd.

Newcastle-under-Lyme. — Electricity Committee. Accepted :—

Laying of a main along Friarswood Road, Cemetery Road, Hitherland, to Drayton Street, £970.—Callender's Cable & Construction Co., Ltd.

St. Helens.—Town Council :—

Relaying junction section of tramway track.—G. Percy Prentham, Ltd.
Supply of materials for the above work.—British Insulated & Helsby Cables, Ltd.; The Rail Welding Co., Ltd.; Hadfields, Ltd.; and Edgar Allen and Co., Ltd.

Staffordshire, Wolverhampton and Dudley.—Joint Committee for Tuberculosis :—

Turbine, &c., for water-power scheme at Prestwood House Sanatorium (including £164 for generator and switchboard of Rees Roturbo type), £4,344.—Warburton & Co.
Electric wiring and fittings, £2,650.—Couzens & Akers, Ltd.

Wrexham.—Town Council :—

Distribution cables for the supply of houses at Acton Park, £1,300.—British Insulated & Helsby Cables, Ltd.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, June 10th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Lecture on "The Stability of Atoms," by Sir E. Rutherford, F.R.S.

London and Home Counties Electricity District Inquiry.—Tuesday, June 14th. At the Institution of Electrical Engineers, Savoy Place, Victoria Embankment. At 10.30 a.m. Inquiry by the Electricity Commissioners.

Chemical Society.—Thursday, June 16th. At Burlington House, Piccadilly, W. At 8 p.m. Hugo Muller lecture, by Prof. B. Moore, F.R.S.

Royal Institution of Great Britain. — Friday, June 17th. At Albemarle Street, W. At 9 p.m. Lecture on "Chemical Combination and the Structure of the Molecule," by Sir J. J. Thomson, F.R.S.

NOTES.

Humidification of Textile Factories.—At a recent meeting of the Cotton Spinners' Mutual Improvement Society, a paper on "Ventilation and Humidification of Textile Factories," was read by Mr H. N. Leask, A.M.Inst.C.E., a member of the firm of Cleworth, Wheal & Co., Ltd. The methods of dealing with various types of buildings and very full details of systems were given in the paper.

Prof. Einstein's Lectures.—Owing to the postponement of the sailing of the s.s. *Celtic*, on which he had booked his passage from America, Prof. Einstein was, explains *Nature*, unable to lecture at King's College, London, yesterday (June 9th), as arranged. It is hoped, however, that he will be able to lecture on Monday next (June 13th), at 5.15 p.m., and all tickets which were issued for Thursday will be available on Monday.

Educational.—The report of the Council of the City and Guilds of London Institute for the year 1920 was presented to the members at the May meeting of the Institute. One interesting matter covered by the report is the question of the closing of the Finsbury Technical College owing to lack of funds. It is gratifying to learn that the College is to have at least another five years of existence—the Institute having guaranteed an annual grant of £3,500 and the London County Council having approved the allocation of £10,000 a year for the continuance of the College. The vacation by Government Departments of premises belonging to the City and Guilds (Engineering) College is recorded. The number of students at this institution showed a very large increase during the year, rising from 337 to 587. The Diploma of Associate of the City and Guilds Institute (A.C.G.I.) was awarded to 100 matriculated third-year students at the close of the session in July, 1920, as against 19 in the previous year. Sixty-three students of the College obtained the degree of B.Sc. (Eng.) in the University of London. The report, dealing with the Department of Technology, says that no examinations were held in Grade 1 of any two-grade or three-grade subject, except in the cases of telegraphy, telephony, and flour milling. The total number of candidates examined in technological subjects during 1920 was 9,825, as against 8,523 in 1919. Ex-Service men were again permitted to enter for any grade of examination without regard to passing in a lower grade. The general income and expenditure account shows an adverse balance of £4,898. The statement of special income and expenditure shows an unspent balance of £1,441.

Appointments Vacant. — Electrical foreman ($375 a month +) for the Federated Malay States Government Railway; shift engineer for the Holmfirth Urban District Council electricity works. (See our advertisement pages to-day.)

Hackney and Non-Union Installations.—At a meeting of the Hackney Borough Council a long discussion took place upon the question of non-Unionist electrical installations. This arose from the decision of the Courts in the case of Dore *v.* The Council, reported in our issues of April 22nd and 29th, and May 6th. The Electricity Committee asked for definite instructions as to the action to be taken in the event of employés refusing to connect up installations carried out by others than Trade-Union members. A Labour member said that two such cases had already been dealt with successfully by negotiation. It was moved that the Committee and the engineer be accorded powers to take any "necessary action" to enable the Council to carry out its statutory obligations. The author of the resolution was asked to define "necessary action," or to give definite instructions. It was decided, however, that the Committee and the engineer should formulate a scheme of action in each case. The mover of the resolution then asked permission to make an addition confirming the action of the Electricity Committee in deciding to appeal against the decision given in the Dore case. This was allowed, and the motion was carried by 28 votes to 23.

The British Association.—Contrary to the usual custom the British Association for the Advancement of Science has arranged that several of the addresses of Presidents of Sections shall be discussed by the meetings in Edinburgh next September. Another new arrangement ensures that not more than two of the sectional addresses or discussions shall take place simultaneously, and thus visitors will not be so liable to miss an important address through attendance at another meeting held at the same time.

The Presidential Address, to be given by Sir Edward Thorpe, will deal with "Aspects and Problems of Post-War Science, Pure and Applied." The sectional presidential addresses include:—"Principles by which Wages are Determined," by Mr. W. L. Hichens; "Water Power," by Prof. A. H. Gibson; a popular exposition of the Einstein theory of relativity, by Prof. A. S. Eddington; and "Speech through the Ether—A Study of the Underlying Principles of Wireless Telephony," by Sir Oliver Lodge. One of the subjects for discussion by a conjoint meeting is "The Structure of Molecules."

Fatality.—On June 2nd an inquest was held upon Frederick Frost, an employé at the Poplar Corporation electricity works, who was killed while on duty. It was stated that deceased was removing the dust from some insulators on a high-pressure switchboard, when a flash was seen and deceased fell from the top of a ladder to the ground. Resuscitation methods were employed without success. A medical witness said that death was due to electric shock. An official of the works giving evidence, said that it was the duty of himself and another to see that switches and links were removed when cleaning was being carried out on the board. On the morning in question, witness inspected the board and gained the impression that it was "dead." However, a switch adjacent to the board remained in. The chief engineer said the switch was on a spare panel. The Coroner said it was another case of the entry of the "human element." A verdict of "Accidental Death" was recorded.

The Royal Air Force Pageant.—The Royal Air Force Pageant is again being held this year at the London Aerodrome, Hendon, by kind permission of the Grahame White Aviation Co., on Saturday, July 2nd. As in the case of the Royal Tournament, all the proceeds will be devoted to Service charities.

The Metric System in Guatemala.—Reuter's Agency is informed by the Guatemalan Minister in London that the National Legislative Assembly has decreed the official adoption of the metric system in the Republic.

Poisonous Dust.—According to the medical correspondent of *The Times*, at the Industrial Welfare Conference, on June 2nd, Prof. Collis mentioned a new piece of scientific work which showed that silica or rock dust is actually a chemical poison for the human body. Workers in it, as is known, are more liable than other people to consumption. What has not, so far, been known is that they are also more liable to kidney diseases. Certain dusty trades are notoriously unhealthy, but, apparently, it is only the rock or stone dust which produces the evil effects.

"Talking" Pictures.—Many attempts have been made to combine the actions of the kinematograph and the gramophone, but only a limited success has, so far, been achieved. A more promising arrangement was recently demonstrated at the Westminster Cathedral Hall by Captain Janion. This is the outcome of a great deal of experimental work by the Webb Syndicate, of the State of Delaware, U.S.A.

The speech-reproducing apparatus is so connected with the kinema projector that absolute synchronism is obtained, and the changing of "records" is automatically effected without a noticeable break in continuity. The gramophone is situated in the operating box and speech is transmitted to a loud-speaking telephone in position near the screen. The result is a very lifelike effect auguring well for the future success of the apparatus.

INSTITUTION NOTES.

Institution of Electrical Engineers. — The Council of the Institution has awarded the following premiums for papers read before or published by the Institution:—*The Institution Premium*, Mr. E. A. Watson, O.B.E.; *Ayrton Premium*, Sir P. Dawson; *Fahie Premium*, Sir W. Noble; *John Hopkinson Premium*, Mr. G. A. Juhlin; *Kelvin Premium*, Prof. E. Wilson; *Paris Premium*, Mr. K Baumann; *Webber Premium*, Mr. J. Paley Yorke; *The Duddell Premium*, Mr. B. S. Gossling; *Extra Premiums*, Messrs. S. Evershed, W. B. Woodhouse, R. O. Kapp, A. E. McColl, G. E. Bairsto, D.Sc., M. B. Field, O.B.E., A. McKinstry, B.A., M.Sc.; and *A Wireless Premium*, Captain R. C. Trench.

Wireless Section.—A paper on "Electric Oscillations along Straight Lines and Solenoids," was read by Prof. J. S. Townsend, F.R.S., at a meeting held on June 8th. A number of experiments made by the author and Mr. J. H. Morrell to find the relation between the frequencies of the normal oscillations of systems were described. The oscillations of solenoids and parallel wires were discussed, and an estimate of the accuracy obtained in measuring wave-lengths by wires was given. A simple method, depending on harmonic oscillation, was described whereby the lengths of short waves measured by means of parallel wires could be compared with those of long waves measured by means of standard inductances and capacities.

Western Centre.—The following have been nominated for election as officers and Committee for the 1921-22 session:—*Chairman*—Mr. A. C. MacWhirter (Cardiff); *Vice-Chairmen*—Mr. F. Tremain (Bristol), and Mr. C. T. Allan (Cardiff); *Committee* (five vacancies)—Prof. F. Bacon (Swansea), Messrs. W. A. Chamen (Cardiff), F. S. Carter (Porthcawl), A. H. Dowson (Bristol), W. Hardy (Bath), W. G. Heath (Plymouth), and Prof. D. Robertson (Bristol). Any further nominations must reach the Hon. Secretary not later than June 14th.

South Midland Centre.—Students' Section.—The report of the Committee for 1920-21 states that the membership has risen from 91 to 210. Seven ordinary meetings have been held at which interesting lectures and papers have been given, including an address by the President of the Institution on January 4th.

Institution of Engineers (India).—On May 3rd the Bengal Association of the Institution was formally established, under the chairmanship of Mr. A. Cochran, C.B.E., M.L.C. The total membership of the Section is about a hundred. The chairman becomes *ex officio* a vice-president of the Institution.

South Wales Institute of Engineers.—At its meeting, last week, the Institute resumed the discussion on a paper on powdered fuel, by Mr. Robert James, Wh Sc., D.I.C. Mr. James analysed the pulverising costs of a plant dealing with 50 tons a day, and, after allowing for interest and depreciation, arrived at a total cost, including cost of drying, &c., of 7s. 6d. per ton. He stated that a plant for firing a Stirling boiler of 40,000-lb. per hour capacity with powdered coal on the Holbeck system is at present approaching completion at the electricity works of the Hammersmith Corporation. In this case the fuel will be made as required in a self-contained turbo-pulveriser, and the system will work under a slight vacuum, so that there should be no chance of coal dust escaping into the atmosphere.

Illuminating Engineering Society.—The report of the Council for the past session states that Mr. J. H. Parsons, C.B.E., F.R.S., has accepted the office of president, and pays a tribute to the services of Mr. A. P. Trotter, the retiring president. New joint committees on gas lamps and lighting appliances, on photometry and allied subjects, and on studio lighting have been appointed. Co-operation with other bodies has been continued, and a session of the International Illuminating Commission is to be held in Paris from July 4th to 9th, 1921.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

As announced briefly in our last issue, Mr. Alex. Moir is retiring from the position of superintending engineer of the London district of the Post Office, after nearly 47 years' service. Mr. Moir started his official career in Aberdeen, his native town, and subsequently served in Edinburgh, Bradford, Leeds, Newcastle, Dublin, and London. In 1903 he was attached to the staff of the Engineer-in-Chief as head of the Construction Section, in which capacity he was responsible for the methods to be adopted in the construction of overhead and underground plant, and for the laying down of the main trunk underground routes. Prior to 1912 the engineering work in the London area was in charge of three, and, subsequently, of two superintending engineers, each of whom was also responsible for a provincial area. On the transfer of the National Telephone Co.'s business to the State, the present London engineering district was formed and placed under Mr. Moir's control. Mr. Moir controls a staff of nearly 6,000, a large proportion of which is at present engaged in overtaking the arrears of construction due to the war. Great strides in this direction have already been made, and much more would have been done but for the difficulties in obtaining the necessary stores. During the war 50 per cent. of the staff joined the Forces; the remainder in addition to keeping the telegraph and telephone services running smoothly, and providing some thousands of special circuits for war purposes, built up the extensive system of communication in connection with the London Air Defences. For his services in this direction, Mr. Moir was made an Officer of the British Empire. Mr. Moir is chairman of the Committee of Post Office Superintending Engineers, and was a member of the War Office Committee responsible for the introduction of the scheme of Army Signalling which proved to be so successful in the late war.

The L.C.C. Highways Committee recommends that Mr. G. W. Stubbings and Mr. S. H. Wigner be appointed technical assistants (Grade II) in the electrical branch of the Council's tramway department at a salary of £250, rising to £300 (based on pre-war conditions), subject to temporary additions making the total remuneration at present £512.

On Friday last the Bradford Corporation Electricity Committee passed a resolution of congratulation to Mr. T. Roles, the city electrical engineer, on his election as a member of the Council of the Institution of Electrical Engineers. The Committee also passed resolutions of thanks to Mr. Roles, Mr. J. Wright (deputy engineer), and their staffs, and to Alderman Wilfred Turner, chairman of the committee, for their able preparation and presentation of the Bradford and Conference scheme at the recent inquiry by the Commissioners at Leeds, into the rival schemes for the establishment of a Joint Electricity Authority for the Aire and Calder District.

York Corporation Salaries Sub-Committee reports having met the staff at the electricity works, who have accepted, under protest, if they are to be permanent, and do not fluctuate with the rise and fall in the cost of living, the following offers of increased salaries:—Mr. E. J. Nichols (chief assistant), from £420 to £490; Mr. G. H. Holmes (station superintendent), from £330 to £390; Mr. T. Gowland (mains), from £300 to £330; Messrs. D. I. Edwards, P. J. Woods, and C. Robinson (charge engineers), from £276 to £325; Mr. Wright (assistant engineer), £178 to £200; and Mr. Inglis, from £184 to £200. The Committee recommends that a proposal of the Electricity Committee to increase the salary of Mr. J. W. Hame, city electrical engineer and tramway manager, to £900 per annum (£600 as electrical engineer and £300 as tramway manager), be deferred until the salaries of the whole of the chief officials of the Corporation are dealt with.

Mr. R. T. Henry has been appointed, out of 20 applicants, to the position of construction engineer for the electric light scheme at Mossel Bay, Cape Province. Mr. Henry was formerly chief engineer at Delagoa Bay, and assistant electrical engineer to the Johannesburg Municipality and the Victoria Falls Power Co. It is expected that the plant will be working in less than six months' time.

Darwen Town Council has agreed to increase the salary of Mr. G. A. Newsholme, tramway manager, by £50 per year, with a further increment of £25 per annum for the next two years.

The *Financial Times* says that Mr. Douglas Vickers, M.P., chairman of Vickers, Ltd., is recovering slowly from a severe attack of gout and rheumatism, precipitated by worry and overwork. It is not expected that he will have recovered sufficiently to leave Aix-les-Bains until the end of June.

Mr. John Bunting, who has been associated for over 20 years with Messrs. Bruce Peebles & Co., of Edinburgh, is severing his connection with that firm to join the Ateliers de Constructions Electriques de Charleroi, for whom he is opening a branch at 56, Victoria Street, London, S.W. 1.

Obituary.—Mr. W. S. Hetherington.—The death took place on May 30th, at the Cumberland Infirmary, of Mr. William S. Hetherington, a member of the electrical staff of Hetherington Bros., Penrith, for whom he had carried out important installations at Lowther Castle and elsewhere. He was 27 years of age.

Mr. J. Phillips.—The death has taken place, at the age of 61 years, of Mr. James Phillips, who had for the past 27 years been assistant chief electrician for the Tredegar Co., at Treorky (Glam.).

Mr. S. Wilson.—The death is announced of Mr. Samuel Wilson, who had for many years been on the electrical staff at the Warrington Corporation Electricity Works.

NEW COMPANIES REGISTERED.

Sennybridge Electric Supply Co., Ltd. (174,920).—Registered May 27th. Capital, £1,500 in £25 shares. To carry on at Sennybridge, Defynock, Brecon, or elsewhere, the business of suppliers of electricity, &c. Minimum cash subscription 30 shares. The first directors are: W. J. Davies, Usk Pharmacy, Sennybridge; W. H. P. Rees, Pantysgallog, Sennybridge; Edward Davies, J.P., Pontarfran, Brecon; Evan Davies, Post Office, Sennybridge; W. Morgan Davies, The Stores, Sennybridge; E. Thomas, Usk and Railway Hotel, Sennybridge; D. Powell, The Castle, Sennybridge. Qualification £50. Solicitors: J. P. J. Powell, 12, Castle Street, Brecon.

F. Darton & Co., Ltd. (174,909).—Private company. Registered May 27th. Capital, £1,000 in £1 shares. To take over the business of a manufacturing optician and scientific instrument maker carried on by F. A. Darton at 142, St. John Street, Clerkenwell, E.C., as "F. Darton and Co." The first directors are: F. A. Darton, Clare Lodge, Snakes Lane, Woodford; O. Darton, Ivyhurst, Reigate. Registered office: 142, St. John Street, Clerkenwell, E.C. 1.

W. A. Tasker & Sons (Bristol), Ltd. (174,904).—Private company. Registered May 26th. Capital, £2,000 in £1 shares (1,500 preference). To adopt an agreement with E. A. Tasker and W. S. Tasker, trading as "W. A. Tasker & Sons," and to carry on the business of motor, electrical and general engineers, fitters in connection with kinematographs, film and picture theatres, &c. The first directors are: E. A. Tasker, 7, North Road, Bristol (permanent chairman, subject to holding 500 shares); W. S. Tasker, 61, Ashley Road, Bristol. Qualification £1. Remuneration of E. A. Tasker £150 per annum; of other directors £100 each per annum. Solicitors: Glyde, Kerslake & Scammell, Fosters Chambers, 17, Small Street, Bristol.

Bedesco, Ltd. (174,989).—Private company. Registered June 1st. Capital, £2,000 in £1 shares (500 preference). To carry on the business of electrical engineers and contractors, suppliers of electricity, manufacturers of and dealers in electric and other lighting sets for bicycles, motor cycles, cars, aeroplanes, motor boats, steamships and vessels, manufacturers of camera holders, stands, and all kinds of photographic accessories, &c. The subscribers (each with one ordinary share) are: Brig.-Gen. H. B. Shackleton, C.B., C.M.G., 7, Park Place, St. James's, S.W. 1; W. C. Devereux, 4, Oxford Street, W., engineer. The first directors are: Brig.-Gen. H. B. Shackleton, C.B., C.M.G., W. C. Devereux, and R. R. Bishop. Qualification £50. Remuneration as fixed by the company. Secretary: W. C. Devereux. Registered office: 35, Bucklersbury, E.C. 4.

Installations, Ltd. (174,998).—Private company. Registered June 1st. Capital, £1,000 in £1 shares. To carry on the business of electricians, electrical and mechanical engineers and contractors, &c., and to take over all or part of the electrical, contracting, and wiring work of the Engineering Equipment Co. (1919), Ltd. The subscribers (each with one share) are: S. C. Box, 3, Bute Crescent, Cardiff, asbestos manufacturer; E. H. Woodhall, Coleridge House, Mount Street, Swansea, secretary; E. V. Johnson, Coleridge House, Mount Street, Swansea, engineer. The said company may, while holding 500 shares, appoint not more than three directors subject thereto, the subscribers are to appoint the first directors. Secretary: E. H. Woodhall. Solicitors: Collins & Woods, 1, Worcester Place, Swansea. Registered office: Coleridge House, Mount Street, Swansea.

Neale Magnet Construction Co., Ltd. (175,020).—Registered June 2nd. Capital, £30,000 in 28,500 preferred ordinary shares of £1 and 60,000 deferred ordinary shares of 6d. To acquire from J. Neale an invention relating to improvements in the design and construction of electromagnets, and to carry on the business of electrical and mechanical engineers, &c. The first directors are: J. Neale, Vintella, Oxshott, Surrey; J. A. Manners-Smith, B.Sc., A.M.I.E.E., Coniston, Haslemere, Surrey. Minimum cash subscription £7. Remuneration £100 each per annum (chairman £150). Registered office: 7, Suffolk Street, Pall Mall East, S.W. 1.

New Welding Co., Ltd. (174,940).—Private company. Registered May 28th. Capital, £15,000 in £1 shares (5,000 preferred). To carry on the business of electrical and acetylene welders, mechanical, electrical, agricultural, constructional, and motor engineers, builders, engineering contractors, &c. The permanent directors are: A. H. Phillips, 9, Hosack Road, Balham, S.W.; C. G. Arnold, 30, Stanhope Gardens, Highgate, N.E.; E. C. Simper, 51, Alwyn Avenue, Chiswick, W. Qualification £100. Remuneration as fixed by the company. Secretary: C. G. Arnold. Registered office: 26, Rosebery Avenue, E.C.

Cooke & Glover (Engineers), Ltd. (174,974).—Private company. Registered May 31st. Capital, £5,000 in £1 shares. To carry on the business of electrical, horticultural, water, gas, mechanical and general engineers, contractors, plumbers, founders, &c. The permanent directors are: F. R. Glover, 98, St. Peters Street, Radford, Nottingham (managing director and chairman); F. A. Glover, 76, Sneinton Boulevard, Nottingham. Remuneration of F. R. Glover £208 and a bonus of £52 for every 10 per cent. or part of 10 per cent. dividend paid per annum; of F. A. Glover £286 per annum. Registered office: 98, St. Peters Street, Radford, Nottingham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

A. Lippold, Ltd.—Debenture dated May 23rd, 1921, to secure £200, charged on company's property, present and future, including uncalled capital. Holder: R. H. Jones, 88, Abbotsford Place, Glasgow.

W. T. Glover & Co., Ltd. (56,124).—Capital, £214,850 in 100,000 preference and 114,850 ordinary shares of £1 each, all of which had been issued at April 4th, 1921, £117,000 being paid up in cash on 67,000 preference and 50,000 ordinary, and £97,850 being credited as paid on the remainder. Mortgages and charges: Nil.

Waste Heat & Gas Electrical Generating Stations, Ltd. (91,738).—Return dated April 14th, 1921. Capital, £350,000 in £1 shares. 320,000 shares taken up. £320,000 paid. Mortgages and charges: Nil.

F. L. Mitchell & Co., Ltd.—E. S. Thorne, of 68, Coleman Street, E.C. 2, as receiver or manager on May 23rd, under powers contained in debenture dated January 26th, 1921.

CITY NOTES.

Electric Construction Co., Ltd.

The net profit for the year ended March, 1921, after providing £6,140 for debenture interest, and £10,000 for depreciation, was £83,110, plus £39,781 brought forward, less balance of E.P.D. for year ended March, 1919, and provision for the year ended March, 1920, £15,148, making £107,744. Interim dividends on the 7 per cent. preference shares and 6 per cent. per annum on the ordinary (less tax) required £11,197, and a final dividend on the 7 per cent. preference shares having been paid, a final dividend at the rate of 9 per cent. per annum is to be declared on the ordinary shares, making 7½ per cent. for the year, plus a bonus of 2½ per cent. on the ordinary shares (all under deduction of income tax), and £19,851 is put to general reserve fund, making it £120,000, leaving £53,498 to be carried forward subject to liability for E.P.D. The directors report that the turnover has been greater than in any previous period, and a corresponding increase is shown in the balance of net profit. Recently, however, orders have been difficult to obtain, in consequence of the unsettled industrial conditions which prevail. The death of Sir James Pender, Bart., is recorded, and it is not proposed to fill the vacancy at present. Annual meeting held yesterday in London.

Australia.—A new company has been formed entitled the Parramatta Electric Supply Co., Ltd., to acquire the undertaking of the company which has been operating under the same name. The old company's revenue was £11,578 for 1920, and the estimated revenue for 1921 is £16,000 when the proposed extensions have been completed. The net earnings are estimated at £3,595 for 1921 and £5,350 for 1922. An issue has been made of £30,000 in 8 per cent. £1 preference shares at par; 22,257 £1 ordinary shares were issued fully paid to the shareholders of the old company. An agreement has been made with the Railway Commissioners for the supply of bulk electricity for ten years, which, it is said, should suffice for the company's needs.

Shanghai Electric Construction Co., Ltd.

At the annual general meeting on June 1st, Sir Alfred Dent, K.C.M.G., said that the company's profits were subject to heavy liability to taxation, as they had to provide not only for excess profits duty at 60 per cent., but also for the new corporation profits tax. The appropriation to general reserve raised that account to £80,000, which, with the sanction of extraordinary general meetings, had been applied in paying up 8,000 new shares at £10 each, which had been distributed as a bonus in the ratio of one new share for every four shares held. This had necessitated increasing the capital to £400,000. An unsatisfactory feature of local conditions was the heavy and increasing depreciation of the subsidiary coinage, due to indiscriminate and uncontrolled minting of copper coins. In spite of this handicap, the traffics and net receipts for the current year were the largest in their history for a corresponding period. This was due in part to the fact that they were constantly adding to their rolling stock in order to cope with the increasing volume of traffic, but the additions made did not by any means meet in full the demand of the Shanghai public for additional traffic facilities. The management had for a considerable period been in negotiation with the Municipal Council for increased powers with a view to the extension of the company's system with railless traction.

Delhi Electric Tramways and Lighting Co., Ltd.

The gross receipts for 1920 were: Tramway undertaking, £16,642; electric supply undertaking, £40,048; representing increases of approximately 10 per cent. and 23 per cent. respectively over the figures for 1919. Both departments were affected by labour troubles during the latter part of the year. The combined undertakings show a net revenue of £22,266, as against £20,430 in 1919. The profit, including the profit on exchange, after charging general expenditure in London and Delhi, and debenture interest, was £31,325, plus £1,362 brought forward. There has been put to depreciation of plant and equipment £10,000; to renewals reserve account £7,500; to reserve for British and Indian taxation £4,000. A dividend of 8 per cent. per annum (less tax) on the preferred and participating shares requires £8,000, and one of 1s. 6½d., less tax, on the ordinary shares will absorb £2,205, leaving £982 to be carried forward. The plant and equipment, including rolling stock, has been maintained in good condition. The expenditure on maintenance, with the exception of special renewals (£2,535), has been charged to revenue. Additions to plant during the year were £7,703. Owing to the state of his health, Mr. J. G. Griffin tendered his resignation of the general managership as at December last, but arrangements have been made under which his technical ability and knowledge of local conditions will be retained. Lieut.-Col. Cecil Barber took up the duties of general manager at Delhi on December 3rd.

The Anglo-Argentine Tramways Co., Ltd.

Sir George A. Touche, Bart., presided over the annual meeting on Tuesday last. He said that they were able to submit more cheering figures than those of 12 months ago. The increased tariff of 12 cents established by Ordinance came into force on April 10th, 1920. The increase was reflected in the traffic receipts, which rose from £3,127,784 in 1919 to £4,014,765 last year, an increase of 28.36 per cent. The gross receipts reached the record figure of £4,413,164. Owing to the war there were heavy accumulations of arrears of dividend, and during the year they had paid away 3½ years' dividends on the 5½ per cent. first preference shares and all arrears on those shares were now wiped out. The working expenses were also at a record figure, and totalled £3,198,028. The traffic expenses had amounted to £1,158,265, an increase of £332,291 over last year—salaries and wages—chiefly wages, accounted for £325,000 of that increase. Their policy had always been to pay wages in proportion to the measure of their prosperity, in order that they might have a responsible and contented body of men, and the advances of the past year were justified by the cost of living. Traction cost £812,693, and electrical energy, which was based upon the price of fuel, showed a decrease of £107,840. The average cost of fuel used by the supply company during 1920 was 118s. per ton delivered at the power stations. Since the end of the year a new contract had been entered into by the supply company for one year's supply of American coal at a price of a little under 60s. per ton c.i.f. Buenos Aires. They got the benefit of that cheaper coal only as from May of this year, by which time the stocks of dear coal were practically exhausted. Maintenance cost £345,064—£69,182 in excess of the previous year. The working expenses had had to bear a new charge of £87,461, being the company's contribution of 8 per cent. on salaries and wages to the official pension fund in Buenos Aires. The net profit of the year, after making the transfer of £133,172 to renewals reserve, and meeting the "City" annuity, and interest on the three classes of debenture stocks, together with sinking funds for the whole of the debenture and share capital, was £593,874. The amount brought forward from 1919 was £175,509, making a total of £769,384. After clearing up all the arrears of dividend on the first preference shares, and paying the current dividend, there remained an available balance of £153,384. As to whether the current dividend on the second preference shares was likely to be earned, he preferred to make no promise. The general prospect was not so good as it was some months ago, and he would be failing in frankness if he said that the payment of another six months' dividend on the second preference shares by September 30th next was beyond doubt. Proceeding to refer to the current contract with the supply company, which was made in 1904 and rearranged in 1909 for the life of the concession, he said they had made a modification of the terms of the contract for the supply of electrical energy which was expected to result in a saving to the company of from £20,000 to £30,000 per annum. The arrangement was a beneficial one to the company, and they were indebted to the Compagnie Générale, and especially to their colleague, Mr. D. Heineman, for bringing it about. The capital expenditure during the year had amounted to £567,333. The present were not times when large capital expenditure was desirable, but if they were to keep pace with the traffic requirements of the population they served, a certain expenditure was necessary. Dealing with labour troubles, the chairman said that in Buenos Aires, as elsewhere, labour had not yet settled down after the unrest caused by the war. Some time ago it looked as if the unrest would culminate in a general strike, but the evil was avoided on that occasion through the good sense of the workers. Their men remained steadfast, and the services continued running normally. The Government were determined to safeguard the right to work, and took energetic measures against the militant agitators who were seeking to place the unions above the law. Owing to the vigorous action of the authorities and the refusal of workmen to be intimidated, the general strike seemed broken and doomed to failure. It was their general manager's constant study to cultivate a feeling of good fellowship in all ranks, but there was a very definite limit to what they could do, and it was possible to pay too much for peace. Concessions which would impoverish the company must in the end impoverish the employés too. Where capital was destroyed labour was irretrievably ruined, as had happened in Russia. The Government were awake to the peril which threatened the industry and prosperity of the Argentine, and were taking steps to exclude revolutionary agents who would work havoc upon the community. He wished our Government would follow a similar course. The ills of the Argentine were temporary and would pass. Its resources were almost illimitable, and though the fulfilment of their more sanguine expectations might be delayed, he thought it would show a lack of vision to take a pessimistic view of its future.

Mr. W. F. Hamilton, K.C., seconded the motion, and the report was adopted.

Cork Electric Tramways and Lighting Co., Ltd.

The report for 1920 states that the revenue was £111,880 and the expenses £94,966, leaving £16,914, plus £2,512 brought forward. Deducting income tax and debenture interest, the balance is £12,203. £6,500 has been added to reserve for depreciation and renewals and £5,703 is carried to revenue new account. The increase in revenue (£21,019) is made up of £4,092 from the tramways, £16,090 from lighting and power, and £837 from other items. The expenses increased by £24,232 as follows: £6,920 in respect of the tramways; £15,453 for generating, £836 for lighting and power maintenance; and £1,023 for general and administrative expenses. The gross profit shows a reduction of £3,213 as compared with 1919, due to higher salaries and wages, coal, &c., and to curfew and other restrictions, and the state of the country. The company claimed against the Cork Corporation for loss of property in the Patrick Street fire, and £3,394 was awarded. A demand for an additional £1 per week and other concessions by the tramway and certain other employés was made in November last which the directors were unable to meet, as the tramways were being operated at a loss. A strike followed in February and lasted for seven and a half weeks—involving a complete stoppage of the tramway service and greatly restricting the supply of current for lighting and power purposes—before the men returned to work. In view of the reduction in gross profit and the loss involved in the strike, the directors are unable to recommend payment of the preference share dividend for the year. The lighting and power tariff has been revised, owing to the increased cost of generating, but as the present rates only applied for the last quarter of 1920 the accounts under review did not benefit materially from the last revision of rates. Application has also been made to the Ministry of Transport for powers to increase the tramway fares. The installation of additional plant for the power station referred to last year is being proceeded with, and it is expected that the new 2,000-kW Curtis turbine will be in operation for the ensuing winter load.

Direct United States Cable Co., Ltd. The report for the year ended March 31st, 1921, states that the sale of the company's cable and properties to the Government has been completed, the purchase consideration of £570,000 being satisfied by the payment of £70,086 in cash, and the handing over of £506,700 5 per cent. National War Bonds, maturing for payment on April 1st, 1923, at £102 per cent. This carries out the arrangement sanctioned by the shareholders, namely, that payment was to be made by the Government two years after completion of the sale, and interest at 6½ per cent. per annum was to be paid upon the purchase consideration till the date of payment. Provision is made in the accounts for all known liabiliites of the company, and the investments have been written down to their actual value, according to market quotations, at March 31st last. A settlement of all claims under the company's pension scheme has been effected for a smaller amount that was estimated. The directors are therefore satisfied they will be in a position to pay a dividend out of the company's income at the rate of 4 per cent. per annum until the war bonds are redeemed in 1923, when the shareholders may confidently look for a return of £6 per share. The total income of the year was £56,530, and after providing for administration expenses and the cost of repairing the cable a balance remained of £38,262, out of which a dividend of 4 per cent. has been paid, carrying forward £4,265.

Oriental Telephone and Electric Co., Ltd. The gross earnings for the year 1920, including dividends and interest from subsidiary companies, &c., were £168,182, plus £11,013 brought forward. Deducting working expenses £109,878, and interim dividends, debenture interest and redemption charges, £22,172, there remains £47,144. A final dividend of 3 per cent., less tax, is paid on the preference shares; a final dividend of 6 per cent., free of tax, on the ordinary shares makes 10 per cent., free of tax, for the year; a bonus of 2 per cent., free of tax, is to be paid on the ordinary shares; there is put to depreciation and general reserve £10,000, and to staff pension fund £2,000, leaving £10,492 to be carried forward. The revenue of the varions branches of the company and the associated companies shows a substantial increase, which is largely due, in the case of the company's own branches, to the favourable rates of exchange ruling during the greater part of the period under review. At almost all centres, new subscribers are awaiting the telephone service, and their requirements are being met as spedily as circumstances permit. After considerable delay on the part of the contractors, the new switchboard equipment at Singapore was brought into operation on June 6th, 1920. The death is recorded of the company's late manager in Mauritius, Mr. E. L. Lalonde. The following dividends have been declared by the Indian local companies, viz.: 16 per cent. by the Bombay Telephone Co., Ltd., as against 18 per cent. for 1919, and 10 per cent. by the Bengal Telephone Co., Ltd., as against 8 per cent. for 1919. Owing to the fall in the rates of exchange the sterling equivalent is less than in the previous year. At December 31st, 1920, this company had a total of 9,017 stations in operation, an increase of 897 during the year. At the same date the Bombay Telephone Co., Ltd., had 9,709 exchange and private lines in operation, being a net addition of 1,829; and the Bengal Telephone Co., Ltd., 6,838 stations, being a net addition of 275. In the case of Calcutta this increase would have been considerably greater but for the serious delay by the contractors in completing the new exchange equipment, which was only brought into use on April 23rd, 1921 more than a year later than was originally anticipated. The Bengal Co. is at present in communication with the Government of India in order to ascertain, if possible, whether it intends to purchase that undertaking in 1923 under the terms of their licence. Similar negotiations have also been in progress during the year with regard to the future of the Bombay Telephone Co., Ltd., as well as of this company's branches in India. It would now appear that the views of the Indian Government incline rather towards an extension of the existing licences than to the acquisition of the undertakings in 1923. The gross revenue of the China & Japan Telephone & Electric Co., Ltd., shows a further increase, but the net result is considerably ess favourable than that of the previous year—the high rates of exchange which continued to prevail having still further ncreased the heavy working expenses and charges in Hong Kong, where subscriptions are payable in sterling. That company has in consequence been unable to declare a dividend for the past year. At December 31st, 1920, there were in Hong Kong and Kowloon 6,112 stations in operation, an increase of 519 during the year. The liquidation of the Telephone Co. of Egypt, Ltd., has not yet been completed—the delay being due to difficulties experienced by the liquidator in settling the long outstanding question of income tax with the Inland Revenue authorities.

United River Plate Telephone Co., Ltd. The gross earnings for the year ended December, 1920, were £1,096,373, and the gross maintenance and other charges in Argentina and London were £855,606, leaving £240,767 profit. After deducting interest on debenture stock, preference dividend for the year, and the interim dividend on the ordinary shares (£72,100) £168,667 remains, plus £35,700 brought forward, making the available balance £204,367. A final dividend of 5 per cent. on the ordinary shares, makes the total distribution for the year 8 per cent., free of income tax. £50,000 is put to reserve, £35,000 to exchange suspense account, and £38,367 is to be carried forward. The company's business continues to progress satisfactorily, the applications for telephone service exceeding by many thousands the capacity of the present switchboard plant. A certain amount of new equipment has been shipped since the accounts were closed, which will assist in overtaking arrears, and much more will be dispatched during the next few months, including the automatic plant for the City of Buenos Aires. To provide further capital the directors have decided to issue to the ordinary shareholders 108,000 new ordinary shares of £5 each at par, in the proportion of one new share for every three ordinary shares held, and allotment letters will be sent out after the meeting.

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Stock Exchange Notices.—The Committee has specially allowed dealings in the following under Temporary Regulation 4 (3):—

Calcutta Electric Supply Corporation.—550,000 ordinary shares of £1 each, fully paid, Nos. 1 to 550,000; 605,000 5 per cent. cumulative preference shares of £1 each, fully paid, Nos. 1,645,001 to 2,250,000.

Stewarts & Lloyds.—100 deferred shares of £1 each, fully paid, Nos. 2,629,931 to 2,630,030.

The undermentioned have been ordered to be officially quoted:—

Calcutta Electric Supply Co.—550,000 ordinary shares of £1 each, fully paid (Nos. 1 to 550,000); and 605,000 5 per cent. cumulative preference shares of £1 each, fully paid, (Nos. 1,645,001 to 2,250,000).

Siemens Bros. & Co.—500,000 shares of £1 each, fully paid, (Nos. 1,000,001 to 1,500,000).

Stewarts & Lloyds.—100 deferred shares of £1 each, fully paid (Nos. 2,629,931 to 2,630,030).

Prospectuses.—*The General Electric Co., Ltd.*—The issue of £3,500,000 7 per cent. mortgage debenture stock at 92½ is for providing funds for the completion of the programme as outlined to the shareholders at the last annual general meeting, and for the repayment of advances from the company's bankers made in connection therewith. Figures given in the prospectus show that on the basis of the profits for the year ended March, 1920, the issue is covered more than 2½ times by the assets. The accounts for the year ended March, 1921, have not yet been finally made up and audited, but the directors are satisfied that the profits exceeded those for the preceding year. The list of subscriptions was to close on or before Wednesday last.

The Tottenham District Light, Heat & Power Co.—A new issue of £91,650 7½ per cent. registered redeemable mortgages is being made at par. The list will close on June 17th.

Guildford Electricity Supply Co., Ltd.—The total revenue for 1920 was £22,537, as compared with £16,783 for 1919, an increase in revenue of £5,755. There is a balance on the revenue account of £5,874, as compared with £2,105 (after crediting depreciation fund account with £2,000) on the revenue account for 1919. After making due provision for debenture interest, and interest on temporary loans, the net revenue account shows a balance of £4,053, and the directors recommend that this be carried forward to the credit of the net revenue account for the present year. The number of connections increased from 1,528 to 1,695. The total costs were £16,663, against £12,677 for 1919. The gross profits were £5,874, against £4,105 for 1919. The directors entered into an agreement on December 6th, 1920, with the Corporation of Guildford for the sale of the undertaking to the Corporation, but the date of taking over by the Corporation has not yet been fixed.

Western Telegraph Co., Ltd.—Third quarterly interim dividend of 5s. per share, free of income tax, for the year ending June 30th, 1921, being at the rate of 10 per cent. per annum.

Coventry Chain Co., Ltd.—Interim dividend of 6 per cent. per annum on the ordinary shares for the half-year ended February, 1921.

Companies struck off the Register.—The following companies have been struck off the Register, and are accordingly dissolved :—

Bourne End Electric Installation Co., Ltd.
Cold Light (Dussaud Processes), Ltd.
Loxley & Co., Ltd.
Northern Power Syndicate, Ltd.
Premier Electric & Hardware Co., Ltd.
Railway & Tramway Advertising Concessions, Ltd.
Richardson's Turbine Co., Ltd.

British Electric Traction Co., Ltd.—Dividend of 4 per cent. on the ordinary stock for the year ended March, 1921.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange business has fallen into quiet lines. The appetite of the investor for good stock has been a little satiated by the amount of security poured out during the past few weeks. Amongst these new issues, the remarkable feature is the surprising absence of rubbish. Nearly all the prospectuses that have appeared have offered the investor a chance of obtaining reasonable security at a fair price. The wild-cat order of promotions is resting, for it is obvious enough that there is little demand even for speculative issues, and rubbish is, of course, essentially speculative. So liberal is the present supply of good stock that, in some cases, the highest premiums attained by recent issues have not been held, and with every week bringing out tempting invitations for the investor's money, the stags have lately been doing well out of making applications for scrip which they had neither money nor the intention of taking up. However, the stagging business has been overdone, and, in one or two instances lately, these eager applicants have found themselves obliged to sell at a loss instead of getting out at the expected premium.

Metropolitan Electric 7½ per cent. debenture stock, after rising to 3½ premium, reverted to 3 premium. Central Electric Notes, which have been up to 5 premium, are now 3¾ premium. City of London Seconds touched 21s. 9d. before they eased off to 21s. 3d. Mond Nickel debentures have been over 5 premium, and are now about 4½ premium. The avid rush for underwriting in the General Electric debenture issue has been followed by a subscription on the part of the public which, when the figures come out, may possibly show that underwriters will be called upon to take up a small proportion of their obligation. Nevertheless, the cry is "Still they come," and substantial fresh offering of capital is known to be ready for issue directly there is a fair prospect of its being successfully underwritten. Whispers speak of the North Metropolitan and the Pernambuco Tramways companies as possible applicants for more money in the near future.

We hope it is not inappropriate to offer congratulations, here, upon the baronetcy bestowed upon Sir Pierce Lacy in the recent list of Birthday Honours. The new baronet is closely connected with several of the more important electrical undertakings, more especially in the provinces. He is a moving spirit in the B.S.T., Ltd. ,which undertakes extensive business in the matter of new issues, and which, for instance, was lately responsible for the Metropolitan Electric Supply Company's 7½ per cent. debenture stock that achieved so swift a success in its appeal to the public.

The prospect of a settlement of the coal strike—one gets used to using the same phrase each week—had a stiffening effect in the Home Railway market, and Undergrounds have carried further their already substantial rise. Prices, moreover, are moving pretty quickly, and Underground Electic £10 shares dropped to 2⅜, to recover to 2¾, while the Income bonds are 3 higher. London & Suburban A debenture has gained an equal amount at 68. North Metropolitan 5 per cent. debenture at 67½ is 2 points up.

The Direct United States Cable Co. issues what may be regarded as its last report as a going concern, because the company now passes by easy stages into the possession of the Government, and, although the final winding up will take a year or so longer, the future fortunes of the concern will interest proprietors only in an abstract manner. Dividends at the rate of 4 per cent. per annum will be declared until 1923, when shareholders, according to the board, may confidently look for a return of £6 per share, comparing with the present price of 5⅝.

The Oriental Telephone Company did well last year, and a final dividend of 6 per cent. on the ordinary shares, making 10 per cent. for the year, is now proposed, plus a bonus of 2 per cent. free of tax, this being at the same rate as was paid a year ago. The United River Plate Telephone is going to pay 8 per cent. free of tax as before, and the directors have decided to issue 108,000 new ordinary shares of £5 each at par to the shareholders, one new share being given for every three ordinary held. As the present shares stand about 6, there is a small bonus involved. The cable group is as strong as ever. Anglo-Americans hold their gains. Eastern Extensions are 5s. higher. Eastern ordinary rose 1, and Indo-Europeans are similarly better. Marconi's keep rather to the easier side, being offered at 48s. 9d., if not cheaper. There is still no word as to when the dividend on Radio preferred shares may be declared.

Mexican Utilities are decidedly good. Mexico Tramways Fives have put on 9½ points. Mexican Light & Power Fives are up 5. Meetings are convened for the end of this month to pass the necessary resolutions for enabling the arrears of interest, and other matters, to be dealt with. And dollar securities are going up sharply on account of the drop in the value of the pound sterling as compared with the dollar. Canadian General Electric shares have jumped to 131½, the preferred to 112½. Electrical Development of Ontario bonds have strengthened to 108½, Rio Tramways Fives to 92½, Shawinigan Power Common to 124½. Holders of such stocks must bless this indirect and freakish reflection of the payment of reparation-money by the Germans.

General Electrics are easier at 21s. 3d., and the B preference at 17s. 3d., on the issue of the new debenture stock. Babcock & Wilcox at 2 5/16 have recovered most of the lately-deducted dividend. Electric Constructions are better at 17s. 6d. The only change in the list of electricity supply shares is ⅛ rise in County of London ordinary, lifting the price to 8s. 8d.

Rubber shares are heavy on a reaction to eightpence per lb. in the price of the raw produce. Moreover, the last week's statistics have reverted to the excess of landings over deliveries. The armament market is quiet and uninteresting, despite the prevailing impression that the miners will hasten their efforts for a settlement before the Government's ten million pounds' offer is withdrawn.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1919.	Dividend 1920.	Price June 7. 1921.	Rise or fall.	Yield. p.c.
Brompton Ordinary..	12	12	6	—	£10 0 0
Charing Cross Ordinary ..	7	8	8⅜	—	10 6 6
do. do. do. 4½ Pref...	4½	4½	8	—	7 10 6
Chelsea..	4	6	8¼	—	9 4 8
City of London	18	14	1 3/16	—	11 16 0
do. do. 6 per cent. Pref...	6	6	17/-	—	7 1 2
County of London	8	8	8½	+ ⅛	9 17 0
do. do. 6 per cent. Pref...	6	6	5⅛		7 7 8
Kensington Ordinary	7	9	4⅛	—	10 18 2
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref. ..	6	6	2¾	—	10 18 2
Metropolitan	6	7	8½	—	10 0 0
do. 4½ per cent. Pref. ..	4½	4½	2 5/16	—	7 13 2
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	6	7	2½	—	9 2 10
South Metropolitan Pref... ..	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	5⅛	—	9 15 2

Telegraphs and Telephones.

	1918	1919			
Anglo-Am. Tel. Pref.	6	6	81½	—	7 7 8
do. Def...	83/6	1½	17½	—	8 11 5
Chile Telephone	8	6	5¼	—	5 6 8
Cuba Sub. Ord.	7	7	7½	—	9 6 6
Eastern Extension	10	10	16⅝	+ ¼	6 3 2
Eastern Tel. Ord.	8	10	167½	+1	5 19 6
Globe Tel. and T. Ord.	8	10	15⅜	—	6 0 4
do. do. Pref.	6	6	9¼	—	6 9 9
Great Northern Tel.	22	22	26	— ½	8 9 2
Indo-European	18	10	85	+1	7 2 10
Marconi	25	25	2 7/16	— 1/16	—
Oriental Telephone Ord.	10	12	2 9/16	—	*5 18 0
United R. Plate Tel.	8	8	5⅛	—	5 10 8
West India and Panama	1/8	Nil	9/16	—	Nil.
Western Telegraph..	8	10	16⅞	—	*5 18 5

Home Rails.

	1919	1920			
Central London Ord. Assented ..	4	4	45½	—	8 15 10
Metropolitan	1½	1½	26½	—	5 17 8
do. District	Nil	Nil	19	—	Nil
Underground Electric Ordinary ..	Nil	Nil	2¾	+ ¾	Nil
do. do. "A" ..	Nil	Nil	7/6	+6d.	Nil
do. do. Income ..	4	2	79½	+3	2 10 4

Foreign Trams, &c.

	1918	1919			
Anglo-Arg. Trams, First Pref. ..	Nil	5½	2¾	+ 1/16	8 8 6
do. do. 2nd Pref. ..	Nil	Nil	8⅛	+ ⅛	8 16 0
do. do. 5 % Deb. ..	5	5	64½xd	+1	7 15 0
Brazil Tractions	Nil	Nil	86	—	Nil
British Columbia Elec. Rly. Pfce.	5	5	56	+1	8 18 6
do. do. Preferred	2½	5	53½	—	*8 15 0
do. do. Deferred	Nil	8	51¼	—	*11 17 6
do. do. Deb. ..	4½	4½	59½	—	7 2 10
Mexico Trams 5 per cent. Bonds..	Nil	Nil	51½	+ 9½	Nil
do. 6 per cent. Bonds..	Nil	Nil	23½	—	Nil
Mexican Light Common	Nil	Nil	11½	—	Nil
do. Pref.	Nil	Nil	18½	+1	Nil
do. 1st Bonds	Nil	Nil	75½	+5	Nil

Manufacturing Companies.

Babcock & Wilcox	15	15	2 5/16	— 1/16	5 18 6
British Aluminium Ord.	10	10	16/3	—	12 6 2
British Insulated Ord.	12½	15	1 9/16	—	9 12 0
Callenders	25	15	1½	—	10 0 0
" 5½ Pref.	6½	6½	17/6	—	7 8 7
Crompton Ord.	10	10	16/8	—	12 6
Edison-Swan	10	10	11/3	—	—
do. do. 5 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	17/6	+1/3	11 8 6
English Electric	—	8	12/-	—	13 6 8
Do. Pref.	—	6	14/6	—	8 6 5
Gen. Elec. Pref.	6½	6½	17/6	—	7 8 7
do. Ord.	10	10	1 1/16	—9d.	*9 8 2
Henley	25	15	1 7/16	—	10 8 8
do. 4½ Pref.	4½	4½	8½	—	6 18 6
India-Rubber	10	10	13/16	—	—
Met.-Vickers Pref.	—	8	1 13/16	—	8 15 10
Siemens Ord.	10	10	23/3	—	*8 12 0
Telegraph Con.	20	20	20½	—	*6 17 6

*Dividends paid free of Income Tax.

THE UNITED ALKALI CO.'S POWER STATION.

A New Mersey-side Station at Widnes.

(*Concluded from page* 707.)

It should be mentioned that the station is uncommonly well lighted; even in the boiler house, basements, and suchlike places there is sufficient natural lighting almost to obviate the necessity to use artificial light during the daytime. Another feature is its freedom from obstruction, ample room having been allowed everywhere.

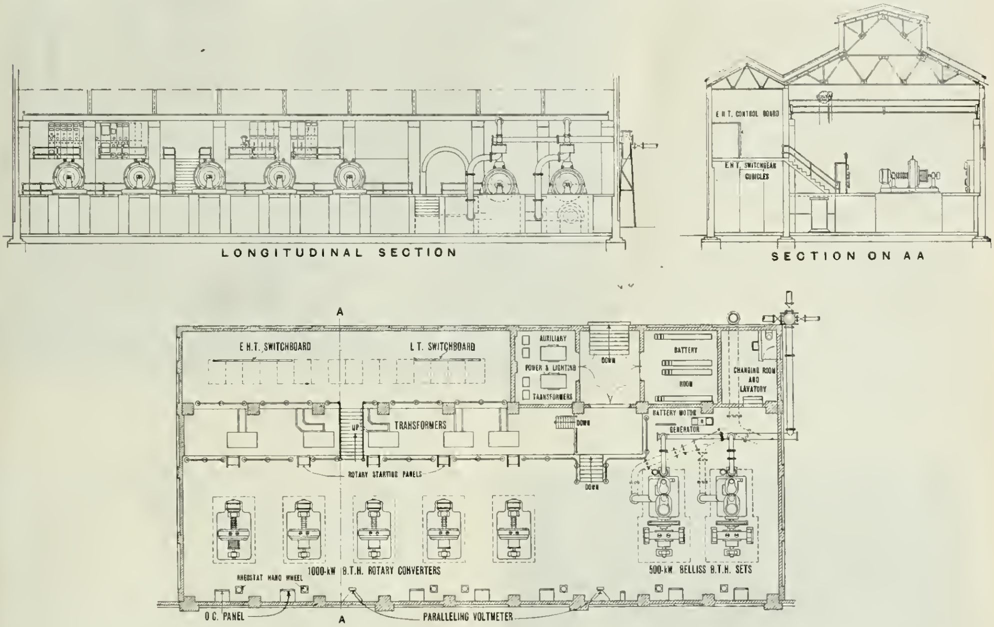


Fig. 11.—Sullivan Sub-station Layout.

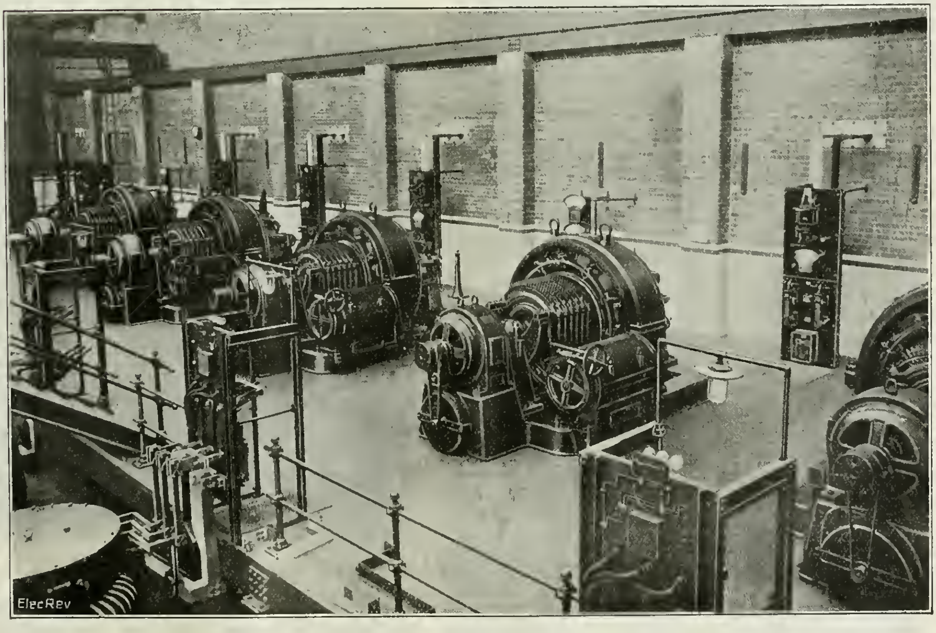


Fig. 12.—B.T.H. 1,000-kW Rotary Converters.

Returning now to the electrical equipment of the station, the high-pressure switchgear was supplied by the Metropolitan-Vickers Electrical Co., Ltd., and is of the cellular type with duplicate bus-bars for controlling the main generators and feeders. The 1,000-A oil switches are of the remote-control electrically-operated solenoid type, and have a short-circuit rupturing capacity rated at 240,000 kVA. An interesting feature of the h.p. switch chamber is the colour scheme devised by Mr. C. P. Sparks. Diagrams are painted on the ends of the cubicles in colours, so as to represent their interior details, and the cubicles themselves are painted in different colours, so that anyone working on the gear may easily differentiate between them.

The generators are fitted with overload relays and Merz-Price balanced protective gear, while the feeders are provided with split-conductor protection and overload relays. The control room is situated in front of the h.p. switch chamber, facing and on the same floor level as the turbine room. It contains a very handsome black slate control board with panels of the desk type, as shown in fig. 14; nothing on this board operates at a pressure in excess of 100 V. In the cable basement is installed an earth resistance which is capable of carrying the full load of one machine for 10 seconds. Two six-core, 0·25 sq. in. per phase, split-conductor, lead-covered cables are laid in parallel for a distance of 2 miles to the Sullivan Works sub-station.

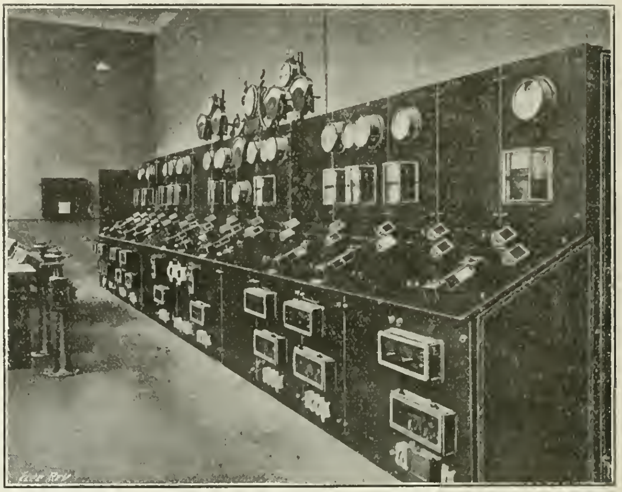


Fig. 14.—Generating Station Control Board.

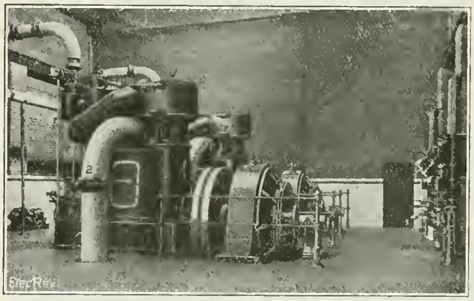


Fig. 13.—Two Belliss-B.T.H. Steam-Electric Generating Sets.

With the exception of the boiler feed-water pumps, all the auxiliary plant in the station is electrically operated at a pressure of 440 volts, for which purpose two 50-cycle three-phase switchboards, with the bus-bars between them, are provided, which are supplied by two 1,000-kVA and one 250-kVA transformers housed in separate chambers. In addition, two 25-kVA three-phase transformers reduce the pressure from 440 to 100 volts for the station lighting, and two small motor-generators are installed for the purpose of charging a 150-Ah 100-V battery for operating the switchgear and for emergency lighting. The whole of the plant and switchboards for the auxiliary and lighting supplies are installed in and controlled from the basement.

As before mentioned, the generated energy is transmitted by underground cables to the Sullivan Sub-station—where it is converted to d.c. and used for electrochemical purposes; fig. 11 shows the lay-out of the sub-station. The three-phase 50-cycle supply is stepped down by means of a bank of Ferranti transformers, each of which has an output of 1,125 kVA, from 6,000 to 170 volts, at which pressure it is fed to five sets of self-synchronising B.T.H. rotary converters, fig. 12, each of which is rated at 1,000 kW at 230 volts, but by means of induction regulation the d.c. pressure may be varied from 190 up to 240 volts. Two sets of voltmeter paralleling equipment are provided, and the a.c. switchboards are mounted on a gallery above the e.h.p. switchgear chamber. The h.p. board, which controls the incoming feeders and the supply to the transformers, is of the remote-control type, fig. 15, the switches being operated by means of solenoids. The l.p. board, which is supplied from two 350-kVA auxiliary transformers, is of the ordinary type, with duplicate bus-bars to facilitate cleaning and repairs, and it controls the power and lighting supplies throughout the plant.

Each rotary converter has its own starting panel mounted between the transformers and the slip ring end of the machine, and also a d.c. panel placed against the opposite wall. The latter panels are of a particularly heavy construction in view of the large currents to be dealt with.

The sub-station also contains two 500-kW 230-volt Belliss-B.T.H. steam-electric generating sets, fig. 13, running at 300 r.p.m., and at a steam pressure of 200 lb. per sq. in. superheated 100° F., the steam supply being furnished by four 16,000-lb. boilers. Both sets are provided with separate d.c. control panels, and run in parallel with the

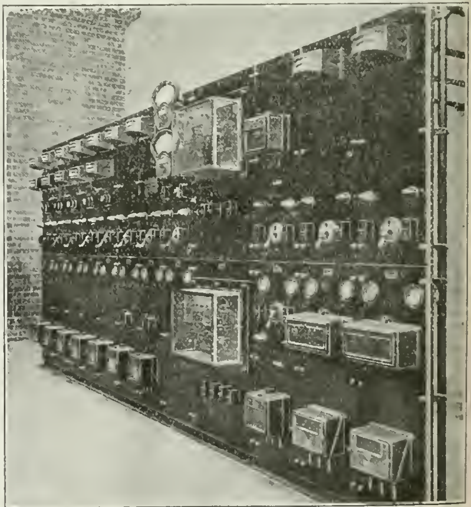


Fig. 15.—Sub-station h.p. Switchboard.

rotary converters, the exhaust steam being utilised for chemical processes.

As in the case of the main generating station the auxiliary power used in the sub-station is at a pressure of 440 volts, which is stepped down from 6,000 volts by two Metropolitan-Vickers three-phase transformers, and a 60-kVA transformer is also provided for reducing the pressure for lighting from 440 to 110 volts. A 6-kW B.T.H. motor-generator charges the 110-volt D.P. battery which furnishes the energy to operate the switchgear, &c.

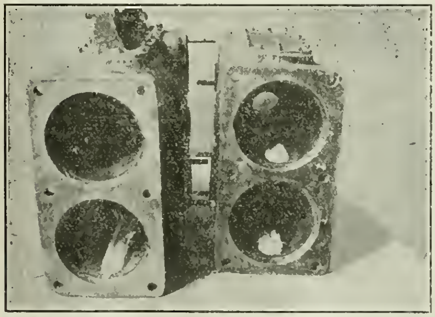
In conclusion, it may be mentioned that Messrs. Drake and Gorham, Ltd., were the main contractors for the plant and machinery, while the building work was carried out by Messrs. Wilson Lovatt & Sons, the reinforced concrete by the Indented Bar Co., and the piling was undertaken by Messrs. Stewarts.

Messrs. C. P. Sparks & Partners acted as consulting engineers; Major F. R. Wilton was the consultant for the river work, and the whole was carried out under the supervision of Mr. Holbrook Gaskell, M.I.E.E., then chief engineer to the United Alkali Co., Ltd., to whom and to Mr. E. M. Hollingsworth, M.I.E.E., electrical engineer to the company, our thanks are due for their assistance in the preparation of this article.

ELECTRO-SALVAGE.

One of the most expensive items connected with the upkeep of machinery of any kind is the replacement or repair of worn parts. Many expedients for making good the ravages of time and friction are resorted to; some of these are attended by success, but most of them are, after all, merely makeshifts for putting off the evil day of replacement. Plain metal bearings may, of course, be replaced at a fairly small cost, but worn shafts present a different sort of problem. They may be turned down to a smaller size—but this is altering a main feature of the design of the machine. It is possible to shrink a collar on to the shaft to make it up to size, but his method is attended by possibilities of slipping or shearing. Worn or scored cylinders may be rebored and fitted with ew pistons, but this, in addition to weakening an engine, ntails rather large expenditure.

Fig. 1.—Repair of Scored Cylinders.



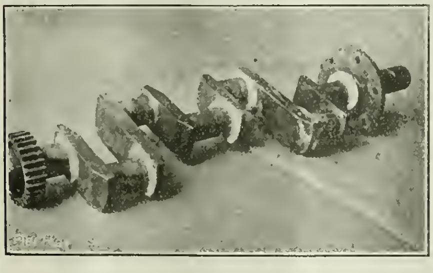


Fig. 2.—A Built-up Crankshaft.

With these and similar facts in mind, it is worth while to udy the possibilities of electro-deposition as a means of uilding up worn parts of machines. In this connection we recently paid a visit to the works of the Fletcher Electro-Salvage Co., Ltd., to see some of the work that may be executed by the deposition of nickel upon machine parts and tools. The process itself is simple—it is the way in which it is employed which makes it successful. The general method of procedure is as follows: The subject to be treated is first cleansed in an alkaline bath in which all grease and dirt are removed. The whole of the article is then dipped in a mixture of paraffin wax and resin which gives it a thick coating all over. The parts which it is desired to build up are then exposed by having the wax stripped off and the piece is immersed for a few seconds in an acid bath prepared according to a secret formula of the firm's. In this vat all oxides are removed, and the bared surface is prepared for deposition. Then the article is suspended in the depositing vat, which is filled with a solution of nickel in ammonium sulphate, and the coating is applied at an average rate of .0005 in. per hour.

We may now say something of the various classes of work treated in this way. One of the first things we were shown was a pair of twin cylinders badly scored by a projecting gudgeon pin. These had been successfully dealt with and brought to a smooth finish (fig. 1). The saving of expenditure represented here was an eloquent tribute to the value of the process. Some wire wheel hubs—rather costly pieces of work—were then inspected. In these the male thread at the extremity and the female thread of the cap were badly worn, so much so that only two or three threads were in engagement. These threads were built up again to their original size at a mere fraction of the cost of replacement—the only alternative. Some shafts which had been ground to about .007 in. under the correct size were seen. These had been coated and finished off at a very economical price. The two slide rest screws of a large lathe in use at the works had been built up by the process in a very satisfactory manner, and numerous other samples of the work were inspected.

An interesting point which may be emphasised, is that armature shafts have been brought up to their original size by this means without removal of the windings. In fact, it would seem that there is no branch of engineering in which the process may not be successfully and economically employed. Any doubts as to the durability, strength, and tenacity of the deposited nickel are fully dealt with in a report of tests carried out at the National Physical Laboratory. For the purpose of the tests a nickel coating approximately 5/64 in. in thickness was applied to a piece of steel 1 in. in diameter. A thread of 40 to the inch was then cut in the nickel. A hardened steel holder was screwed over the thread and the other end of the coated steel was screwed $\frac{7}{8}$ in. Whitworth and inserted in another holder. The assembly was then subjected to a gradually increasing tension, and no signs of breaking down were apparent under a load of ten tons. The nickel coating was then cut away to within .215 in. of the end, and the same test was again applied. Under these conditions the coating was pulled off by a tensile load of 11.95 tons, and then part of the steel upon which it was deposited also broke away. This represents a breaking load of 17.6 tons per sq. in. of adhesion surface. At the same time Brinell hardness tests were carried out on a nickel coating .04 in. thick deposited upon samples of steel measuring 2 in. by 2 in. by $\frac{1}{2}$ in. Three ball impressions were made, using a ball of 5 mm. diameter and a load of 750 kg. The diameters of the impressions were obtained in two directions at right angles by a measuring microscope, and the hardness numbers calculated by dividing the load in kg. by the spherical area of the impressions in sq. mm. In three tests these numbers were 377, 366, and 349 respectively. The hardness number of the steel on which the nickel was deposited was 298, and the corresponding number for a mild steel of 32 tons per sq. in. ultimate stress is approximately 150.

It is evident from these tests that the nickel deposit becomes to all ordinary intents and purposes an actual part of the metal to which it is applied. The process is necessarily a continuous one, and when the plant is shut down at night current is supplied to the vats by a battery of accumulators. The thickness of the deposit can be regulated within very fine limits as the outcome of a long period of careful experiment.

Fig. 2 shows a crankshaft in which the worn parts have been brought up to size by this process.

The "Exide" Battery Service System.—The increasing use of electric vehicles, as well as the popularity of accumulator batteries for automobile starting and lighting, has made it imperative that special arrangements should be made in all parts of the country to provide for the repair and replacement of batteries. A booklet recently issued by the Chloride Electrical Storage Co., Ltd., shows how advanced these arrangements are. In practically every town of importance "Exide" battery service stations now exist, and the booklet gives a list of these. These stations are not merely collecting centres, forwarding batteries to the company for repairs; all repairs are executed in them, and fully-charged replacement accumulators are always available. The list also gives the names and addresses of colonial and foreign agents.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

An Ediswan Feeder Pillar.

Fig. 1 illustrates a 1,000-ampere feeder pillar which has recently been manufactured by The Edison Swan Electric Co., Ltd., at the Ponders End works for a large power consumer.

The supply is on the 3-wire system, the power being taken from the outers, and there is a circuit for a small amount of lighting between the outers and the neutral bus bars and links seen below the fuses. The fuses on the left are rated at 1,000 amperes, and the other two pairs at 500 amperes each. The illustration shows the front of the pillar, but there are doors at the back opening in a similar manner.

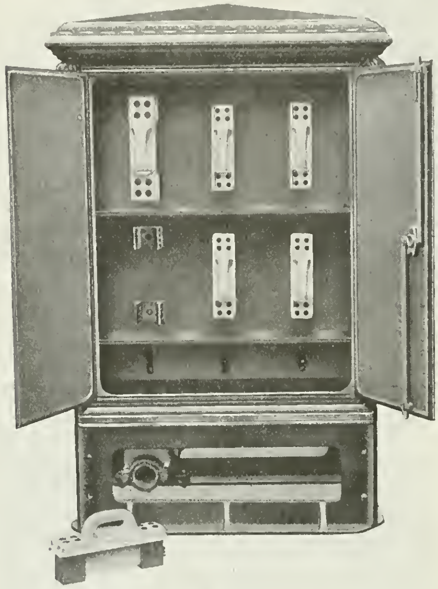


Fig. 1.—A 1,000-A Feeder Pillar.

The Edison Swan Electric Co., Ltd., is also supplying the .5, .5, .1 sq. in. lead-covered and armoured cable and the junction boxes which will connect the pillar to the consumer's switchboard.

The Willys Lighting and Power Plant.

Starting five years ago, the Willys light and power plant has become established in the American market, and is now being offered in this country on a co-operative sales plan by Messrs. Willys Overland Crossley, Ltd., of Heaton Chapel, Stockport.

The first impression one gets of the plant, which we recently had an opportunity of inspecting, is its compactness and extreme simplicity. Upon examination it is found to be a most complete outfit, and is absolutely self-contained. The engine is an air-cooled, 3-h.p., Knight sleeve-valve one, and cooling is very efficient, 36 hours constant running finds it absolutely cool. There is no water to freeze, heat, or require a large tank. A Venturi draught tube is used to cause the flywheel to create a partial vacuum within the tube and around the cylinder, so that fresh air rushes in and reaches all parts of the cylinder and also the generator. The Knight sleeves do away with all noisy valves, valve springs, tappets, and intricate small parts. This engine is very quiet, free from vibration, and it does not require frequent adjustment. Carbon, so detrimental to other engines, is claimed to improve the Knight engine by building up the sleeves and sealing the compression more tightly. The engine speed is 1,350 r.p.m.; it is high enough to give a steady light when driving direct from the generator, and yet assure long life, quietness, and economy. There is no carburetter, that device being replaced by a simple valve. The fuel tank is in the base and holds two gallons, or sufficient to operate the engine for nearly eight hours. The oil is also contained in part of the base. The engine will burn either petrol, benzol, or paraffin.

The engine is direct coupled to an Auto-Lite 1¼-kW generator, the armature of which is keyed to the crankshaft, as is the flywheel; they revolve as one piece. The generator is shunt wound, has four poles and two positive and two negative brushes. Its capacity is 1,250 watts—that is, 33⅓ amperes at 37½ volts. The fifth ignition brush also collects 5½-volt energy for ignition purposes. Every generator and armature is tested to 1,000 volts, and the generator is cooled by forced air.

The battery is big enough to absorb the full charge rate of the generator. It can be fully charged from dead in five hours, and the plates are claimed to provide from 40 to 50 per cent. greater capacity than any other lighting plant of similar size. The Ah capacity is 225, and the battery consists of 16 cells of the sealed-glass type big enough to run a ½-h.p. motor without the aid of the generator.

The control system is very simple and ingenious; it eliminates the usual switchboard with its fuses, terminals, and complicated wiring; it makes the plant self cranking and self stopping; it is entirely enclosed in a metal housing, includes a master switch, an overload circuit breaker, battery gauge, charge and discharge indication, and is built in part of the plant and subject to no vibration.

The engine, develops full 3 h.p., and the generator alone will supply electricity for 63 lights without using the battery; the starting and stopping operations are extremely simple, and can be mastered by the uninitiated in a few minutes.

A New Electric Fire Bar.

A new type of fire bar made by Automatic & Electric Furnaces, Ltd., 281-283, Gray's Inn Road, W.C. 1, consists of a hollow heating element about one inch in diameter, having an open front with irregular criss-cross pieces (see fig. 2).

A very closely wound helix of special wire placed *inside* the element provides the heating unit, and when placed in circuit the whole mass glows at a consumption of 500 watts—which is similar to the power consumption of all standard electric fire bars.

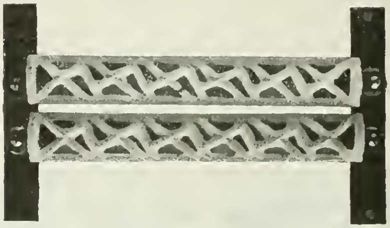


Fig. 2.—The "Furnace" Fire Bar.

The small irregular criss-cross pieces forming the front of the element effectively break up the straight lines obviating the severity and monotony of the usual plain white fire bar The large area of "solid red heat" as it appears in use produces a pleasing impression of warmth.

It is stated that these fire bars have been designed as the result of experience obtained in the construction of electric furnaces, consequently the temperature of the heating coi in these bars is very high, a result obtained without in any way impairing the life of the winding. They are known a "Furnace" bars.

"Philips" Night-lamps.

From time to time we have referred to the progress of th neon lamp, and we are now able to report its introduction t the market in this country by the Sloan Electrical Co., Ltd. of 12, Golden Lane, E.C. It takes the form of a ¼-c.p. night light, but is ideally adapted for use in any position where very small amount of light is sufficient, as in corridors, cupboards, &c. This lamp possesses no filament; it is in effec similar to the Moore light or the mercury vapour lamp, in tha the light proceeds from an electrical discharge in a gas between electrodes, the latter consisting in this case of wir helices and the gas being neon. The light emitted is of beautiful orange colour, and as it proceeds from the gas th intrinsic brilliancy is very low—hence a soft, rich, effect produced. The life of the lamp, we are informed, is man thousand hours; apart from accidental fracture of the bulb, th only source of deterioration is the gradual blackening of th bulb. Thus a lamp used for eight hours a day requires renew once a year. The consumption is only 5 watts. The lamp made for 110 V and upwards a.c., and 150 V upwards d. For nurseries and hospitals it is an ideal night-light, and f hotels, theatres, &c., it is suitable for a variety of situatio such as lighting exits and fire alarms. Another useful app eation is to pilot lighting on switchboards, &c.

JOINT ELECTRICITY AUTHORITIES.

The West Riding Inquiry.

The Conference Case.

(*Continued from page* 731.)

On the resumption on Monday, Alderman Wilfred Turner, chairman of the Bradford Electricity Committee, Chairman of the Conference scheme, and director of textile factories using electric power very extensively, was the first witness for the Conference scheme, and, in answer to Mr. T. R. D. Wright, explained how Bradford came to be a leading factor in this scheme. Prior to the issue of the Commissioners' notice as to the establishment of the Aire and Calder district Bradford had realised that, owing to physical limitations, the Bradford generating works were approaching the time when extension to meet the growing demand would be impossible, and an agreement was come to with the Yorkshire Electric Power Co. and the Electrical Distribution of Yorkshire, Ltd., as to the construction of a generating station on the Bradford Corporation's estate at Esholt, and a joint scheme of supply. Upon the advent of the Act of 1919 and the notice of the Aire and Calder district, Bradford took its place in the general Conference scheme, and the local proposal was suspended.

Questioned as to the principle of representation on the Joint Authority, Mr. Turner said Bradford was fully in agreement with the principle of public control, and expressed the view that the vesting of authority in public control was one of the most essential parts of the scheme.

Asked as to his views with regard to an authority comprising partly public representatives and partly company representatives, witness thought difficulties would arise in such a hybrid authority and handicap working. It was very desirable that the authority should consist solely of the one type of representatives.

In cross-examination by Mr. Wooll, witness agreed that, apart from urban district authorities, only nine out of sixteen borough authorities in the area had passed definite resolutions in favour of the Conference scheme. He did not agree that the essential financial aspects of the scheme were *ultra vires*, though he admitted there was a good deal that was *ultra vires* in both the Conference and Leeds schemes. He denied that the Conference scheme hung chiefly on the element of compulsion in the acquisition of existing undertakings, and disputed Mr. Wooll's suggestion that the scheme involved a change of the system of control representation.

Sir Harry Haward: Is it quite clear, Mr. Wooll, that the Conference scheme involves compulsion?—Mr. Wooll: I am certain it does from the point of view of legal construction, as the clauses stand.

Mr. Miller: I hope I made it quite clear in my opening statement that although the form of some of these clauses as they stand describe vesting, the Conference's intention is to obtain the agreement of the company, and there was no suggestion of compulsion.

In further answer to Mr. Wooll, who questioned whether the scheme satisfied the requirements of Section 6 of the Act of 1919 in giving representation to all authorised undertakings in the district, witness held that the proposed representation, after agreement with the company, essentially met that requirement. The Conference preferred representation based on population rather than on output, because that was less likely to fluctuate greatly, and because it was felt to be more fair all round. He did not deny that the scheme proposed three times the representatives for three boroughs of that for Leeds, though the electrical output of those boroughs was only one-sixth of that of Leeds. With regard to any possible deficiency, the scheme depended upon a basis of electrical consumption, because obviously it would not be fair to "come down" on districts other than those which had the commodity at the lowest cost. Mr. Turner admitted that the only fatal objection to the Conference was the possibility of failing to reach ultimate agreement for the acquisition of the Yorkshire Power Co.'s undertaking. The Conference had not applied itself to the question whether the scheme would be carried on with or without Leeds.

Sir John Snell pointed out that if the Commissioners accepted the Conference scheme they would have to be satisfied as to agreement between the parties concerned or would have to insert some such words themselves.

Mr. J. A. Greene (for the West Riding District Councils' Association, including councils which were not in the Conference) said the Conference scheme seemed to involve the question of rating imposed on districts not on the Joint Board. This was an important matter in case of any deficiency.

On the question whether the Conference would be content with a majority of representation, Mr. Turner said that a special meeting of representatives of the Conference had been held since this question was raised on Saturday, and had decided that under no circumstances could any departure be made from the attitude of representation in respect of any company possessing rights in perpetuity, but that, under certain conditions, rather than sacrifice the scheme, the Conference would be prepared to consider the desirability—if so directed by the Commissioners—of temporary representation of a company with authority in any area where the distribution had been handed over to the company for a fixed period of years. If Leeds declined to come in he believed the Conference would be prepared to carry on without it. It did not regard the inclusion of Leeds as so essential as the acquisition of the Power Co.'s undertaking. It could not accept the Leeds plan of a Joint Authority owning and controlling only new stations.

Mr. Wooll intimated that these aspects of the scheme must be radically modified before Leeds could come to any possibility of agreement.

Examined by Mr. Hunter Gray (for the Yorkshire Electric Power Co.), Mr. Turner admitted that without the part of the scheme described as *ultra vires* the scheme as a whole would be useless. If the Joint Authority were not formed he took it that Bradford would be committed to its Esholt station scheme of 1918, jointly with the Power Co.

Mr. J. A. Greene questioned the witness closely as to the clauses in the scheme dealing with the pledging of rates of local authorities to meet any deficiency which might arise. Mr. Turner held that districts in which supply would be costly to the Joint Authority, such as Holmfirth, could not expect that areas which had been able to generate their own energy cheaply should be mulcted in a share of that increased cost. Deficiency arising out of comparative inefficiency of the Joint Authority was not contemplated, because the co-ordination would of necessity effect economies. In answer to a question as to whether it was proposed that whenever any consumer took a supply from the Joint Authority the local authority of that area thereupon came under the rating obligation, the witness said the idea was that there should be safeguards against deficiency in proportion to the consumption of that area, and that the rating authority would have powers to recover the proportion of deficiency from the actual parties who were consumers. Subsequently Mr. Turner admitted that he could not point to anything in the Act which justified the Conference in presuming that rating powers could be gained, but said the Conference had not confined itself entirely to the Act, and had tried to produce a workable and business-like scheme for providing a cheap and abundant supply. He hardly thought the scheme would be proceeded with, without the compulsory rating powers.

Asked by Mr. Tyler (for the railway companies) what representation was provided on the board for such large consumers and bodies of such technical expertness as railway companies, Mr. Turner said they would have the representation of all their ratepayers and consumers—through the public representatives. Though direct railway representatives might be advisable on the linking-up scheme, he saw no reason why they should have a special place on the Joint Authority under his scheme.

In answer to questions by Mr. Woodhouse as to distribution—especially affecting the Electrical Distribution of Yorkshire, Ltd.—Mr. Turner said no plans had been made for acquiring that company, and no competition in distribution was contemplated by the scheme on the part of the Joint Electricity Authority. He agreed that, to some extent, the position of the Distribution Co. had been overlooked.

Mr. Woodhouse pointed out, also, that although the Conference agreed that there should not be two distributors in one area, the scheme proposed to take over the Power Co.—which included some distribution services—and also allow the Distribution Co. to continue its services. Witness replied that where the Joint Authority took over the Power Co.'s undertaking any distribution service involved would be taken over also. He expressed some surprise on learning that the Power Co. and the Distribution Co. were supplying different classes of consumers side by side in the same areas. If that meant that two sets of mains had to be installed, it would seem to be undesirable expense.

Mr. Thomas Roles, electrical engineer to the Bradford Corporation, past-president and member of the Council of the Incorporated Municipal Electrical Association, gave technical evidence on behalf of the Conference scheme, and outlined the history of the activities of the Technical Advisory Committee to the Conference. He said one of the reasons which prompted the framing of the Conference scheme was the existing system of supply, chiefly in the Power Co.'s service, from a considerable distance, whereas there were generating stations of local authorities much nearer. By unified control that kind of waste could be avoided, as well as such needless duplication of cables, as occurred between Halifax and Sowerby Bridge, and possibly in other areas, owing to the supply by different authorities. As to the authority in control, from the engineering point of view it did not much matter whether the authority were a public body or a company, so long as there were one central control; but as managers of electrical undertakings the Technical Committee came to the conclusion that, in view of the holdings of the prospective authority, and the opportunities for greater co-ordination, it was advisable that the authority should be one of elected public representatives. The advent of the Act of 1919 was considered by the engineers to make it impossible to work a Joint Authority successfully whilst the Yorkshire Power Co. continued in being. As to the idea of the company being part of the authority, it was felt that to get money cheaply it was necessary to have the rates behind the scheme, and that it would not be fair to put the public rates as a backing to a private company. The company's plant used as a nucleus would effect an economy, whereas if the company remained as a separate concern it might well obtain unfair priority over any other undertakers. All the generating authorities except Leeds had agreed to vest their undertakings in the Joint Authority under the scheme, at a figure of 52.7 per cent. of their total capital expenditure. He was very sure the authorities would not be prepared to sell their plant to the Power Co. on these terms. They would want the capital value of to-day. In going through the technical details, Mr. Roles said 33,000 volts pressure was decided upon, because that was the limit at which the cable makers would give a full guarantee, and because, on the average lengths of eight to twelve miles between centres, this was regarded as more economical than higher pressure. In view of the importance of the main transmission, it was proposed that all except some little amount of cross country secondary service should be underground. On the question of sites, Esholt was inferior to Ferrybridge or Wakefield, because extra expense would be involved in cooling provision, though it had advantages in the matter of coal supply. The conclusion of the Engineers' Committee was that Wakefield and Esholt stations should be proceeded with forthwith. The Leeds site was felt by the engineers to be quite insufficient from the point of view either of space or of water cooling facilities. The Bradford sewage works at Esholt could utilise for the next 75 years all the ash likely to be produced by the generating station. In view of the urgent electrical needs of the West Riding the Engineers' Committee suggested that the Ministry of Transport should commence construction immediately, but that the matter should be taken over immediately the Joint Authority was formed.

The Inquiry was then adjourned.

On Tuesday morning Mr. Thomas Roles was further questioned by Mr. Wooll as to the basis of representation on the proposed Joint Authority, and held to the view that if the authority were to be an owning and operating authority the representation should be limited, as an ideal, to duly elected public representatives of the bodies supporting the scheme. Financially, at the same time, he did not deny the fairness, in a larger body which would form practically a consumers' council, and be a non-operating body, of some form of representation of large consumers, such as distributive companies. Mr. Roles did not accept a suggestion by counsel that the Conference scheme was purely an orgy of optimism. He did not agree that the estimate of output of the Conference scheme, which was roughly 250 million units sent out for 1926—meaning an increase of 150 per cent. in six years from the output of 1920—was excessive, and thought the much lower estimate of the Leeds scheme must be due to the Power Co.'s output being under-estimated. He held strongly by the Conference estimates, even though for 1930-31 the Conference figure was 856,800,000 units, as against only 618,300,000 units on the Leeds estimate. He agreed that as to sales 90 per cent. was a fair average as against units sent out, or 85 per cent. of units generated.

Mr. Wooll contended that, in similar manner, putting the most optimistic light on the Conference figures, the comparative working costs were as follows: Coal consumption, Conference estimate, .299d. per unit sent out. Leeds 1920 cost, .509d.; Bradford, .529d.; water, oil, stores, &c., Conference estimate, .007; Leeds, .019; Bradford, .018; wages, Conference, .041; Leeds, .089; Bradford, .084; repairs, maintenance, &c., Conference, .027; Leeds, .057; Bradford, .154; rates, taxes, &c., Conference, .010; Leeds, .018; Bradford, .029; management, Conference, .021; Leeds, .041; Bradford, .051. Mr. Roles said he would accept those figures.

Summarising the position, Mr. Wooll asked if Mr. Roles really expected to run the capital station at half the cost of 1920 at the two nearest existing stations?—Witness: If we don't there is not much hope for the future of electricity supply. There is entirely different plant and better conditions.

The Chairman: Is not the position that the load factor of your station is 75 per cent., whereas counsel is comparing that with existing stations which have a load factor of something under 30 per cent., and therefore the two sets of figures are hardly comparable.

Mr. Wooll: What do you regard, as an engineer, as the possibilities of your scheme unless you secure the acquisition of the Power Co. by consent?—Witness: Our scheme goes.

What are the prospects if Leeds refuses to come in?—On the technical side the scheme would not be affected materially. The financial results would be better with the Leeds load included.

The Chairman: Does failure to secure acquisition of the Power Co. by consent mean total condemnation, rather than modification?—No, sir; the scheme would have to be recast, but as far as the Committee of Engineers is concerned they will never be satisfied unless there is some co-ordination scheme as regards the bodies which are in agreement, whatever happens as regards Leeds and the Power Co.

Asked whether, failing the Conference scheme, he would consider the Leeds scheme more desirable than the existing system of independent suppliers, witness said he would prefer independent arrangement between the Power Co. and the localities.

In answer to Mr. Hunter Gray (for the Power Co.), Mr. Roles said that from the engineering point of view of production of a cheap and effective supply, he did not doubt that the Yorkshire Power Co., if in entire control of the whole district, could do the work as effectively as could a joint body of local authorities, but such entire control by a company was not a practical suggestion. Bulk supply by the company to the towns was quite practical, but was not the scheme of economy desired.

In reply to the Chairman as to the wide variation in the capital charges and working costs estimated in respect of the new capital stations, Mr. Roles said the Conference figures had been arrived at after close inquiry into large American practice, and bearing in mind the higher wages in America and his own addition of 20 per cent., he believed the Conference figures were a very probable estimate.

Mr. Percy Greaves, consulting mining engineer, Fellow of the Institution of Mining Engineers, managing director of four colliery companies and former chairman of the Wakefield Electricity Committee, gave evidence to the effect that the maximum of subsidence of land at the Wakefield site due to coal mining operations had been reached, and the site was quite safe from any disturbance.

Ald. Wilfred Turner, recalled to give evidence as to the prospects of demand for electric drive in the West Riding wool industry, said that of the 2¾ million spindles less than 10 per cent. were at present under electric power. He believed the figure for looms was slightly higher, but not more than 10 per cent., and for wool combing decidedly lower. There was, therefore, a wide field of development for electric power.

Mr. F. Ogden Whiteley, city treasurer of Bradford, and a member of many important bodies connected with accountancy, gave evidence as the financial adviser to the Conference scheme. He said he had estimated that the capital could be raised on the security offered at 6½ per cent. for the money raised during the first five years, and 6 per cent. for the money raised during the second five years. If the first money were raised on short-date loans, as was very popular in the North, there would be an advantage, because there would not be the continuance of payment in the second period on the initial 6½ per cent. loan. He did not accept the view, as expressed by Mr. Collins, of Birmingham, that the composite authority as suggested by the scheme would be at a disadvantage in borrowing money as against a single local authority or a company. He did not think the absence of Leeds would make any material difference in view of the substantial nature of the other authorities concerned, and the absence of the smaller authorities represented by the West Riding District Councils' Association would have no effect whatever. If the Joint Authority wished to raise money solely on stock and revenue it would certainly cost 1 per cent. more than if the rates were behind the borrowing. He did not contemplate a deficiency, and even the statement that the rates were behind the scheme meant that any call to meet a deficiency would be upon the several local electricity accounts rather than upon the general rates. Whilst being prepared to raise the whole of the purchase money for the taking over of the Yorkshire Power Co., the scheme provided for the probability that a proportion of the company's shareholders would take scrip of the new undertaking, as had happened in the case of the purchase of gas companies in Bradford from time to time.

On Wednesday, May 25th, Mr. F. Ogden Whiteley, financial adviser to the Conference scheme, was cross-questioned closely by Mr. Wooll (for the Leeds scheme) and by members of the Commission on details of his financial tables. He said it was not the intention of the Conference scheme that the Government should lend money, except that the Ministry of Transport should be asked to finance the initial operation of the scheme owing to the electrical urgency, and the Joint Authority would take over the work and responsibility within twelve months. He admitted, in answer to Mr. H. Booth, that this clause might be *ultra vires*. The estimates had been based on the assumption that the Joint Authority would be constituted by April, 1922. They anticipated the issue of three millions sterling within six months of the legal birth of the Joint Authority. Asked if he could explain the great difference between the Conference estimate of working capital and the Leeds estimate, the witness gave detailed figures of his calculations, and drew attention to the fact that the Conference estimate was based on a month's or six weeks' payments, whereas the Leeds estimate was based on a full three months. He believed that, in the early stages, at any rate, six weeks' basis of credit was quite safe. The accounts were usually monthly. He agreed that by reducing the estimate to a similar period's credit the Leeds estimate would be lower, instead of higher, than the Conference figures. Asked as to the figure of the estimated cost of purchase of the Yorkshire Electric Power Co., Mr Whiteley said he had no grounds for believing the figure would find favour with the company, but it was a figure which, if he were advising the company, he would advise it to accept. He did not agree that the present was a bad time to buy out an electrical company, though he recognised the appreciation of buildings and plant in recent years.

Further evidence in support of the financial proposals of the Conference scheme was given by Mr. G. D. Rowe, a member of the London Stock Exchange and of the Special Finance Committee appointed by the Treasury to Regulate the Issue of Stocks by Local Authorities, who expressed confidence as to the raising of the money under the Conference scheme, and felt that the Joint Authority would enjoy an advantage of from 1 per cent. to 1½ per cent. over any private company in borrowing. Indeed, apart from the effect of external factors such as great strikes, the Bank of England rate, &c., he thought the money could be raised more cheaply than was allowed for in the scheme. The mere absence of Leeds from the scheme would not affect the loan detrimentally, unless Leeds took up an actively hostile attitude. In reply to cross-examination by Mr. Wooll, the witness said if Leeds undertook a propaganda campaign against the scheme, it might affect the matter to some extent both as regarded investors and underwriters, but the discriminating underwriters would have to be shown that the absence of Leeds was a serious technical weakness in the scheme. He thought it could easily be explained that Leeds had justification for its isolation as a large self-contained centre. A great undertaking like that proposed would introduce a more free market for the realisation of money invested in the electrical undertaking than was the case with shares in a private company to-day. In reply to Sir Harry Haward, the witness said he believed that the absence of a certain number of the smaller local authorities from the scheme would have a negligible effect on the raising of the money if the scheme were led by the big boroughs like Bradford; he agreed that if the electric power company or big industrial undertakings like railways were represented on the Joint Authority, they would be a source of strength.

Mr. W. M. Selvey gave expert evidence on behalf of the Conference as to the provisions for water cooling at the proposed capital stations. It was proposed at Esholt to construct a pond of 22,500,000 gallons capacity, by the use of which, and also the sewage effluent of the Bradford sewage works there, the cooling plant would be quite independent of the river Aire. The utmost pond capacity he could calculate upon in connection with the Leeds site at South Accommodation Road was 4,370,000 gallons, which would be insufficient to meet the cooling demands. Flowing water of the river Aire at the Leeds site, including canal lockage and some sewage, and subject to dry weather variation, would bring the supply there to 33,000,000 gallons, so far as he had been able to gather, though 35,000,000 gallons had formerly been given by Mr. Hefford as the more normal supply. At the Wakefield site, where the water supply was ample for any requirements of this plant, there were 22.3 million gallons if calculated as a pool, even if there were no flow—but there was always a flow—and an additional 3.9 million gallons of flow, as calculated at the minimum after a six months' drought.

At this stage Mr. Miller concluded the case for the Conference scheme by handing in the 1918 agreement between Bradford Corporation and the Power Company, in respect of Esholt prior to the advent of the Electricity (Supply) Act, 1919. He also put in a letter to the Town Clerk of Bradford from the Town Clerk of Sheffield, reporting that the joint conference of the Sheffield and Rotherham Corporations had passed a resolution that they did not favour the Power Company's inclusion in the proposed authority for the North-East Midlands authority, but would consider the question of taking over the company's undertaking.

(*To be continued.*)

THE (LONDON) ENGINEERS' CLUB.

On Thursday last week a large and enthusiastic meeting of supporters of the proposal to form an Engineers' Club in London was held at the Hotel Cecil. In the unavoidable absence of Mr. E. Manville, M.P., Mr. C. H. Wordingham, C.B.E., was invited to take the chair, and in doing so said he had always strongly felt that there should be an Engineers' Club in London, on the lines of the Manchester Engineers' Club.

The Hon. Secretary, Mr. Edmund L. Hill, after referring to the death of two valued supporters, Lord Moulton and Mr. E. L. Orde, read a report on the work that had been done towards the formation of the Club by the Executive Committee, showing that about 1,600 applications had been received, and that hopes were entertained of obtaining most suitable premises which were about to be vacated by the Road Club, thus enabling a start to be made early in July. He then moved that the Engineers' Club be constituted forthwith. The resolution was seconded, and after various questions had been put and answered by Mr. Hill, it was carried unanimously. It was also unanimously resolved, on the motion of Mr. Cash, hon. solicitor to the Executive Committee, that the Club should be formed as a company limited by guarantee, the guarantee being limited to a maximum of £5 per member. A third resolution, also carried unanimously, authorised the appointment of a General Committee to act until the end of the first annual general meeting, with powers to proceed with the necessary organisation and arrangements for the housing of the Club. Following on this, it was proposed that the existing Executive Committee be appointed *en bloc*, with power to add to its number, and after the names had been read by the Chairman, the resolution was passed with one dissentient. Mr. Edward Manville was unanimously elected president, and Mr. E. L. Hill was elected hon. secretary by acclamation.

In the course of the proceedings it was made clear that the new organisation was intended to be a "social" club, and that alien enemies would be rigidly excluded from membership. Some discussion took place regarding the admission of American and other honoured alien engineers resident in this country, and after various propositions had been put forward with a view to meeting the difficulty caused by the rather precipitate adoption of a resolution confining "permanent membership" to British subjects, the matter was practically left to the discretion of the Committee (except in respect of alien enemies).

The feeling of the meeting, which comprised nearly half the supporters resident in London, was unmistakeable; it was clear that the audience was eager to form the Club and get it into working order with the least possible delay. Even the members of the Committee were surprised at the enthusiasm displayed and at the number of engineers who had found time to attend the meeting. We understand that the number of applications received is now over 1,700, and that the negotiations for premises are proceeding satisfactorily. For the present no entrance fee is payable, but it is anticipated that in the near future one will be imposed. The subscription for town members is ten guineas per annum; for country members five guineas, and for overseas members two guineas. Full particulars can be obtained from the hon. secretary, Mr. E. L. Hill, 39, St. James's Street, S.W.1.

ELECTRICAL RESEARCH.

The quarterly progress report of the British Electrical and Allied Industries Research Association (E.R.A.) states that the Council is carrying out a comprehensive programme of research at the National Physical Laboratory. Of its sectional activities it is reported that tests are being made upon cotton fabrics, dressed and undressed, of various weights, and treated with varying thicknesses of varnish. A collection is being made of samples of treated fibrous insulating materials, with a view to classification before proceeding with these tests. A complete series of purchasing tests is to be made on samples of untreated papers used for various electrical purposes, such investigation including the testing for impurities such as metallic inclusions and carbon obtained from soot in the atmosphere, as well as porosity conditions. A large number of samples of treated papers has been collected. The numerous other materials in use have been classified, with the exception of vulcanised fibres, and a preliminary schedule of acceptance tests for purchasing purposes has been prepared.

In the section dealing with composite insulating materials, on completion of experimental work general clauses for mechanical and electrical tests will be prepared. Fire-resisting materials have yet to be dealt with. Proposed clauses for tooling tests on ebonite are being prepared. In connection with porcelain insulators a valuable report has been received from Messrs. Langton & Harris on preliminary researches on electric and mechanical strength, temperature effects, hardness, specific gravity, thermal conductivity, and moisture absorption. Programmes of research are being dealt with in respect of insulation resistance, surface improvement, dielectric strength, and uniformity of vitrification.

In the section dealing with mica and micanite, the views of users of these materials for commutators, obtained in response to a questionnaire, are not supported by sufficient evidence to enable decisions to be made at present. Information on commutation troubles not directly connected with mica and micanite is being forwarded to the B.E.A.M.A. for the benefit of manufacturers. The committee is considering research on abrasive hardness, and on the manufacture of micanite. Troubles met with in the manufacture of condensers are being tabulated for consideration.

In the section dealing with insulating oils, the final draft of the preliminary purchasing specification for insulating oils for transformers, oil switches, and breakers, is to be submitted to the British Engineering Standards Association. The National Physical Laboratory has undertaken researches on vapour pressures, thermal transference coefficients, and thermal conductivity. Research is proceeding on specific heats, latent heats, boiling points, the effect of numerous catalysers on sludging, such as metals in contact with paint, the effect of the electric arc on the oil, the carbon deposit and sludge produced in transformers and switches.

In the conductor section, conclusions of wide application may be drawn from investigations of the thermal and moisture conditions of the soil. The mathematical formulæ developed in three-core cable work are being checked over a wide range, and experimental work is progressing on methods of measuring dielectric losses and the effects of grouping and spacing cables.

In the section of electric control apparatus a report is being issued in sections on the phenomena of switching and arcing, based on information collected from power-station engineers and others. Co-operation with the Home Office is being continued in testing mining switchgear. A report is now in preparation on the design and operation of heavy-duty fusible cut-outs and incidental matters. Information is being collected on the rupturing capacity of d.c. circuit breakers with a view to the improvement of purchasing specifications. A committee has been formed to consider a programme of research on conditions arising from the use of larger plant, in respect of the conductivity of bolted, clamped, and screwed joints.

A substantial contribution has been made by this Association to the funds required for research with regard to the corrosion of condenser tubes, which is being conducted by the Institute of Metals.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

14,206. "Lamp sockets." British Thomson-Houston Co., Ltd. (General Electric Co.). May 21st.

14,218. "Inductance coils for wireless telegraphy, &c." E. C. Atkinson. May 21st.

14,220. Electric motors." W. R. Macdonald. May 21st.

14,222. "Combined electric transformer and hummer." E. Dobson. May 21st.

14,230. "Electrical precipitation apparatus." Lodge Fume Co., Ltd., and L. Lodge. May 21st.

14,231. "Electrical precipitation apparatus." Lodge Fume Co., Ltd., and N. Stallard. May 21st.

14,252. "Means for producing perforated tape by electric current impulses." G. J. J. Rosendahl. May 21st.

14,272. "Controlling arrangement for electric current." H. Brownlow and C. A. Hadley. May 23rd.

14,289 and 14,290. "Combined electric switches and plugs." J. B. Tucker. May 23rd.

14,295. "Bases for trolley poles for electrically-propelled vehicles." E. M. Munro. May 23rd.

14,302. "Galvanic batteries or cells." E. E. G. Boite, W. H. Edridge, and Lyto, Ltd. May 23rd.

14,312. "Electric flat irons and heating means therefor." A. E. Alexander (Iserson). May 23rd.

14,314. "Electric ignition of signals, &c., to be dropped from the air." O. D. Lucas and M. L. Experimental, Ltd. May 23rd.

14,318. "Low-voltage protective circuit controllers." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). May 23rd.

14,319. "Motor controllers." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). May 23rd.

14,324 "Dynamo-electric machines." A. H. Midgley. May 23rd.

14,325. "Control of dynamo-electric machines." A H Midgley. May 23rd

14,330. "Electric coding machine." E. H. Hebern. May 23rd.

14,331. "Electro-magnetic clocks." M. P. Favre-Bulle. May 23rd. (France, May 21st, 1920.)

14,332. "Oil tanks for electrical apparatus, &c." P. Gatta. May 23rd.

14,334. "Electron discharge apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). May 23rd.

14,335. "Centrifugally operated switches." British Thomson-Houston Co., Ltd., and A. P. Young. May 23rd.

14,340. "Radio-telegraph break-in system." P. M. Ware. May 23rd.

14,352. "Electric commutators." A. O. Hinchliff, Watliff Co., and S. J. Watson. May 23rd.

14,389. "Electric accumulators." W. Whitehead. May 24th.

14,404. "Electro-magnetic wave signalling apparatus." G. Hill and J. O. Mauborgne. May 24th. (United States, May 24th, 1921.)

14,442. "Electro-magnetic long-distance switch." G. Matt. May 24th.

14,445. "Battery indicator systems." G. Cooper and J. H. McIlroy. May 24th.

14,453. "Wireless signalling systems." British Thomson-Houston Co., Ltd. (General Electric Co.). May 24th.

14,470. "Tumbler switches, &c." Appareillage Gardy Soc. Anon. May 24th. (Switzerland, May 25th, 1920.)

14,482. "Electrical controlling devices." M. Walker. May 25th.

14,490. "Contact starters for electric motors." G. V. Hornby and H. Watson. May 25th.

14,518. "Interchangeable parts for wireless and electrical apparatus." G. H. Moody. May 25th.

14,535. "Automatic telephone systems." Automatic Electric Co. and (Automatic Telephone Manufacturing Co., Ltd.). May 25th.

14,543. "Electric accumulators." G. Philippart. May 25th. (France, May 31st, 1920.)

14,545. "Frequency multipliers for alternating electric currents." P. Trichard. May 25th. (France, May 26th, 1920.)

14,550. "Motor controllers." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). May 25th.

14,555. "Electric transmission over long distances." A. M. Taylor. May 25th.

14,561. "Electric discharge devices." British Thomson-Houston Co., Ltd. (General Electric Co.). May 25th.

14,562. "Electric heating units." British Thomson-Houston Co., Ltd. (General Electric Co.). May 25th.

14,563. "X-ray apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). May 25th.

14,571. "Secondary electric batteries or accumulators." Chloride Electrical Storage Co., Ltd., and B. Heap. May 25th.

14,573. "Wireless signalling." P. P. Eckersley and C. S. Franklin. May 25th.

14,574 "Means for actuating electric relays." Ges. fur Drahtlose Telegraphie. May 25th. (Germany, July 23rd, 1920.)

14,575. "Circuits for electrical oscillations." Ges. fur Drahtlose Telegraphie May 25th. (Germany, July 30th, 1920.)

14,604. "Suspension device for reflector bowls for electric lights, &c." W. A. Salmon. May 26th.

14,637. "Coupling for electric conduit." F. G. Grist. May 26th.

14,655. "Means for operating electric bells." W. Clark and Clark's Neo-Electric Devices, Ltd. May 26th.

14,659. "Electric heaters." C. H. W. Morrison and M. & P. Enterprises, Ltd. May 26th.

14,663. "Electric speedometer." A. M. Low and Low Engineering Co., Ltd. May 26th.

14,672. "Electric switches." F. Lorand. May 26th.

14,673. "Apparatus for diminishing magnetic dispersion in electric transformers." Akt.-Ges. Brown, Boveri et Cie. May 26th. (Switzerland, June 2nd, 1920.)

14,675. "Contacts for electric switches." A. P. Welch. May 26th.

14,695. "Electric safety lamp for miners." L. A. Didier. May 26th. (France, August 17th, 1920.)

14,702. "Electric furnaces." I. Rennerfelt. May 26th. (Sweden, June 2nd, 1920.)

14,709. "Magneto contact breaker spring guard and conductor." H Richardson. May 27th.

14,713. "Definite time-limit relay or time-lag device." J. Bowie and J. Henderson. May 27th.

14,777. "Ignition magnetos for internal combustion engines." British Lighting & Ignition Co., Ltd., and E. O. Turner. May 27th.

14,778. "Ignition magnetos for internal combustion engines." British Lighting & Ignition Co., Ltd., and E. O. Turner. May 27th.

14,787. "Electricity measuring instruments." H. Lucas and O A Miller. May 27th.

14,790. "Change-over apparatus for operating vehicles with different voltages." Akt.-Ges. Brown, Boveri et Cie. May 27th. (Germany, May 28th, 1920.)

14,792. "Sparking plugs." H. G. Longford and Sphinx Manufacturing Co., Ltd. May 27th.

14,795. "Switches" H. A. Gill (J. W. Zander & Co.) May 27th.

14,801. "Windings of alternating current dynamo-electric machines" British Thomson-Houston Co., Ltd., and H. W. Taylor. May 27th.

14,814. "Process for direct production of titanic ores or slags." J. J. Loke. May 27th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

29,528. "Dynamo-electric machines." L. J. Stephenson. May 15th, 1919. (143,181.)

32,413. "Aerial systems employed in wireless signalling." S. B. Smith and G. M. Wright. December 24th, 1919. (163,070.)

32,500. "Electric lamp casings and holders." W. Boydell & Sons, Ltd., and J. Boydell. December 29th, 1919. (163,071.)

32,724. "Improvements in variable electrical resistances by the jointless grading of the resistance wire forming the same." A. Bursill. December 30th, 1919. (163,072.)

1920.

600. "Ignition devices for internal combustion engines." F. A. Smith. January 7th, 1920. (Patent of addition not granted.) (163,077.)

673. "Ventilation of dynamo-electric machines." British Thomson-Houston Co., Ltd., and H. W. Taylor. January 8th, 1920. (163,079.)

877. "Electric welding systems and apparatus." British Insulated and Helsby Cables, Ltd., and L. B. Wilson. January 10th, 1920. (163,083.)

3,305. "Cooling devices for electrical apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). February 3rd, 1920. (163,090.)

3,336. "Alternating current induction motors." Aktieselskabet Jydsk Elektro. April 12th, 1919. (141,671.)

3,413. "Electric switches." P. B. Handley. February 4th, 1920. (163,092.)

3,492. "Electric cut-out systems." F. S. Enrich and C. P. Serrano. February 4th, 1920. (163,094.)

3,797. "Electrically operated coin-freed automatic machines." J. J. Prinzing and R. Bertschinger. September 16th, 1919. (151,232.)

3,918. "Electrical measuring-in instruments." British Thomson-Houston Co., Ltd., and R. C. Clinker. February 9th, 1920. (163,097.)

4,128. "Electric starters and cut-outs used in connection with electric lighting plant employing internal combustion engines." A. H. Railing, C. C. Garrard, and W. Wilson. February 11th, 1920. (163,111.)

4,144. "Combined electric switches and wall plugs and sockets." Walsall Hardware Manufacturing Co., Ltd., W. Compson, and A E. Read. February 11th, 1920. (163,113.)

4,243. "Device for ascertaining the direction of submarine sound waves." Signal Ges. November 20th, 1917. (138,917.)

4,273. "Wireless telegraphy and telephony." A. K. Macrorie, H. Morris-Airey, and G. Shearing. February 11th, 1920. (163,117.)

4,463. "Protective devices for alternating current systems." A. H. Railing, C. C. Garrard, and A. E. McColl. February 13th, 1920. (163,129.)

4,809. "Electric power transmission systems." British Thomson-Houston Co., Ltd., and F. H. Clough. February 17th, 1920. (163,136.)

4,986. "Bayonet sockets for electric lamps." J. Wegmann. February 22nd, 1919. (139,469.)

5,375. "Miner's safety lamp." D. J. Thomas. February 23rd, 1920. (163,143.)

5,740. "Receivers for use in connection with signalling by sound waves." M. I. Pupin. February 4th, 1918. (139,498.)

5,749. "Electric controllers for use in electrically-propelled vehicles and other purposes." P. A. H. Mossay, Mossay & Co., Ltd., and Ransomes, Sims and Jefferies, Ltd. February 25th, 1920. (163,153.)

6,150. "Electric switches." J. H. Tucker & Co., Ltd., and W. J. Line. March 1st, 1920. (163,159.)

6,773. "Electric condensers." L. Segal. July 8th, 1919 (146,925.)

8,919. "High speed electric or other locomotives." British Thomson-Houston Co., Ltd., and F. W. Carter. March 26th, 1920. (Additions to 128,106.). (163,185.)

9,373. "Fittings for electric, gas, and the like lighting." A. G. Beaver and Sun Electrical Co., Ltd. March 31st, 1920. (163,189.)

9,492. "Sparking plug for explosion motors, especially for aero motors" A. Custoza. April 1st, 1919. (141,074.)

10,906. "Telemotor apparatus." W. J. Paulin, T. C. Fortune, and T. McLeod. April 20th, 1920. (163,198.)

11,934. "Recovery of zinc by electrolysis." Electrolytic Zinc Co. of Australasia Proprietary, Ltd. December 24th, 1919. (155,792.)

13,257. "Construction of incandescent electric lamps." F. Bergery. May 13th, 1920. (163,207.)

15,337. "Symmetrical quick-acting contact breaker for magnetos for ignition purposes." G. B. Gousset. June 20th, 1919. (145,405.)

21,732. "Spark plugs." H. A. Myers. July 20th, 1920. (163,228.)

36,505. "Electric fuses." Metropolitan-Vickers Electrical Co., Ltd. January 12th, 1920. (156,586.)

36,506. "Electric fuses." Metropolitan-Vickers Electrical Co., Ltd. January 12th, 1920. (156,587.)

Film Studio Lighting.—The gasfilled metallic-filament lamp is rapidly growing in favour as an illuminant for portrait studio lighting, but its use in the production of kinematograph films has not been developed to the extent which it deserves. Experiments in this direction recently made with gasfilled lamps in the studios of Messrs. Holams, Ltd., showed that the light is a much closer approximation to daylight than that of the arc lamp, and the images on standard orthochromatic film are also more colour-true.

Comparative trials were made by taking views of the same scene on the same day under exactly identical conditions, the one under arc lamps and the other under the light from Osram gasfilled lamps. The colour scheme was purposely made as rich and comprehensive as possible so as to present a really difficult subject. In the first case 12 enclosed arc lamps were used taking 15 amperes each at 200 volts, a total of 36 kilowatts; in the second case 16 1,500-watt Osram gasfilled lamps in G.E.C. studio reflectors, and consuming in all 24 kilowatts, were employed. The results of the experiments tended to show that the gasfilled lamp was worthy to play a much larger part in film production thau hitherto, from the point of view of film-quality alone. These lamps are easily handled, and the absence of complicated mechanism makes for simplicity of operation and low cost of supervision and maintenance. A very small staff of electricians would be needed for the largest installation. No energy is wasted in resistances, and no expensive converters are necessary; the light does not vary in quality throughout the life of the lamp, reaches its full value immediately the lamp is switched on, and is perfectly steady.

THE
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ELECTRICAL REVIEW.

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THE INDUSTRIAL OUTLOOK.

THE great question occupying the minds of employers and workers at the present time is that of wage reductions. It is probably true to say that everyone realises that wages must fall, and the points for consideration are: By how much, and in what steps?

By the time these words are before our readers it is possible that the engineering industry will be at a complete standstill. It is doubtful whether the coal strike will be settled, and practically certain that the cotton trade will still be idle. The iron and steel industry has been almost entirely stopped, as a consequence of the coal trouble, since the beginning of April.

The cotton trade represents approximately one-third of our national exports. The world, as Sir Robert Hadfield has told us, is hungry for steel. It is also hungry for British coal and engineering products. We are exporting none of these things, but we are buying foreign coal, and burning imported oil under our boilers wherever it is possible—perhaps "necessary" would be a more applicable word—to do so. Short of actual violence and civil tumult, our greatest enemy could not wish to see the country in worse plight; but, apart from Ireland, the complete calm, almost amounting to apathy, of the public, is perhaps one of the most remarkable features of the situation.

It is, unfortunately, only too true that there is a serious depression in trade. Orders are scarce, and competition, for what business is available, is exceedingly keen. Yet we know that many of the large firms, particularly in our own industry, have well-filled order books; it has, indeed, been an outstanding feature of speeches at shareholders' meetings for the statement to be made that the factory can be kept going for a considerable time. Firms in this position cannot, and we believe it is safe to say they do not, want a stoppage; and when, as we have shown over and over again, output, production, plenty of everything, is the crying need of the time, it is clear that it is not in the interests of the nation or of the world at large that three of our leading industries, with numberless secondary trades, should be shut down. The workers themselves would, of course, rather be at work earning money than be idle.

Who, then, is in favour of closing down? Obviously it can only be such firms as have not enough work in hand to keep going, and those whose standing charges are so small that it is of little moment whether they keep open during the slump or not. English folk are very individualistic, and there are many small business concerns in existence which must feel the present condition of things very keenly.

When overhead charges are small, direct wages are apt to loom larger in the mental landscape than is warranted by their actual importance. Direct wages form but one of the constituent factors of the price of the finished product. In some classes of electrical apparatus direct wages amount to from 16 to 20 per cent. of the works cost when the goods are made in a large works. The rest of the cost consists of material and of overhead charges in the factory. The commercial charges and profits have then to be added, so that the proportion of the whole selling price represented by direct wages becomes still less. In a smaller concern, overhead factory charges and commercial expenses are both relatively and absolutely smaller, and the direct-wage proportion is relatively greater, both for this reason and also for the reason that the small concern will not infrequently do most of its business by underselling its larger competitor.

We can now see a reason which might impel a small firm to make drastic cuts in wages; and in employers' conferences the small firms are in the majority, so that their votes can carry the issue. So we find that, in spite of a reserve of orders which can be drawn upon, like a banking account, to tide over the evil day, there is a danger that by excessive reductions of wages, resulting in strikes, we shall proceed to kill export business by increasing the period required for delivery, and deliberately force the trade of the world into the hands of those who are ready, and willing, to work for it.

The industrial situation is comparable with the military situation as it existed in the spring of 1918. The enemy is not labour, but bad trade, and we shall defeat that enemy by co-operation, team work, and goodwill. These granted, the needs of the world will provide plenty of work, and it will be found that the workers' standard of living can be maintained at a level considerably better than before the war. We repeat that labour is not the enemy, and consequently it is wrong to talk of "the conflict with labour." Talk of that kind does no good, but only exacerbates tempers on both sides.

In this connection the remarks of Mr. Robert Fleming at the meeting of the Investment Trust Corporation last week are worthy of quotation: "To-day the great bulk of the cost of everything we buy consists of wages, so that any general fall in wages must necessarily bring down with it the cost of living. Thus no real reduction in the standard of living need take place if that standard is not wasteful, but carefully economical. . . But even lower wages and greater production are not enough unless combined with the highest efficiency from the capital and managerial end."

Why is not more use made of the Industrial Courts? They were hailed with acclamation as a statesmanlike provision for the settlement of industrial differences, but the dockers' dispute remains almost the only example of the reference of such a dispute to such a Court. It ought not to be necessary for ministers—even the Prime Minister—to take a hand in such matters. It may be necessary in the case of coal, because coal has been under Government control, and the Government has offered £10,000,000 for the purpose of letting wages down with rather less of a bump than the owners appear to find necessary. It almost seems as if this is another of the cases in which excellent machinery has been provided, but, through some error of judgment, remains unused. Surely, even if coal cannot be referred to an Industrial Court, the cotton and engineering disputes can be.

The suggestion is not new, and we hope it may bear fruit speedily, for assuredly the continuance of the present condition of things is a grave national disaster.

Lighting Authorities and Actions for Negligence.

A CASE which was heard in the Court of Appeal recently (Sheppard *v.* Mayor of Glossop, ELEC. REV., April 15th, 1921, at p. 479, and *Law Journal*, April 23rd, at p. 160) raised a point which is of considerable importance to lighting authorities—especially in view of the fact that, on account of the coal trouble, restricted lighting has become necessary. The facts of the case having been fully reported in our pages, we may limit our reference thereto by stating that the plaintiff brought the action, claiming damages for personal injuries owing to the negligence of the defendants in not lighting a certain gas lamp.

Mr. Justice Greer held that the effective cause of the plaintiff's losing his way and falling over the retaining wall was the turning-off of the light in the lamp, that the defendants were the lighting authority of the district under Section 161 of the Public Health Act, 1875, and that, by causing the lamp to be extinguished, they caused the place to become a dangerous trap into which the plaintiff fell; and the learned judge awarded him £279 10s. damages. The defendants appealed. Section 161 of the Public Health Act provides that an urban authority may (*inter alia*) provide lamps and other apparatus for lighting the streets within their district and also gas for such purposes throughout the whole or any part of their district.

The Court allowed the appeal, holding that the effect of the section was to give the defendants authority to light their district, but it created no obligation to light it, and gave them a discretion as to whether they would light only some portions of their district; *and it also gave them full discretion as to when the lamps were to be kept lighted in any portion of the district which they elected to light.*

It is all-important to observe that the above decision was based upon the Public Health Act, 1875. It does not follow that local authorities in all parts of the country can be excused in the like circumstances, because in some places an obligation to light—as opposed to a power to light—is imposed upon the authority. Thus in Carpenter *v.* Finsbury Borough Council ((1920) 2 K.B. 195) Sec. 130 of the Metropolis Local Management Act has to be considered. By that section: "Every (local authority) shall cause the several streets . . . in their district to be well and sufficiently lighted and for that purpose shall maintain or set up and maintain a sufficient number of lamps in every such street and shall cause the same to be lighted with gas or otherwise and to continue lighting at and during such times as such vestry or board may think fit necessary or proper. . . ." It was held under this section that the obligation of the local authority as to any particular street is to ensure that it is well and sufficiently lighted. Where an accident is alleged to have been due to the insufficient light provided in a street it is for the tribunal of fact to determine whether the statutory obligation of the local authority has been complied with; it is not enough for the local authority to say that in their discretion they considered that the lighting actually provided was sufficient. It will, therefore, be seen that the Glossop case has no application in the metropolis. It is important, too, to observe that in coming to the conclusion at which it arrived the Court of Appeal overruled the finding of Mr. Justice Greer that the plaintiff had been lured to destruction by a trap, *i.e.*, the sudden and unexpected extinguishment of the light. In this respect two important previous decisions appear to be overruled; but notwithstanding the ruling of the Court of Appeal, it is clearly desirable for any lighting authority to give due warning to the public if electric or other lamps have to be extinguished in a public place.

The Electrification of Railways.

IN a recent issue we drew attention to the divergence of opinion manifested in different countries with regard to the type of current selected for the electrification of railways. We are indebted to Prof. S. Parker Smith for further information, published in this issue, which emphasises the fact that agreement on this subject is very far from attainment. Broadly speaking, we may say that the English-speaking nations favour the use of direct current, and that, except where their influence holds sway, as in the Argentine, and in France, all other countries are adopting alternating current, mainly single-phase.

The situation demands very serious consideration; if we confine our attention to the direct-current system, we run the risk of being cut off from the vast market for electric railway plant that we may confidently expect to see developing in foreign countries, unless we are in a position to prove that d.c. is better than a.c. for this purpose. Much depends upon the development of the mercury-vapour rectifier and the thermionic type of rectifier; when these are capable of dealing with the heavy railway loads with certainty, the case for the d.c. system will be materially improved, but that time has not arrived, and it behoves us to be prepared to carry out railway electrifications on the largest scale with single-phase current if the need arises.

THE RELATIONSHIP BETWEEN EFFICIENCY AND WORKING COSTS OF SMALL MOTORS AND GENERATORS.

By E. G. KENNARD, A.M.I.E.E.

The extent to which differences in efficiency exist in dynamos and motors, of similar rating, obtainable at the present day may not be generally recognised amongst engineers.

It will be found, however, that where tests of different makes of machines are compared, very considerable differences in the efficiency values exist, depending on the design, type, and material employed in the manufacture, and the purpose of this article is to draw attention to the extent to which the variation of commercial efficiency may affect the working costs of electrical machinery as seen from the small consumer's point of view.

Some important changes have taken place since the year 1914, which affect very considerably the question of rating and efficiency of electrical machinery, viz. (*a*) considerable increases in the cost of electrical energy ; (*b*) revision of the rules (for electrical machinery) of the British Engineering Standards Association, Specification No. 72 (1917).

With regard to the former item, a table showing the difference between pre-war and post-war prices for electrical energy was published by the Electrical Review (June 13th, 1919), representing 240 supply undertakings in the British Isles.

Many of the prices quoted are for two-rate and sliding-scale systems, and are therefore unsuitable for the purpose of comparison, except in a general sense.

Some 63 undertakings, however, quote flat-rate systems of charging, and these values have been analysed, giving the following results :—

Average Prices of Electricity for Power in the United Kingdom in Pence per Unit.

Place.	No. of undertakings.	1914.	1919.	1921.
London	11	1·13d.	2·0d.	2·3d.
Provincial towns ...	52	1·71d.	2·65d.	3·05d.
London & provinces (average)	63	1·63d.	2·55d.	2·94d.

Since the publication of this table a further increase in the price of energy has been general. This is shown in column 4 above at 15 per cent. above the 1919 values. For present-day values the average cost per kWh for power may be taken at 2·94d., or, say, 3d. per unit.

It should be borne in mind, however, that these figures are based only on some 26 per cent. of the total number of returns published by the Electrical Review, and that if it were possible to form an average for the sliding-scale systems, the value would be somewhat lower. This mean value of 3d. per kWh will, nevertheless, be of use as a basis for cost calculations, as over 60 per cent. of the prices quoted for power at flat rates fall within 20 per cent. of this figure. It is interesting to note that the maximum and minimum flat-rate prices for power were 6·5d. in the Ogmore Valley district, and 0·873d. in the Manchester district.

Two important changes in the Specification of the Engineering Standards Association, No. 72 (1917), have been noted which materially affect the question of rating for electrical machines, and, consequently, have an important bearing on the subject in hand.

First (paragraph 46 and relative table), the temperature rise limit after the maximum temperature has been attained is now fixed at 55° C. for a.c. windings in slots, and 50° C. for rotating armatures with commutators, corresponding to temperature rises of 99° F. and 90° F., where only 70° F. was allowed formerly.

Secondly, as regards overload, whereas formerly a 25 per cent. overload test was required for one hour, the new specification (paragraph 79) allows for a 50 per cent. excess current test for 15 seconds only. Obviously, if these altered conditions of rating are strictly adhered to, a wide departure will be made in the electrical properties of modern machines compared with those designed to meet the requirements of previous specifications.

An important feature is the certainty of obtaining the maximum efficiency at 75 per cent. of the full rated load of the machine, a condition which (transformers excluded) was rarely obtainable, and, in fact, with many machines of low temperature rise the maximum efficiency was not attained until 25 per cent. overload was reached.

The curves in fig. 1 illustrate the difference in efficiency values for a 5-kW d.c. machine having its maximum values at $\frac{3}{4}$ and $1\frac{1}{4}$ of the full rated load.

The advantage of the more highly rated machine is clearly apparent for any class of work where varying loads are experienced, and, in addition, lower no-load losses are obtained.

Before proceeding with the study of working costs of various types of machines, it is desirable to have some reliable information concerning the maximum efficiency it is possible to reach commercially, and what special means to employ to obtain it. With this object in view, the writer has prepared a number of designs to a standardised plan, employing most recent methods, and using as a basis for calculation the constants derived from tests of the best materials obtainable commercially.

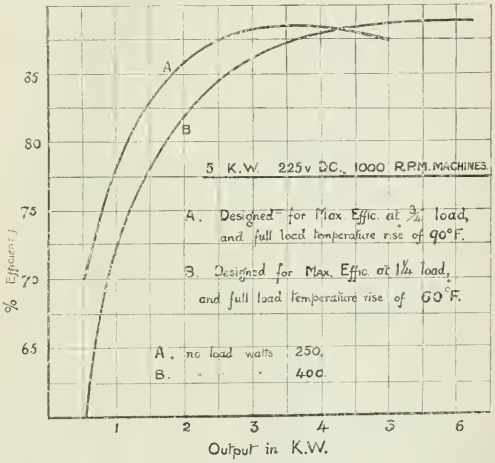

Fig. 1.—Illustrating the Difference Between Two Machines with Maximum Efficiency at $\frac{3}{4}$ Load and $1\frac{1}{4}$ Load Respectively.

Direct-current machines have been considered, as it is possible to predetermine their performance with greater accuracy than with alternating-current machines, also the same machines are serviceable both as dynamos and as motors.

To commence with, a terminal pressure of 225 volts has been chosen, and it will be seen to represent a fair compromise between the limits of high and low-voltage d.c. circuits. With low-voltage machines the commutator losses are higher than with high-voltage machines ; this difference is offset by reduced copper losses owing to a higher "space factor" in the armature slots and field coils being obtained.

Groups of designs have been prepared for machines ranging from 0·1 kW up to 10·0 kW at rated speeds of 500, 1,000, and 2,000 r.p.m. respectively, and for two and four-pole machines. Interpoles have not been included in the designs. Generally speaking, the efficiency of a machine is slightly reduced when interpoles are employed, and these calculations have been made on the basis of low armature reactance voltage (not exceeding 2 volts per segment) ; the commutation would, therefore, be quite good without having to make use of interpoles.

In order to obtain consistent results when preparing a line of designs, it is necessary to adhere as far as possible to certain predetermined values for such factors as the current density in copper, flux densities in teeth, cores, magnets, &c.; in the following table the values chosen for this particular investigation are indicated, and also the limits which it is customary to employ in the preparation of designs by various makers :—

TABLE I.

—	Values employed in this article.	Limits found in standard practice.
Ratio of arm. diam. to core length. 2 pole ...	·78*	2 pole, ·5 to 1·1
Ratio of arm. diam. to core length. 4 pole ...	·39*	4 „ ·3 to ·55
Mag. density in arm. core	10—14 kilolines	4—12 kilolines
„ „ „ teeth	21—22 „	18—22 „
„ „ air gap	6·0—7·0 „	3·0—7·5 „
„ „ mag. core	15·0 „	5·0—16 „
Thickness of slot insulation	1·0 mm.	·8—1·6 mm.
Slots per cm. of periphery	·7	·4— ·9
Comm. segs., per slot ...	3	1 —5
Field spool current density	1·5 per sq. mm.	1·2—4·0 per sq. mm.
Current density in brushes	8·0	3·0—9·0 per sq. cm.
Brush pressure per sq. cm.	·1 kg.	·1— ·3 kg.
Style of winding ...	2 circuit single	various

* These values ensure a round or square section for the magnet core.

The main factors when designing for high efficiency are: First, *choice of materials*.

Iron cores when subjected to reversals of magnetism should be of Stalloy or similar brands.

Magnet cores and yokes for direct-current excitation should be of wrought iron or soft mild steel sheet of the highest permeability obtainable.

All copper conductors should be in accordance with the values specified in the Engineering Standard Specification No. 7. Insulating material should be of superior mechanical strength, heat-resisting properties, and high disruptive strength.

Carbon brushes should have self-lubricating properties, and be capable of being run at high current densities.

Secondly, *technical considerations*.

It is essential to obtain high "space factor" in all current-carrying coils, and as this value is the ratio—

$$\frac{\text{Area of copper conductors}}{\text{Area of winding space}}$$

a high space factor is dependent on the following points :—

(*a*) Minimum thicknesses of insulating material (consistent with safe working) employed for covering conductors, spool windings, and slot linings.

(*b*) Extreme care in winding all coils and solenoids so that all turns lie close together and wires do not cross.

(*c*) All winding spaces to be completely filled up.

Commutator losses may be kept low by employing brushes of high current density, and a fairly low brush pressure not exceeding 0·15 kg. per sq. cm.

Ball bearings should be used where possible, as a smaller air gap may then be employed.

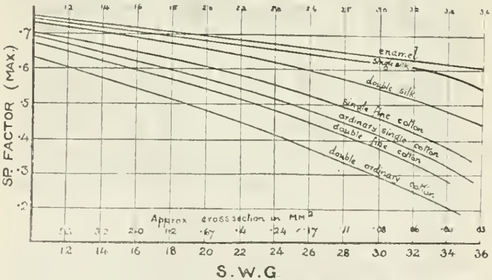

FIG. 2. SPACE FACTORS FOR ROUND CONDUCTORS COVERED WITH DIFFERENT INSULATING MATERIALS.

A set of curves showing the space factor values for round wires employing various kinds of insulation is shown in fig. 2. It is apparent from the study of these curves that a large improvement in coil design is possible where enamel or silk-covered wires are used in place of the double cotton-covered wires at one time in general use. To take one example, a No. 20 S.W.G. enamel-covered wire has a space factor of 0·7; taking the copper cross section at ·66 sq. mm., the area occupied by the insulated wire would be ·92 sq. mm. Now a No. 22 S.W.G. wire insulated with double cotton, and having a space factor of ·45, would also occupy approximately an area of ·9 for the insulated wire, so that by substituting an enamel-covered wire for a double-cotton-covered wire, the area of copper could be increased by 63 per cent., thus allowing a current 1·28 times as great to be used for the same I^2R loss and representing a gain both in output and efficiency.

The usual practice in machine design is to proportion the armature dimensions according to the required output. In this investigation a somewhat different procedure has been adopted, the plan being to commence with an armature of fixed dimensions, and from these, to work out the rating so as to occur at the point of maximum efficiency. This has been done for a number of different sizes, and curves plotted from the points so obtained give the output in kilowatts in terms of the armature cubical dimensions.

At this stage an example of a worked design will illustrate how the values for the above curves were obtained.

Selecting a machine for 225 volts, 1,000 r.p.m., 2 poles, and having the dimensions (armature diameter)² × (armature gross length), or $D^2 L_g$ in cm. = 1,500, it is required to find the electrical output corresponding to the highest efficiency.

As the point of maximum efficiency occurs when the variable or I^2R losses are equal in value to the constant losses, it follows that—given a machine of certain dimensions—the lower the value of the constant losses, the higher will be the maximum efficiency; therefore iron, shunt, and friction losses must be kept as low as possible.

Given $D^2 L_g$ as 1,500, then $D = \sqrt[3]{1{,}500/·78} = 12·4$ cm., and L_g the gross length = 9·8 cm., these being suitable values for obtaining magnet cores of round section.

Magnet core area = $9·8^2 \times ·785 = 76$ cm.²

Taking "B" at 15·0 kilolines and allowing 20 per cent. for magnetic leakage, a flux of 0·94 megaline through the armature is obtained.

Estimating by the ordinary routine method, the field ampere turns required to overcome the reluctance of the magnetic circuit, the value 1,680 is obtained (per pole).

For calculating the copper losses in shunt and armature coils, the following formula may often conveniently be employed.

I^2R loss = weight in kg. $\times d^2 \times K$, where d = current density in amperes per sq. mm., and K a factor depending on the temperature at which the winding will operate (at 60° C., $K = 2·25$).

At a current density of 1·5 amperes per mm.² the total copper area in the shunt coil will be 1,680 ats./1·5 × 100 = 11·2 sq. cm., and taking the mean length of a turn as 40 cm., the total weight of copper per spool = 4·0 kg.

Watts lost per spool are $4·0 \times 1·5^2 \times 2·25 = 20·5$.

It has been established experimentally by different authorities that the core losses in revolving armatures are fairly proportional at ordinary working values for the relation "watts per kilogram" in terms of "flux density" × "cycles per second" where the latter product does not exceed a value of 360, but when this value is exceeded the losses increase to a greater extent.

Then building the armature from best quality low loss materials the economical flux density can be estimated so as to give "K" approximately 360, provided a density of 14·0 kilolines is not exceeded, increased reluctance then being the limiting factor.

Using Stalloy iron at $B = 14·0$ kilolines, and at a frequency f of 16·6 cycles, the iron loss amounts to 21 watts.

Adding 22 watts to include windage, bearing, and brush friction losses, and 41 for total shunt loss, a total of 84 watts for the constant losses is obtained.

The next step is to proportion the armature windings to suit the required voltage and speed, and to determine the loading in amperes that will correspond to an I^2R loss of 84 watts.

Number of armature conds. = $(V - IR) \times 10^2/f \times$ flux in megalines
$= 21{,}000/16·66 \times ·94 = 1{,}344$, with 28 slots = 48 per slot.

Estimating the maximum area of the slot to conform with the uncorrected tooth density of 22·0 kilolines, ·98 cm.^{2} per slot is obtained, and arranging the conductors 12 deep × 4 wide, a depth of 15 mm. and width of 6·5 mm.

Employing a slot lining 1 mm. in thickness, a space factor of ·365 can be obtained, allowing a wire of ·98 mm. diam. and ·74 mm.^{2} section to be used.

Estimating the average length of one armature turn to be 68 cm., a total weight of 3·0 kg. of copper is obtained.

Then amps. per mm.^{2} per arm. cond.

$$= \sqrt{\text{Watts/kg.} \times 2{\cdot}25} = \sqrt{84/3{\cdot}0 \times 2{\cdot}25} = 3{\cdot}52.$$

Total armature current = 3·52 × ·74 × 2 = 5·2.

Watts input to armature at 225 volts = 1,170
Total losses, excluding shunt winding = 127
Armature output at maximum efficiency = 1,043
Total input to motor (including shunt) = 1,211
Maximum efficiency ... ... = 86 %

With three segments per slot, and eight turns per segment, the reactance voltage, as calculated by Hobart's formula, is approximately 1·3 volts : a much greater load could, therefore, be carried without sparking at the brushes. Calculations for temperature rise show that (where a maximum temperature of 90°C. is permitted) a full-load rating of 1·25 to 1·35, according to the rated speed, above the point for maximum efficiency may be obtained, as follows :—

Rated speed of machine.	Maximum efficiency occurs at—
500 r.p.m.	65 % of full load.
1,000 r.p.m.	72 % of full load.
2,000 r.p.m.	77 % of full load.

Thus, it is seen that the condition of maximum efficiency at ¾ load is readily obtained.

In fig. 3 the full line curves have been plotted from the results of 36 separately worked designs prepared by the writer in accordance with the foregoing method for obtaining maximum efficiency.

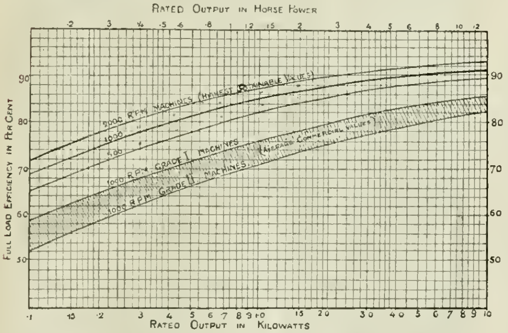

Fig. 3.—Efficiencies of d.c. Machines of Different Types and Various Rated Outputs and Speeds.

These represent an average value between two and four-pole designs. Generally speaking, a slightly higher value is obtained when using two poles for a given rating, but an economy in weight is effected by the use of four poles ; but it may be accepted that for ratings ranging from 0·1 to 10·0 kW, the difference in efficiency between two- and four-pole machines is immaterial.

The results shown graphically by the curves in fig. 3 establish the important fact that it is possible to design machines of considerably higher efficiency than is usually obtained commercially, which tends to prove that in most circumstances the first cost of the machine is the first consideration.

In support of these figures it is mentioned that a small motor built on the lines indicated and rated at 100 watts at 1,000 r.p.m. gave a maximum tested efficiency of 67 per cent., the net weight being 36 lb. ; the cost for material was not excessive, but special care was taken in winding, &c. In order to emphasise the difference between what may be termed the ideal values for efficiency, and those obtainable from the majority of machines at present on the market, in fig. 3 the shaded area represents the limits of full-load efficiency, as observed in most of the machines manufactured at the present time.

The lower values (Grade II) can usually be attributed to the use of cast-iron magnetic systems in conjunction with a poor space factor in armature slots. This low value is sometimes unavoidable where very high flash volt tests are required by the purchaser.

It will also be observed from these curves that high-speed machines are more efficient than those of a low rated speed. This condition holds good up to a point where the increase in rated speed occasions a reversal of flux through the armature of not more than 60 cycles per second, corresponding to a speed of 3,600 r.p.m. for two-pole machines, and 1,800 r.p.m. for four-pole machines.

At speeds above these limits the increased losses in the armature core tend to offset any advantage that is obtained by a reduction in copper losses, also considerations of armature temperature rise may prevent working at the maximum efficiency.

(To be continued.)

AN AGREEMENT TO SERVE ABROAD—ITS LEGAL ASPECT.

(From a Legal Contributor.)

Many young English electrical engineers are tempted to go abroad ; to forsake the land of their birth and take up employment in some one or other of our great dependencies. Some are even lured into the service of persons or Governments in foreign countries.

The tide of this special form of emigration has been flowing very strongly since the war, and it is still flowing. The present outlook in these islands is not altogether hopeful for the young and energetic ; for the man who wants to get on by his own exertions. "Better fifty years of Europe than a cycle of Cathay." So run the old lines ; yes !—But they were written before everything had been turned upside down in a European conflagration.

But zeal to travel on the road to victorious fortune should be tempered with discretion. A job in the Colonies or elsewhere abroad must not be rashly accepted. The salary offered may be high and the prospects inviting, but it is necessary to scrutinise with particular care the terms upon which the services are to be rendered. To reduce an agreement to writing is at all times expedient. It is doubly necessary to do so when the parties who have entered into the arrangement are to be far apart.

Let us first briefly enumerate the points to which attention must be directed in drawing up such an agreement. The salary, when and where and how it is to be paid ; who is to pay travelling and other expenses ; for what period the service is to endure ; whether it can be put an end to by either party, and if so, what notice is necessary ; how disputes are to be settled ; according to what currency remuneration is to be paid ; and whether there is to be any restrictive covenant preventing the engineer practising in the same place for a stated period after the termination of the contract. All these questions have to be carefully considered.

It should be mentioned, in the first place, that a written agreement is absolutely essential in certain cases. Thus a contract of service which is not to be performed within the space of one year from the making thereof must be in writing.

So it has been decided that a contract to serve for one year, the service to commence on the second day after that on which the contract is made, is a contract not to be performed within a year (Britain *v.* Rossiter, 1879, 11, Q.B.D., 128). It may be mentioned, however, that where there is a contract to serve for one year, the service to commence on the day next after that on which the contract is made, this is not a contract which is not to be performed within a year (Smith *v.* Gold Coast and Ashanti Explorers, Ltd., 1903, 1 K.B. 538).

We may assume, however, that in the ordinary case of an engineer taking an appointment at a yearly salary, without the duration of the employment being mentioned, the agreement must be in writing.

As to the salary, the time and place of payment of instalments should be specified. Where it is a lump sum payable by quarterly instalments, the instalments can be recovered as they fall due. So where a man was employed as consulting engineer for £500, payable in equal quarterly instalments for 15 months to complete certain works, and he died after two instalments had become due, but before the work was finished, his administrator was held entitled to recover the two instalments (Stubbs *v.* Holywell Railway Co., 1867, L.R. 2 Ex. 311).

All expenses other than living expenses should be provided for in the agreement. In going abroad to take up a post heavy travelling expenses will be incurred. These should be provided for by a payment in advance. If the climate is unhealthy, malaria or other diseases may add very materially to the cost of living—or trying to live. In these circumstances the question whether the salary is to continue during incapacity caused by illness is one which should certainly be settled beforehand.

Again, the expenses of travelling both out *and home* should be arranged for; care being taken to provide specially for the travelling expenses of the servant's wife. Although he may not be married at the date he signs the agreement, he may possibly find a wife before his term of service comes to an end, and he may not want to leave her behind when he comes home!

The length of notice requisite to terminate the contract is a matter which should be carefully considered before the agreement is signed, inasmuch as the position of an engineer in a foreign country who is suddenly dismissed is deplorable to a degree. He ought to insist on being given such a length of notice that it will be impossible for him to be left stranded. Service is usually determined by notice, and the question is: What notice must be given? When the hiring is a yearly hiring it cannot in general be put an end to by either party before the end of the year. If, therefore, on the one hand, a master wrongfully dismisses his servant during the year the servant may maintain an action against him for such wrongful dismissal, and a jury might assess the damages at the amount which he would have earned had he been allowed to serve to the end of the year.

A hiring at a salary of so much a year is a hiring for a year certain. So where a man was employed as engineer to the defendants at a salary of £500 a year, and was dismissed at a three months' notice, he was held entitled to recover salary for the unexpired portion of the year (Buckingham *v.* Surrey & Hants Canal Co., 1882, 46 L.T. 889).

It is clear, however, that where it is a question of foreign service, special care should be taken to provide for an adequate notice. Attempts are sometimes made by employers to obtain an option to dismiss at will. In Down *v.* Pinto, 1854, 9 Ex. 327, the defendant having established smelting works at Carthagena, in Spain, offered to employ the plaintiff as foreman, by letter, containing the following passage: "I should require you to enter into an agreement to remain with me for at least *three years at my option*. Salary £250 per annum." It was held that this did not enable the defendant to put an end to the service at his will, but that it was a yearly hiring, with an option for the defendant to require the plaintiff's services for three years, or put an end to it at the expiration of the first, second, or third year.

Care should be taken to make the right to give notice reciprocal—that is, to enable the engineer to say: "I want to go" within a certain period. This is the more important, because a yearly servant, wrongfully quitting his master's service, forfeits all claim to wages for that part of the current year during which he served, and cannot, after having wilfully violated the contract, claim the sum which his wages would have amounted to had he kept his contract.

The importance of making provision in the contract for notice to quit was emphasised in a case (Baker *v.* The African Association) which was heard on January 20th, 1910, in the King's Bench. A man was engaged to go to Calabar, on the Gold Coast, as a clerk, at a yearly salary. The agreement provided that if he failed to give satisfaction to the employers' agents, or absented himself from his duties, &c., the agent might summarily dismiss him, in which case he would have no claim for his passage home. He was under covenant not to trade within 30 miles of Calabar for two years after the termination of his employment, subject to a penalty of £100. On his returning to England he was suddenly dismissed, no reason being assigned. The clause as to the duration of the service provided as follows: "The said A. (meaning the clerk) shall, as from the date of leaving Liverpool for Africa, become and, subject as hereinafter prescribed, continue for two years, or until the date of his leaving Africa, in the service and employment of the said employers as clerk . . . at Calabar . . . provided always, however, that the employers may at any time hereafter, at their absolute discretion, terminate this engagement at any earlier date than specified if they may desire to do so." It was held that under this clause the employers had an absolute discretion to fix an earlier date for the termination of the agreement than the two years, but that the clause did not give them an absolute discretion to dismiss Baker summarily within the two years without giving him a reasonable notice.

With regard to settlement of disputes it is most desirable that the agreement should clearly indicate the law or system of laws according to which they are to be adjusted. People sometimes have a prejudice against the mere mention of the word "dispute" in an agreement; but disputes must and will occur, and when they do it is eminently satisfactory for an Englishman at least to have them adjusted according to the law of his own country.

It may be mentioned that if the employer is a foreigner there is (generally speaking) very little difficulty in getting him to accept a clause providing for the settlement of disputes in accordance with English law. It is said, indeed, that some foreigners have more confidence in English judges than they have in those who administer the law in their own countries.

Finally, there should be no room for doubt—especially in these days—as to the *currency* in which the proposed salary is to be paid. It may be said that the amount of his "screw" is the first thing an aspirant for a job abroad will inquire about; but he should have it fixed and set down in writing. *Litera scripta manet; vox audita perit.* And while on this subject a currency—if one may venture to drop a hint upon a question of general rather than legal interest—it is well to bear in mind that "rates of exchange" mean very little unless they are considered in relation to the cost of living. To hear that you are to have a salary of £2,000 a year in a country at the back of the beyond, where the exchange is said to be in your favour, may be very attractive; but the attraction begins to wear off when you arrive at the place to find that the cost of living is four times what it was in old England!

Finally, we have to consider the question of restrictive covenants. A restrictive covenant prevents a man entering into competition with his late employers after the service comes to an end. If it is unreasonable, whether as to time or space, it will not be enforced, but it is not easy to show that a covenant is unreasonable. No engineer should sign an agreement with a restrictive covenant if he can possibly avoid it. It may be mentioned, however, that it has lately been decided that a man who is wrongfully dismissed need not observe the restrictive covenant to which he was subject.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Printing Press Controller.

We recently had the pleasure of inspecting a new type of printing press controller at the Vauxhall Works of the Electrical Apparatus Co., Ltd., South Lambeth Road, London, S.W. 8. The gear under review, as will be seen from fig. 1, is motor operated, the firm having employed for the purpose a machine of the standard type as fitted in its well-known motor controllers of the Navy pattern. The motor functions at slightly over half its normal capacity, so that there is a liberal overload capacity, and provision has been made for varying its speed and, consequently, the rate of insertion or cutting out of resistance in the main motor circuit; the inching speed can also be varied to suit requirements. The device, which has been designed to control printing presses, but may with equal success be used in conjunction with machine tools and suchlike machinery, is robustly but neatly constructed, and it may be bolted on the wall or placed in any other convenient position, its function being controlled by means of push buttons, which may be located wherever desired. The buttons are five in number, namely, "start," "stop," "low speed," "high speed," and one for "inching," and they are all fitted with magnetic blow-outs. Any one of the five buttons on being depressed acts as the master button until released, so that none of the others will function if depressed in the meantime, except, of course, the "stop" button. After having seen the controller in operation, we must congratulate the makers on having produced such a neat and serviceable design; the device certainly appears to do all that is claimed for it.

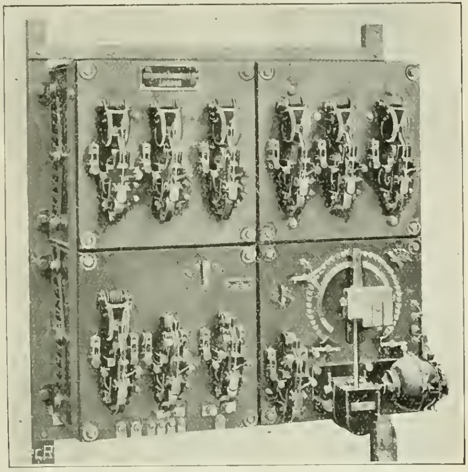

Fig. 1.—A Motor-operated Printing Press Controller.

A New Repulsion Induction Motor.

The *Electrical News* describes a new single-phase motor of the repulsion start, induction type, which has recently been produced by the Robbins & Myers Co. This motor is furnished for services which require high starting torque with low starting current. The motor starts as a repulsion motor. At full speed a centrifugal device operates, short circuiting each commutator bar and lifting the brushes, thus avoiding unnecessary wear. The action of this device is positive, and does not depend upon play of the armature to push the brushes from the commutator. The interior of the motor is protected by ventilated enclosing heads, a removable cover being provided on the commutator end for inspection of the commutator and brushes. The end head at the commutator end is marked for the three positions of the brush rocker arm which give clockwise and counter-clockwise rotation and neutral. The average starting torque from rest is 350 per cent. of full load torque and the average starting current is 300 per cent. of full load current. The motor will bring up to normal speed a load of from 1¼ to 1¾ normal full load. The maximum running torque is over 200 per cent. of full load torque. This motor is at present furnished in ½ h.p. size only, but other sizes ranging from ¼ to 1 h.p. will soon be in regular production.

A New Bonding and Earthing Clip.

Messrs. Leopard Bros., 81, Micheldever Road, Lee, S.E.12, have sent us a sample of a new form of earthing and bonding clip designed by them. The chief novelty of the clip, fig. 2, lies in the gripping of the earth wire in the bight of a loop of copper tape. This is a much safer arrangement than the mere retention by a screw or bolt head. The perforations in the copper tape enable one size of clip to be adapted to several sizes of conduit or metal sheathing. The design is protected by a provisional patent.

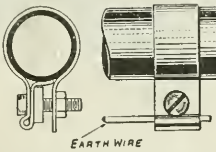

Fig. 2.—A New Bonding and Earthing Clip.

A Novel Electric Vehicle.

The accompanying illustration, fig. 3, was reproduced from a photograph of a unique little electric vehicle which has been specially designed for the use of town shoppers and invalids. It is known as the Lewis Electric Sedan, and its leading features are the ease with which it can be controlled, moderate speed, and low operating cost, which is said to amount to only one halfpenny per mile. It is without doubt one of the lightest and neatest machines on the road, and without passengers it turns the scales at 6½ cwt. As will be seen, it is of the 3-wheel type, and will accommodate two passengers who are completely protected from wind and rain. There are no foot pedals at all. One lever controls the operating switch and at the same time works a brake fitted to the rear wheel. A second brake is operated by means of Bowden wires which are attached to the tiller steering arm. The propelling energy is furnished by a battery of Tudor accumulators which is large enough to enable the vehicle to run, it is claimed, a distance of 50 miles on one charge, the speed attainable being about 10 m.p.h.

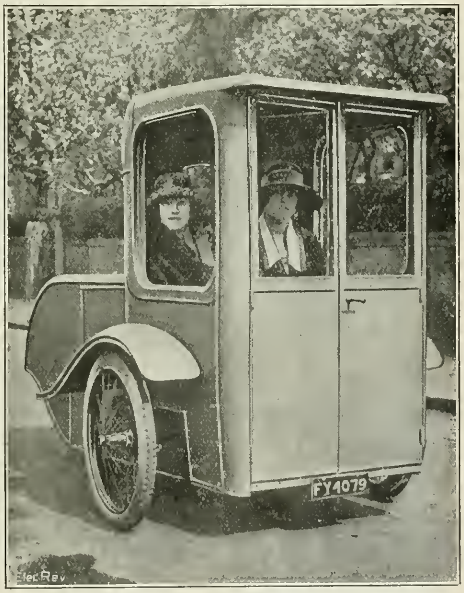

Fig. 3.—A Lewis Electric Sedan.

A New Electric Vulcaniser.

We have received particulars of a new electrical vulcaniser for rubber tires from Mr T H Warburton, 81, Cannon Street, E.C.4 The apparatus (fig 4), which is designed for connection to an ordinary lighting supply of 100, 150 or 250 volts, consists of a heating element contained in an aluminium case. A shaped wooden block is placed under the tire, and the bottom of the aluminium container is formed to fit over the top of the tire and the two are braced together by a steel bar and bolts and wing nuts. An opening in the top of the case permits the insertion of a thermometer, which is specially calibrated to indicate when the correct temperature is reached for various kinds of repairs. It is possible with this device to vulcanise parts of an outer tire cover without removal of the tire. The illustration is reproduced from the motor

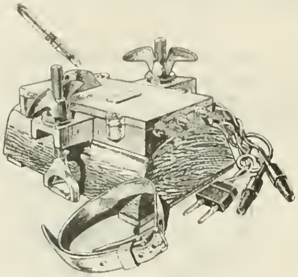

Fig. 4.—An Electric Vulcaniser.

An Electric Egg Tester.

We have recently received inquiries regarding electrical egg testers, and the description given by the Toronto *Electrical News* of a tester recently put on the market by the Stumpp and Walter Co., of New York, may be of interest. The apparatus consists of a box containing a dry battery and a small lamp. A cylindrical hood projects from the top of the box, and the lamp circuit is closed by placing an egg upon the top of this hood. The battery is capable of holding out for the testing of between 15 and 20 thousand eggs, and so "running charges" are negligible.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR MAY, 1921.

Compared with the previous month, there was an increase of about 20 per cent. in the total value of exports during May. A slight decrease occurred in the import figure, while the total value of re-exported goods fell by approximately 44 per cent. The most prominent item in the export figures is that of "submarine telegraph and telephone cable," which was twice that of the previous month. Increases also occurred in the export values of meters, traction motors, and telegraph and telephone instruments and apparatus; noticeable falls took place in respect of exported glow-lamps and insulated wire. As regards imported goods, unenumerated electrical goods and machinery experienced a decline, but this was balanced by increases in most of the other items. The fall in the value of re-exports was occasioned chiefly by a large drop in the item of "meters."

Values of Electrical Exports and Imports for May, 1921.

	Exports.	Imports.	Re-exports.
Electrical goods and apparatus (unenumerated)	£174,649	£43,021	£7,999
Insulated wire	313,537	13,042	956
Glow lamps	46,798	25,998	134
Arc lamps and parts	3,193	2,922	—
Batteries	71,908	5,941	—
Meters	46,727	14,936	2,685
Carbons	3,134	8,544	39
Electrical machinery:—			
Railway and tramway motors ...	33,695	—	—
Other motors and generators ...	251,649	—	—
Electrical machinery (unenumerated)	174,281	93,622	1,377
Switchboards (not telegraph or telephone)	16,826	3,115	—
Telegraph and telephone cable and material:—			
Telegraph and telephone wire and cable (not submarine)	128,075	5,155	—
Submarine telegraph and telephone cable	807,090	—	—
Telegraph and telephone instruments and apparatus	171,642	28,347	2,829
Totals... ...	£2,243,201	£244,643	£16,019

THE "GLO-CLAD" WIRING SYSTEM.

In the past we have described many wiring systems each possessing its distinct features and advantages, although all have much in common. The same may be said of the "Glo-clad" system designed by Messrs. W. T. Glover & Co., of which some particulars are given below.

It is claimed that the "Glo-clad" system fulfils all the requirements expected of an efficient installation, that is, it is watertight, gastight, acid-proof, and electrically continuous; in addition, it is said of the system that the important item of cost, which includes maintenance, bears comparison with that of systems requiring less initial outlay.

The "Glo-clad" system is an "open" one. The cables are rubber insulated and protected by a sheath of lead alloy which, while of comparative hardness, is ductile enough to permit of its being readily bent. These cables are made up with one or two cores as required, each conductor consisting of 3/.036 in. wires, the twin cable being designed primarily for a.c. circuits. The junction box is of cast iron into the outlets of which brass glands are screwed. These glands bear an internal thread and the metal sheath of the incoming cable is screwed to fit into the gland; a packed lock-nut holds the gland in position, and prevents the access of moisture. Fig. 1 shows in section the arrangement described, and fig. 2 gives a plan view of a fitted 4-way junction box. It will be seen from the view of the box that the wires are bunched into connectors which are completely enclosed in porcelain, and this rests upon a porcelain base. The joint between the box and its lid is of the tongue-and-groove type, and is made up with watertight packing and secured by four screws.

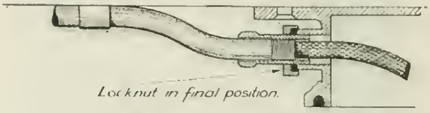

Fig. 1.—Final Position of Gland (Section).

The cables are ordinarily run upon wood strip—where this can be screwed to ceilings and walls. In the case of steel girder roofs a special steel tray is employed. Fig. 3 shows these systems in use, both steel tray and wood strip; a watertight switch specially designed to suit the system is also seen in this illustration. A very useful tool supplied with this system serves a three-fold purpose. It takes the shape of a pair of pliers, but the head is divided into three parts, one for cutting the sheath of single "Glo-clad" cable, one for cutting the twin cable, and a centre part for stripping the rubber insulation from the conductors.

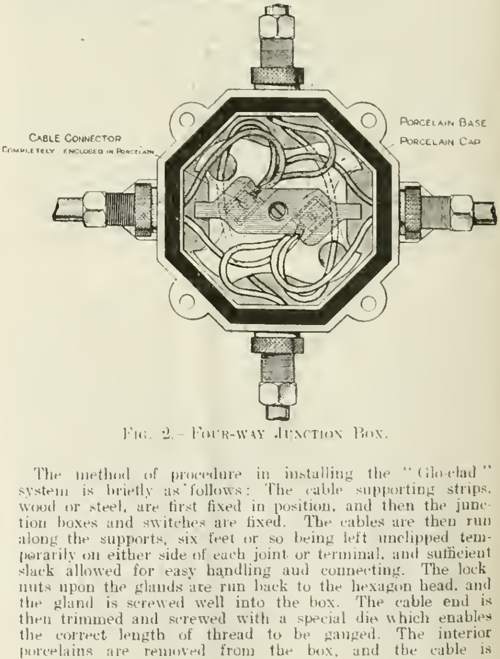

Fig. 2.—Four-way Junction Box.

The method of procedure in installing the "Glo-clad" system is briefly as follows: The cable supporting strips, wood or steel, are first fixed in position, and then the junction boxes and switches are fixed. The cables are then run along the supports, six feet or so being left unclipped temporarily on either side of each joint or terminal, and sufficient slack allowed for easy handling and connecting. The lock nuts upon the glands are run back to the hexagon head, and the gland is screwed well into the box. The cable end is then trimmed and screwed with a special die which enables the correct length of thread to be gauged. The interior porcelains are removed from the box, and the cable is threaded through the gland. The cable is pulled home so that no slack is left outside the box, and the correct position of the cable within the gland is thus assured. The gland is then unscrewed from the box and thereby screwed on to the threaded cable, and the locknut is brought up into position against the end of the box socket. The connections are then made, and the porcelains put into position. Special lids for the boxes have been designed to meet various lighting requirements. Other fixtures are multiple switch boxes containing three or five switches in one case, combined switch and distribution boxes, and distribution boxes with fuses mounted on hinged bars enabling them to be swung out for inspection or replacement.

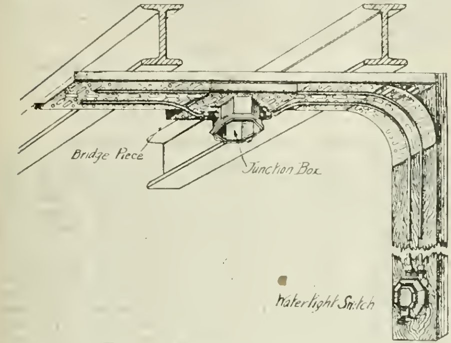

Fig. 3.—Methods of Installation.

ELECTRICAL DEVELOPMENT IN JAMAICA.

The Kingston correspondent of *The Times Trade Supplement* says that two exhaustive reports on the subject of hydro-electric supply and the electrification of the Jamaica Government Railway have been presented to the Legislative Council for consideration this year.

Mr. H. Howard Humphreys, who visited the island during 1920 and made an investigation on behalf of the Colonial Government, deals with four rivers in the central portion of the island in his report. These streams conform to the necessary stipulations, and he points out that in normal times their development would have been a comparatively cheap matter as no impounding dams and other expensive works are necessary; the pipe and conduit lines are short, while the fall, volume of water, and constancy of flow are satisfactory within the required limits of power. As the pipelines and conduits will be laid north and south, there does not appear to be any grave risk from earthquake shocks in the locality. Owing to the possibility of earthquake damage and for other reasons, it is desirable to avoid the eastern end of the colony.

The estimated cost of the works projected with steel at its present high price, and on the assumption that the pipes are purchased in the United Kingdom, is £420,450. Should the pipes be purchased in the United States together with reinforcing steel, a saving of £18,000 is anticipated. The estimates provide for the whole of the engineering work from the intakes to the turbine inlets and other charges.

Seven transformer sub-stations are recommended on the two main sections of the railway at a cost of £160,000, ranging from 500 to 1,500 kW. For overhead trolley, feeder, transmission, and telephone and telegraph lines the cost is estimated at £800,000; and for the purchase of 21 electric locomotives, at £273,000. The cost of the whole enterprise is placed at £1,970,240.

Mr. Humphreys's report was referred to Messrs. Preece, Cardew & Rider, who advised the Crown Agents that in the first instance three power stations should be provided with 13,000 water h.p. or 7,280 kW; power would also be available for industrial and lighting purposes. With a plentiful supply available, the question of irrigation should receive more attention, as pumping schemes, which have hitherto been too costly, could be undertaken. Direct current is recommended for the railway.

The consulting engineers are convinced that the rivers tested are sufficient to give power to operate the railways and leave a considerable margin for other purposes; development of the rivers would render the island practically independent of the coal supply for power purposes; the island would thus become self-supplying. Electrification of the railway would bring about considerable improvement in the passenger and traffic services, while a supply of electrical energy at reasonable rates should encourage the development of new industries and add to the general prosperity of the island.

LEGAL.

An Irish Electricity Agreement.

At Carrick-on-Shannon Quarter Sessions, before Judge Brown, an interesting case was listed, in which Messrs. Telford, Grier and McKay, electrical engineers in that town, but having an office in Glasgow, sought to recover from consumers amounts due for electric lighting supply.

It apeared that, by an agreement between the company and the Carrick-on-Shannon District Council in 1917 for the public lighting of the town and the pumping of the water supply, it was provided that the rate per unit to private consumers should be 6d. for light up to a certain amount, and then 3d. The company found that it could not continue supply at these rates, and proposed to charge 9d. per unit. Business houses and other private consumers refused to pay this increased rate.

For the company, Mr. Gillespie held that the company could not, and should not, be asked to supply at a loss. Notice of the increased charge had been duly served, and instead of refusing to take the supply the parties had gone on using power. His view was that the District Council had no power to make an agreement on behalf of private consumers.

His Honour decided to give a decree for each amount, as claimed. He was of opinion, with Mr. Gillespie, that the Council had no power to make such an agreement. If private consumers had signed the agreement it would have been a different matter.

Bastian Electric Co., Ltd.

The petition of W. F. N. May and Another for an order for the compulsory liquidation of the Bastian Electric Co., Ltd., was before Mr. Justice P. O. Lawrence in the Companies' Winding-up Court on Tuesday (June 14th).

Mr. Dighton Pollock, for the petitioners, said it stood over for 14 days to see if anything could be done to pay off the claim. Certain negotiations were going on, he thought, which might result in a settlement. He therefore asked for another week's adjournment.

This was granted.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electric Light Wiring Systems.

With reference to the recent discussion in your columns, I am enclosing herewith a few samples of cab tire cable which has been in use for about three or four years.

It was run on porcelain insulators in the open air, but was protected from the direct effects of the sun and weather by a roof. The wires were kept from 2 in. to 3 in. apart.

In the majority of cases it has failed at bends and also underneath the insulators.

I may add that it was immune from steam rollers.

Wireman.

June 10th, 1921.

[Some of the faults take the form of cracks in the sheathing at bends; other samples show unmistakable evidence of severe local overheating. Apart from these features, the sheathing appears to be in its normal condition.—Eds. Elec. Rev.]

An abstract of the above paper by Mr. F. T. Alldread, and of the discussion on the same, published in your current issue, refers so frequently to C.T.S. wiring, and in some cases with such a lack of knowledge of the subject, that we trust you will allow us to deal with the matter in your columns as briefly as possible.

To begin with, Mr. Alldread has invented a new name for C.T.S., namely, "Hard rubber-cased V.I.R. wiring." We fail to see the need for rechristening this well-known type of cable, and would also point out that "hard rubber" is almost a standard phrase for ebonite, and so is likely to be misunderstood, especially by American readers. Mr. Alldread states that the sheathing cracks at a considerable period after installation where the wires have been bent at a very sharp angle. This statement is hardly worth dealing with unless as a very exceptional case, in view of the fact that Mr. Alldread later states that *he has no experience of cab tire cable!*

Mr. Garbett states that he had found serious difficulty with cab tire cable at the ends, principally with regard to the risk of contamination with printers' ink and rough usage.

We know nothing about troubles from this, but are confident that C.T.S. will stand up to both items better than any other cable protecting material.

Regarding the ends of cables where exposed to the elements, Mr. Garbett says he has never yet seen any system which dealt with troubles from this exposure. He, therefore, must be unaware of the St. Helens corrosion-proof fittings, of which many thousands are in use, in corrosive and weather-exposed situations.

Mr. Crowdy calls C.T.S. "funny stuff," but does not explain where its humour comes in, except to state that some people prefer to use it and others refuse!

He also states that the ends of C.T.S. cable are a serious matter with regard to the shrinking of the sheathing from fittings after erection.

The only explanation we can give for such an exceptional experience is that the sheathing has been pulled too tightly down to the fittings mentioned, and later the rubber has been allowed to gradually ease back; but there should be no need for such an abuse of the elastic properties of the sheathing. We have had these works and offices completely fitted up with C.T.S. for power, lighting, heating, telephones, &c., during the past eight or ten years, with the main object of finding out any defects, but have been unsuccessful so far, even with regard to the shrinking peculiarity mentioned by Mr. Crowdy, nor have we heard of this before from any other user.

Mr. Whitley states that the manufacturers of C.T.S. wire made a great mistake in recommending it for any or every purpose, and that though for certain purposes it was extremely useful, there were circumstances where it should not be used.

It is a pity that Mr. Whitley did not mention these unusable circumstances to make his statement useful as well as merely vaguely detractory.

We beg to reply that we do *not* recommend C.T.S. for any purpose for which it is in the slightest degree unsuitable. For instance, a letter appeared in your columns recommending C.T.S. as being best for hot situations, whereupon we immediately wrote to contradict this, so far as situations under considerable and continual heat are concerned. We also do not recommend C.T.S. for underground mains (as mentioned by Mr. Revell), as, although it is used for mains where sewers are the only available conduits, this is merely because there is no room in the road for other conduits to be put down, and no other type of cable would stand the conditions inside sewers. For ordinary mains work it is too expensive.

In conclusion, may we suggest to compilers of papers on the very important and interesting subject of wiring, and to those who intend to discuss such papers, that if they are in any doubt about C.T.S., on applying to this company they will receive full information as to its advantages *and limitations.*

St. Helens Cable & Rubber Co., Ltd.,
J. H. C. Brooking,
General Manager.

Warrington.
June 13th, 1921.

[It should be remembered that the paper and discussion referred to were both severely condensed before publication in our columns.—Eds. Elec. Rev.]

With reference to your report of the interesting discussion on various systems of wiring, I would like to make a few remarks.

I have had 22 years of electrical wiring, and am conversant with all systems. I will take the various systems in their order:—

Screwed tubing, lead-covered paper-insulated,, lead-covered vulcanised rubber, wood casing, and cab tire.

All the above systems are quite in order when installed in dry places, but are failures in exposed and damp atmospheres.

You will notice I have omitted c.j. tubing, either with continuity grip fittings or push-on fittings; neither of them are satisfactory, and I would prohibit them, as it is impossible to get a proper continuity job.

Concealed Work.—Under floors and plaster, &c., you are reduced to fewer systems. Screwed tubing, lead-covered vulcanised rubber, lead-covered paper-insulated, cab tire, but not wood casing.

For the past 18 months I have been acting as temporary installation inspector to a large Corporation electricity undertaking, and I can honestly say I have come across very few good jobs done in casing. Twenty years ago you would get splendid casing jobs, but the wiremen of to-day don't or won't understand it.

For all vertical runs behind plaster I would insist upon nothing else but heavy-gauge screwed steel tubing and fittings, whatever the system; if lead sheathing is used, the tubing to be bonded to the lead.

Damp Situations.—I have tried every system, and have been reduced to two that have stood the test, namely, cab tire and vulcanised rubber and braided stranded wire run on bobbin insulators (not cleats), and bound with tar marlin cord.

The various engineers were quite in order when they stated that the terminal ends of the cab tire split or reduced, leaving bare wires. I got over this difficulty by binding the ends with good quality adhesive Para rubber strip ⅜ in. diameter. In large works or warehouses, provided you have plenty of ceiling height, h.d. stranded copper wire run on insulators for the line wire would be in order. For the above system I use porcelain covered switches such as the D. & S. or Premier make.

For a suitable cheap house wiring system I would recommend the B.I. & H. system of lead-covered paper-insulated wire, but instead of using lead trays or boxes for jointing, I would suggest front recessed wood blocks and bottle wax or low-grade sealing-wax—not the wax recommended by the makers—and using the usual bonding clips for earthing.

I have installed thousands of lights on this system, and have found it low both in cost of labour and material, also the insulation test is equal to wood casing and lasting.

Regarding Stannos wire and other systems akin to it, they are quite all right on pressures up to 100 volts, but I would not handle them for higher pressures.

G. Hough.

Oldham.
June 12th, 1921.

Fire Prevention and the Insurance Companies.

Your issue of the 3rd inst. contains a letter from Mr. E. W. Hubbard, who expresses the view that it is as much in the interest of insurance companies as of the public that the former's fire loss ratio should be reduced, and he doubts the actuarial experience of any one who does not agree with him.

I wonder if he has really thought the matter out. It may be worth while to provide him with material for thought.

First of all—for it is best to proceed by easy stages—would it be in the interest of insurance companies if the risk of fire was eliminated altogether, if, in fact, the fire loss ratio was reduced to zero? The answer is in the negative. If there were no fire risks, there would be no fire insurance companies.

Secondly, would it be in the interest of the insurance companies if the risk of fire was diminished by one-half or any other percentage one likes to name? The answer is still in the negative, for exactly the same principle applies. If the risk of fire is reduced, premiums tend to fall. It is true the fall may be prevented or delayed by the elimination of competition and other artificial bolsterings, but the tendency exists.

Thirdly, since the fire loss ratio is the percentage of premiums paid by the public which they receive back in payment of fire claims, the greater the percentage they receive back the better it is for them and the worse for the companies. An abnormally low fire loss ratio means that the insurance companies are charging too much premium. That is the complaint as regards "protected risks." The loss ratio is much too low.

Fourthly, since the real concern of the insurance companies to-day is their expense ratio, reduced premium income hurts their most tender spot, for a reduced premium income means an increased expenses ratio.

No one wants bureaucratic interference if it can be avoided. One would prefer to rely on the broad outlook, the public spirit, and the wise unselfishness of the giants who hold the insurance monopoly. If only these qualities were a little more apparent!

F. Collett.

London.
June 13th, 1921.

Kinema Supply.

In "Lindsell *v.* Paignton Electric Light Co., Ltd.," you reported in April, 1920, that Mr. Justice Bailhache's decision was that the energy used for the motor generator ". . . *must* be paid for at the lighting rate."

I should be glad to know whether supply authorities generally are charging the lighting, power, or an intermediate rate for this supply.

C. Culmer Hodges.

Dawlish Electricity Works.
June 9th, 1921.

[Supply authorities are not bound by the decision in the Paignton case; they can formulate any tariff they please for kinematograph theatres as a class of consumer. From data that we collected in 1919 it appeared that practice was very variable, all three methods mentioned by our correspondent being in use.—Eds. Elec. Rev.]

Wear of Rotary Converter Slip Rings.

I was very interested to read in your issue of May 20th an article by "Koocaf" regarding uneven wear of slip rings on a rotary converter. While I agree with his suggestion, and also Mr. W. G. Stuart's remarks as to the transference of metal from brush to ring or ring to brush, there is, I think, another action taking place which has a greater effect. The friction between two rubbing surfaces such as a slip ring and a brush varies according to the amount of current flowing between them, being greater with a heavy current than with a small current, and consequently the amount of wear will vary also. I am in charge of rotary converters where the angular distance between the brushes on the slip rings is equal to the angular distance between the north and south poles on the field of the machine, but still the flats form very badly. They are ten-pole machines, and there are ten high places and ten hollows on each ring, thus proving that this other action is present. I think that if it could be arranged to place two brushes, one each to correspond with a north and a south pole, and two more to correspond with positions between the poles (on a ten-pole machine that would mean two brushes 36 deg. apart and two more 36 deg. apart, but either 18 deg. or 54 deg. form the other pair), it would practically do away with the uneven wear. The other alternative would be to provide some means of shifting the brushgear round to a different position periodically, but I should prefer the first method myself.

Bernard T. Smith.

London.
June 8th, 1921.

The Lubrication of Ball Bearings.

In fitting ball bearings to dynamos and motors there seems to be a divergence of opinion between various manufacturers as to the provision of lubricators, some being in favour of the use of a screw-down grease lubricator, and others fitting no lubricator whatever.

Ball bearings require very little lubricant. I have found that a bearing properly washed out and packed with grease will give perfect service for at least a year without attention. It is desirable that a ball bearing should be thoroughly washed out at least once a year.

If lubricators are fitted, the tendency, especially with unskilled labour, is to fill them up with grease, or possibly oil, to such an extent that the surplus is frequently distributed over the commutator and windings.

No doubt there are very good arguments in favour of fitting lubricators, and an expression of opinion by your readers, I am sure, would be of great interest to dynamo and motor manufacturers who standardise on ball bearings.

J. C. Todman.

London.
June 9th, 1921.

"Though One Rose from the Dead."

Several months ago I ventured to make a simple statement of fact which was not well received by some of your correspondents, and I now enclose a short report of a recent speech of Mr. Robert Fleming, at the meeting of the Investment Trust Corporation, from which I take the following remarks said to have been made by the late Lord Moulton:—

"There is no prospect of our being able to bear the burdens of the future unless by advances in technology—the science of the industrial arts—we are able to produce better and more cheaply than our competitors."

Are there still any dissentients?

W. H. M.

June 11th, 1921.

The Grading of Mains Engineers.

The correspondence on the above subject is very interesting, and no doubt our worthy brothers—Charge and Mains Engineers—have all grievances, but both of these gentlemen seem to forget the meter engineer, a grade which is not even mentioned in the Award 9,281, not the E.P.E.A. Award alone, because there are members belonging to the E.T.U. as well as the E.P.E.A. "Meters" has been for years looked upon by the powers that be as an insignificant occupation, yet if probed in all its branches, it should rank with the charge and mains engineer. The whole question is involved by the fact that the "Stoker" Award 9,281 is too obscure. There should be a schedule laid down giving grades to all the technical staff; at present it gives great prominence to just two or three grades. My 25 years' experience convinces me that the mains engineer should be recruited from the mains department, not from the generating station—that is, promote a mains foreman who, after all, is the man that should know. Do any of your readers know of any grading for the

Meter Engineer?

June 4th, 1921.

A Peculiar Phenomenon.—"H. E." desires to thank Mr. C. R. C. Hadfield for his clear and interesting explanation of this.

BUSINESS NOTES.

Bankruptcy Proceedings.—J. F. Lyons, electrical engineer, Front Street, Consett, Durham.—The first meeting of creditors was held on June 8th at the Official Receiver's Office, Pearl Buildings, 4, Northumberland Street, Newcastle-upon-Tyne. According to the statement of affairs the liabilities amounted to £1,208, against assets estimated to realise £529, or a deficiency of £679. No cash book had been kept by the debtor. He had entered into a contract under the Chester-le-Street housing scheme. The creditors decided to appoint Mr. A. E. Carr, of Newcastle, as trustee of the estate, with a committee of inspection. The public examination herein was fixed to be held on June 9th at the County Court, Westgate Road, Newcastle-upon-Tyne, but the debtor did not appear (by permission of the Official Receiver), and the examination was adjourned.

T. P. Pollit & Co., Ltd., electrical and mechanical engineers, Fish Dock Road, Grimsby. The following are creditors:—

Bates, J. G.,	£26	Pethers, Ltd.	£26
Edison Swan Elec. Co., Ltd,	1,803	Pilkington Bros.	10
Falk, Stadelmann & Co., Ltd.	18	Roberts & Jackson	15
Grimsby Tramways Co...	18	Roberts, R. W.,	11
Hildred, Geo. (Meters), Ltd.	22	Sisson, W., & Co., Ltd.	21
Hansdell & Co., Ltd.	23	Siemens Bros. & Co., Ltd.	74
Kaye & Sons	32	Taskers Engineering Co., Ltd.	23
Legal Insurance Co.	19	Walker, R. C., Ltd.	12
Morley & Co., Ltd.	226	Reeves, A. R.,	15
Napier Kimber, Ltd.	32	Smethurst, J. W.,	77
Nicholson Bros.	13	Pollitt, M.	25

S. H. Dougherty (Mersey Electrical Co.), electrical engineers, Liverpool.—Trustee (Mr. H. W. Bowler, 30, North John Street, Liverpool) appointed June 7th.

Alfred John Harrison, trading as the Xtra Lighting Co., 4, 5 and 6, Old Market, Sunderland, Durham, electrical and gas engineer.—The adjourned public examination of this debtor was held recently at the Court House, John Street, Sunderland. He was questioned with reference to his financial affairs, and the examination was closed.

R. B. Hand & Co., Ltd., electrical engineers, 63, High Holborn, W.C.—In pursuance of the provisions of the Companies (Consolidation) Act, a meeting of the creditors of the above was recently held at the offices of Mr. Charles May, solicitor, 175, Lavender Hill, London, S.W. It was explained that the meeting had been called as the shareholders had passed a resolution in favour of voluntary liquidation, and had appointed Mr. P. J. Hooper, of 53, The Broadway, Wimbledon, S.W., as liquidator. According to the statement of affairs presented, the liabilities totalled £3,952, while the assets comprised stock, fixtures, and fittings, amounting to £1,942, which were estimated to realise £1,096. The liquidator stated that he had not been able in the time at his disposal to prepare any figures regarding the trading, and he could not give a detailed account of how the deficiency had arisen. The company was registered nearly two years ago with a nominal capital of £1,000. The issued capital amounted to £800. The creditors passed a resolution asking the company to appoint Mr. W. J. Osborn, of Messrs. Corfield & Cripwell, I.A., Balfour House, Finsbury Pavement, E.C., as the joint liquidator of the company, together with a committee of five of the principal creditors.

F. E. J. Padmore, electrical contractor, Marlborough Road, Nuneaton.—The public examination was held at the Coventry Bankruptcy Court on Monday last before Mr. Registrar Kirby. The statement of affairs showed liabilities £211, assets nil. Debtor stated he commenced business in November, 1918, with £5 capital. The causes of failure were keen competition and loss of trade through the strike, and also illness. The examination was closed.

T. Hardman, electrician, Rawtenstall.—First meeting, June 21st at the Official Receiver's offices, Manchester. Public examination, July 15th, at the Public Hall, Rochdale.

C. T. Stanton (Southern Electric Engineering Co.), electrical engineer, 25, Beckenham Road, Penge.—Last day for proofs for dividend, June 29th. Trustee, Mr. T. Gourlay, Official Receiver's Offices, 132, York Road, E.C. 1.

Dissolutions of Partnership.—E. E. Clarke & Co., electrical engineers and contractors, 4, Alhambra Buildings, Morecambe.—Messrs. E. E. Clarke and H. Schofield have dissolved partnership. Mr. Clarke will attend to debts.

Willis & Shaw, electrical engineers, 37, Haley Hill, Halifax.—Messrs. H. Willis and S. Shaw have dissolved partnership. Mr. Willis will attend to debts.

Fowler & Jones, electrical engineers, 1a, Menzies Street, Liverpool.—Messrs. H. Y. Fowler and A. E. Jones have dissolved partnership. Mr. Fowler will attend to debts and continue the business.

Henry Jones & Co., electrical and general engineers, 80 and 49, Ebury Mews, Eccleston Street, S.W.—Messrs. H. Jones and N. A. Usmar have dissolved partnership. Debts will be attended to by Mr. Jones, who will continue the business under the same style.

Trade Announcements.—Mr. S. Betts, lately with Messrs. J. H. Winter & Co., of Bristol, has commenced business as an electrical engineer at 63, Oxford Street, Weston-super-Mare.

Messrs. Perry, Savage & Co., electrical engineers, have commenced business at 28, Conway Street, Birkenhead.

Messrs. Booth & Bomford, Ltd., electrical engineers, have removed to 22, St. Andrews Crescent, Cardiff. Telephone number, 1466. Telegrams, "Induction, Cardiff."

Messrs. Williams, Pell & Baring, Old Serjeants' Inn Chambers, 5, Chancery Lane, W.C. 2, have been appointed sole agents for the United Kingdom for the sale of electrical machinery and apparatus made by the Heemaf Co., of Hengelo, Holland.

Allied National Corporation, Ltd., engineers and export merchants, of 34, Great Tower Street, inform us that after June 25th their address will be 72-74, Victoria Street, S.W.

Messrs. A. J. Wright & Co., manufacturing electricians, have removed from 61, Eden Grove, Holloway, N., to 395, City Road, E.C. 1.

Messrs. C. H. Runnalls, electrical engineers, of Sutton (Surrey), have removed their business from 6, St. Barnabas' Road, to new premises in Grove Road.

The Forest City Electric Services Co., Ltd., of 39, Chapel Street, Salford, will on June 20th remove their offices and stores to new premises as under:—Offices. 10, Princess Street, Chester Road, Manchester; stores, 2 and 4, Cornbrook Road, Manchester. The telephone number will remain unchanged.

Catalogues and Lists.—Messrs. Anderson & Burgess, 122, Wellington Street, Glasgow.—A type-written stock list of paper of various kinds. Priced.

Messrs. Rayner & Heald, Ltd., Duke Street, Derby.—Stock list of two- and three-phase squirrel-cage and slip-ring induction motors.

The Priory Electrical Engineering Co., Bath Street, Birmingham.—An illustrated leaflet describing a new type of ceiling rose fitting.

Messrs. W. J. Bithell, Ltd., Whitehall House, 29-30, Charing Cross, S.W. 1.—An illustrated booklet, dealing with automatic grabs for excavating, dredging and lifting.

Messrs. W. T. Glover & Co., Ltd., Trafford Park, Manchester.—List No. 14, describing in detail the "Glo-clad" wiring system. Full illustrations and prices are included.

The Mirrlees Watson Co., Ltd., Scotland Street, Glasgow.—An illustrated pamphlet, giving particulars of surface-condensing plant installed in the Dalmarnock station of the Glasgow Corporation.

Messrs. Williams, Pell & Baring, Old Serjeants' Inn Chambers, 5, Chancery Lane, W.C. 2.—A number of illustrated descriptive pamphlets dealing with the products of the Heemaf Co., of Holland, which include motors, switchgear, &c.

Automatic and Electric Furnaces, Ltd., 281-283, Gray's Inn Road, W.C. 1.—Heat Treatment Bulletin No. 28, "The Heat Treatment of Carbon Tool Steel." This is a full, but condensed, description of tool-steel production, with details of the various processes, such as forging and rolling, full and short annealing, normalising, hardening and tempering.

Messrs. Underwood (Manchester), Ltd., 53, Brown Street, Manchester.—Leaflet No. 23, illustrating "Moonstone" half-watt fittings (bowls). Priced.

The Edison Swan Electric Co., Ltd., Ponders End., Middlesex.—List No. H H 226, a comprehensive catalogue of electric fans for all purposes, with descriptions of special accessories such as automatic shutters, regulating resistances, oscillating bases, adapters, &c. Fully priced and well illustrated.

Engineering and Colliery Appliances, Ltd., Sheffield.—Two leaflets giving particulars and prices of "Ecal" hack-saw blades.

Catalogues Wanted.—The Scientific Electrical Works, electrical engineers and instrument makers of Charlotte Street, Dublin, desire to receive catalogues from manufacturers of electrical machinery, apparatus, and accessories, &c.

Messrs. Hamilton & Liddaman, Ltd., factors, of 12, Charing Cross Road, W.C. 2, will be pleased to receive catalogues and price-lists of electrical apparatus, accessories, cable, &c.

Book Notices.—"Aluminium Facts and Figures." 68 pp. London: The British Aluminium Co., Ltd. Price 5s. net.—This is a new and revised edition of a pocket-book of great value to all who are connected with the use or supply of aluminium. Everything which it is desired to know about aluminium appears to be included. Full details of the physical, mechanical, and electrical characteristics of aluminium and its alloys are given, and a comparison is made in most cases with the equivalent properties of copper. Many details and directions for working are given, such as hammering, spinning, pressing, jointing, polishing, &c. Other particulars too numerous to mention are given in comprehensive tables.

Scientific Paper of the U.S. Bureau of Standards No. 410, "Thermal Expansion of Copper and Some of its Important Alloys." 69 pp. Washington: Government Printing Office. Price 25 cents.—This publication gives data on the thermal expansion of 128 samples of copper and its alloys of various compositions under heat treatment, mechanical treatment, &c.

The *Decimal Educator* for June contains, *inter alia*, extracts from a memorandum by Mr. Harry Allcock on the importance of the adoption of the metric system in this country for the development of foreign trade, and from a lecture by the hon. secretary of the Decimal Association, Major G. E. M. Johnson, explaining the use of decimal costing methods in the offices of a large engineering firm. It is published by the Decimal Association, price 6d.

"The Technology Reports of the Tôhoku Imperial University, Sendai, Japan." Vol. II, No. 1. Pp. 40. Tokio: Maruzen Co., Ltd.—Included in this issue are "A Fundamental Study of Japanese Coal," "The Energetics of Telephone Receivers," "On the Discharge through an Aluminium-Cell Lightning Arrester," and "General Consideration of an a.c. Circuit with Periodically Variable Resistance."

Credit for Mexican Importers.—The British Vice-Consul at Guadalajara, Mexico, reports that local merchants are showing great interest in the importation of United Kingdom manufactures, but, the development of business is being seriously hindered by the lack of standard types of credit allowed by United Kingdom firms to Mexican importers. He adds that United Kingdom manufacturers and exporters do not seem to have the courage to make clean-cut credit propositions, while many send catalogues without prices and seem to hope that orders will ensue from correspondence.—*Board of Trade Journal.*

French Moulded Insulation.—With reference to the note appearing in our last week's issue under the above title, we are informed that the submarine accumulator box shown was made for the American Navy and not the British Admiralty.

The Union of German Electrical Engineers.—The Central Union of the German Electrotechnical Industry held an ordinary meeting, under the presidency of Herr Carl von Siemens, in connection with the electrical exhibition which took place at Essen at the end of May. After mentioning that the Union had advocated the maintenance of State control over the export and import trade, the general report stated that, as a consequence of the general improvement in the supply of raw materials, it was no longer of any importance for the Union to look after the interests of members in procuring such materials. Negotiations were proceeding with the organisations concerned with regard to the prices and conditions of delivery of porcelain and of transformer sheets, and new conditions would presumably be issued in the near future.

As to the situation of the question of reconstruction in France, Herr Henrich stated that orders were to be expected in the early future from France for "weak current" installations, as it was proposed to undertake the re-establishment of entire telegraph and telephone networks in the destroyed districts. Dr. Sieg, director of the Gottfried Hagen Accumulator Works, of Cologne-Kalk, mentioned in this connection that the aggregate sum of the deliveries devolving upon the German electrotechnical industry from the reparation demands "only amounted to 2,500,000,000 marks," of which 1,500,000,000 marks applied to telephone and telegraph installations. As a consequence, "the re-establishment orders remained far behind the expectations." Thus the impression was gained that the French preferred to purchase at home, even if it were more costly to do so.

It was further mentioned that the Union of German Electrical Engineers (V.D.E.) had decided to discontinue, as from October 1st, the use of substitute metals (iron, zinc, &c.), because they are unprofitable. The Government, however, is considering a scheme for maintaining such substitutes, particularly aluminium.

For Sale.—By direction of the Disposal Board, Messrs. Bowling Bros. will sell by auction on June 28th and 29th at H.M. Dockyard, Pembroke Dock, and on June 30th at the Pembroke Airship Station, Milton, a quantity of machinery stores, including generating sets, motors, lamps, carbons, &c. For particulars see our advertisement pages to-day.

Suggested Polish Credit Scheme.—At the London Chamber of Commerce, on June 14th, Mr. S. Janicki, editor of the *Polish Economic Bulletin*, outlined a scheme for establishing Polish external trade by means of a Polish Industrial Credit Society. Mr. Janicki said that Poland was a wealthy country, but owing to the lack of guarantees, had been unable to gain the confidence of foreign merchants. To meet this need, a group of Polish manufacturers had suggested the formation of an Association with headquarters at Warsaw and a branch at Lodz. Only merchants and manufacturers owning real property in Poland would be eligible for membership, as the system of guarantees would be based upon the value of such property. Mortgage bonds in dollars, sterling or French francs would be issued, charged upon this property. Such loans would not exceed, during the first five years' working, 40 per cent. of the value of sites and buildings, or 50 per cent. of the value of plant and machinery, based on pre-war standards. The loans would be written off in periods of 15, 20 or 25 years, a sinking fund for this purpose being commenced at the end of the first five years. The society would receive 7 per cent. interest on advances, and would pay 7 per cent. interest upon its bonds. The Polish Government would be responsible for the capital and interest of the society's bonds up to, it is understood, £20,000,000.

Lead Report.—Messrs. James Forster & Co., in their report of June 11th, say:—"Closing prices yesterday were £23 2s. 6d. for June and £22 12s. 6d. for September, against £22 2s. 6d. and £22, respectively, at the end of last week. Each day this week we have had an active and rising market up to Thursday, when the top prices paid were £23 7s. 6d. for June and £23 for September. The intrinsic position of the metal—as we have pointed out for some time past—is very strong, in spite of the coal strike and consequent dislocation of business. . . . Consumers in London and the provinces who have been in the market this week for prompt and June supplies have found none available except from refiners' works (which means 20s. premium on market values for "foreign") or from public stocks."

Living on Capital.—At a luncheon of the National Association of Merchants and Manufacturers, last week, Lord Emmott, who presided, said that the recent war was much more exhausting and devastating than the Napoleonic wars. We were not yet on the high road to recovery, and were not getting our export trade back to any satisfactory extent. He was appalled by the apparent levity with which large classes of our people looked on the present state of affairs. The great industrial disputes in progress at present meant that we were living on our capital. The quiet way in which these disputes were being borne was a great tribute to the sanity of our people, but the fact of their existence and intensity showed a lack of realisation of the jeopardy in which the country stood industrially to-day.

Sir Drummond Fraser said that the Financial Department of the League of Nations unanimously decided, on May 31st, to recommend the application of the international credits scheme for the restoration of Austrian finances. Credit was the fundamental need, and the Ter Meulen scheme was the accepted solution. It left intact, the ordinary channels of trade and provided a reservoir of credit which could be tapped by genuine traders. The economic restoration of Austria was the key of the whole situation.

German Interests in South America. — Although through financial necessities the South American undertakings of the German Transmarine Electricity Co., of Berlin, were transferred about a year ago to the Compania Hispano-Americana de Electricidad, of Madrid, it should not be overlooked that the Germans have by no means lost interest in the great original undertaking which formerly represented a gold value of something like £12,000,000. The issue to German holders in exchange for their shares and bonds of shares and interest bonds in the new Spanish company has continued the individual proprietorship of the former and of the Swiss undertakings which are also concerned. But what is, perhaps, of particular importance to the Teutonic mind is the decision which was reached at the meeting of the Spanish company on May 31st to elect to the board of directors Dr. A. von Gwinner, E. Heinemann (Deutsche Bank), O. Olven (Berlin Electrical Undertakings Co.). and Dr. Salomonsohn (Disconto Gesellschaft). On this basis the continuation of the German hands and of German plant in the South American supply undertakings and tramways is a foregone conclusion. It would be of interest to hear what the Spanish electrical manufacturing companies and firms have to say on the question. If they formerly entertained any hopes of securing a good customer in the Compania Hispano-Americana, these expectations will doubtless be dispelled by the addition of four German directors to the board of the company.

A Telephone Charge Guide.—We have received from Messrs. Geo. W. Wheatley & Co., Ltd., shipping agents, &c., a useful booklet which gives the charges for telephone calls from exchanges in the Inner London zone to exchanges within a 10-mile radius, and also to stations within a 25-mile radius.

Foreign Trade.—May Figures.—The following are the values of imports and exports of electrical goods and machinery in May :—

	May. 1921. £	*Inc. or dec.* £	5 months, 1921. *Inc. or dec.* £
Imports.			
Electrical goods, &c.	151,021	+ 39,604	+ 577,215
Machinery	1,073,697	− 444,142	− 1,283,044
Electrical machinery	93,622	+ 31,784	− 11,267
Exports.			
Electrical goods, &c.	1,783,579	+ 778,369	+ 2,760,335
Machinery	6,923,072	+1,441,879	+17,038,615
Electrical machinery	459,625	+ 314,601	+ 1,351,641
Re-exports.			
Electrical goods, &c.	14,642	− 1,271	+ 75,505
Machinery	90,650	− 66,417	− 90,521
Electrical machinery	1,377	− 1,409	— 6,558

British Trade-Mark Applications.—Below is a summary of the recent applications for British trade marks in respect of goods and productions connected with the electrical trades and industries :—

Magnavox. No. 411,317. Class 8. Electrical sound-amplifying devices, loud-speaking telephones, marine telephones, aircraft telephones, &c. The Magnavox Co., 2,725, East 14th Street, Oakland, Cal., U.S.A. January 7th, 1921.

Tucker. No. 408,083. Class 8. Electric switchboards. No. 408,084. Class 13. Electrical devices, fittings, accessories, &c. No. 408,085. Class 16. Articles made wholly or partly of porcelain or earthenware for electrical purposes. J. W. Tucker & Co., Ltd., King's Road, Hay Mills, Birmingham. September 23rd, 1920.

Multi Frex. No. 413,588. Class 11. Portable high-frequency and cautery apparatus for curative purposes. Ernest J. Bradbrooke, trading as E. J. Bradbrooke, 14, Granville Place, London, W. March 19th, 1921.

Spondella. No. 410.335. Class 50. Artificial filaments and fibres made wholly or principally from cellulose derivatives. British Cellulose and Chemical Manufacturing Co., Ltd., 8, Waterloo Place, London, S.W. December 2nd, 1920.

Turbolite. No. 409,005. Class 6. Electric generating machines. Henry E. Elrod Co, 220, Interurban Buildings, Dallas, Texas, U.S A. October 22nd, 1920.

Three Star. No. 412,165. Class 8. Electrical accumulators (not for medical purposes), electric lamps, dry batteries, &c. John Abrahams & Co., 54, Redcross Street, London, E C. February 2nd, 1921.

Greenbat. No. 401,878. Class 22. Electric trucks. Greenwood and Batley, Ltd., 16, Great George Street, Westminster, S.W. March 15th, 1920.

Wittonite. No. 413,750. Class 50. Insulating preparations, electrical. General Electric Co., Ltd., 67, Queen Victoria Street, London. March 24th, 1921.

Engineers' Continental Tour.—Part of the investigations of the Engineering Trades Joint Committee, says the *Manchester Guardian*, have been completed. The members include representatives of the Employers' Federation and of the Trade Unions, and their tour of Continental engineering centres has been a revelation of the efficiency of the organisation of the trades in Belgium, Holland, and Germany, and the anxiety and willingness to increase outputs.

One of the objects, so far as the labour side is concerned, is to obtain data as to the desirability of instituting generally a 44 hour week. On the Continent it is noted that a 48-hour week is worked, and selling prices are much lower than ours. While British shipyards pay £19 per ton for British ship-plates, Germany is sending ship-plates Holland for £6 10s. per ton.

Tramway Workers' Wages.—Convened by the United Vehicle Workers, a conference of delegates representing tramway employés throughout the United Kingdom was held at the Central Hall, Westminster, on June 13th, to consider a proposal of the employers to reduce wages by 5s. a week. Tram drivers, conductors, washers, and other workers in the yard affected by the scheme number in all some 150,000. No official statement was issued at the close of the conference, which lasted over four hours, but it is understood that arrangements have been made for a negotiating committee representing the workers to confer with the employers in London on Thursday (yesterday), with a view to reaching an agreement.—*Daily Telegraph.*

In connection with this matter the *Daily Herald* states that the employers have not put into operation the recommendation of the Court of Inquiry, held in March last, that the wage standards existing in March should be stabilised until December 31st next.

The Engineering Wages Dispute.—On Tuesday last both parties to the wages question in the engineering industry sat in full session to discuss means of agreement. The original proposals of the employers' side were, a reduction of 3s. per week as from June 16th, a further reduction of 3s. per week as from July 16th, and the cessation of payment of the "Churchill" 12½ per cent. bonus in September. Against these proposals the Trade Unions put forward the following alternatives, which they intimated would be acceptable to their members :—A reduction of 6s. per week in time rates, and 15 per cent. in piece rates in two instalments—the 12½ per cent. and 7½ per cent. bonuses to remain. The employers would not entertain the idea of this arrangement, but modified their original terms by extending the period over which the reductions would be effected. The Unions replied that if the notices of reduction were suspended for a fortnight a ballot would be taken among their members upon these last proposals. To this the employers would not agree, and a stoppage of work appeared probable. It was suggested that the employers' proposals would be voted upon by the workers during the first fortnight of the closing of the works.

On Wednesday Dr. Macnamara met representatives of both sides in the hope of averting a stoppage.

As we go to press we learn that the employers have agreed to suspend their notices until the end of June, in order that a ballot of the employés may be taken.

Tenders for Public Contracts in Argentina.—The Commercial Secretary to H.M. Legation at Buenos Ayres, in a report on the above subject, states that with regard to contracts for which tenders are invited locally, United Kingdom firms cannot tender direct but only through a properly accredited agent, or through a local merchant firm which takes over their quotation and tenders it in his own name. The invariable stipulation that tenders must be made on Argentine stamped paper and be accompanied by a deposit of 3 per cent. of the tender price, and further requirements, make necessary the final preparation of the tender locally and preclude firms from drawing up the tender in the United Kingdom for presentation in Argentina.

United Kingdom firms who are not represented in Argentina, but who wish to be in a position to submit tenders, may care to arrange with the London office of some Buenos Ayres firm to present their tenders. Names of suitable firms will be furnished on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W. 1.

Should, however, the appointment of a firm in Argentina to act as their agent be preferred, the Department will be pleased to receive details of the requirements of United Kingdom firms for transmission to the Commercial Secretary for the usual inquiries.—*Board of Trade Journal.*

Outings.—On June 11th, the Designs Section Staff of the G.P.O. Engineering Department went for their sixth annual outing. The party motored to Keston, where it divided up and spent its time, according to taste, in visiting various well-known places in the neighbourhood (they were aided by an admirably drawn-up guide), or rambling over the Common. After tea several photographs of the party were taken, and the return was made by a different route.

On June 4th about 90 of the staff of the electricity department of the Stepney Borough Council held their annual outing, proceeding by char-à-bancs to Hindhead, where they were met by the borough electrical engineer and manager (Mr. Wm. C. P. Tapper, M.I.E E), and the chairman of the Electricity Supply Committee (Alderman Major C. R. Attlee, M.A.). Dinner was served at the Seven Thorns Hotel, Mr. Tapper occupying the chair. The party then returned to the open air, and cricket, football, and rambles over the common and to Wagoners' Wells were indulged in. At 5 p.m. an official photograph was taken, and tea was then partaken of. The return journey was made *via* Guildford, Leatherhead, Epsom, and South London.

Gretna Factory to be Sold.—It was stated at a meetin of the Carlisle City Council, on June 14th, by Mr. Partric Kerr, who was a member of a recent deputation to the Government from Gretna, that the War Office had decided to "wash its hands of Gretna," and in all probability the factory would be handed over to the Disposals Board. The construction of the town of Gretna was one of the large enterprises of the Ministry of Munitions, which converted a peat bog, fringing the sea, into a veritable city, with cordite factories employing about 12,000 persons. The buildings and equipment cost £9,184,000, and the cost of working the factory for two years was £12,769,000. Extensive electrical plant and installations for lighting and power were laid down which have been described in our pages.

LIGHTING AND POWER NOTES.

Aberdeen. — Oil Fuel. — Some interesting figures regarding the cost of adapting boilers to oil firing were given recently at a meeting of the Emergency Sub-Committee of the Electricity Committee. It was estimated that the cost of converting one boiler was £700. Four hundred tons of oil per week would be necessary, and a tank with that capacity would have to be installed. The total cost of converting all the boilers and arranging for storage capacity would be at least £12,000.

Extensions Sanctioned.—The Town Council has received the consent of the Electricity Commissioners to extend the Corporation generating station by the installation of one 10,000-kW turbo-alternator set, two 36,000-lb. boilers, and the construction of the necessary buildings.

Bath.—Year's Working.—The income of the electricity undertaking for the year ended March 31st last was £45,495, as compared with £35,547 in the previous period. Working expenses amounted to £38,045, as against £28,888, leaving a gross balance of £7,450 (£6,659). The payment of capital charges absorbed £9.396, resulting in a net deficit of £1,946, which compares favourably with a loss of £4.120 in 1919-20. It is stated that the increased revenue is due chiefly to increased charges, and partly to increased consumption. The price per unit was raised during the year from 6½d. to 8d., and the number of units sold rose from 1,879,617 to 2,675,592.

Bournemouth.—Price Increase.—The Bournemouth and Poole Electricity Supply Co. has notified the Council that the following increased scale of charges for power is in operation as from March 25th last:—Up to 1,000 unit per quarter, 3½d. per unit; from 1,000 to 2,000 units 3d. per unit; from 2,000 to 5 000 units, 2½d. per unit; from 5,000 to 10,000 units, 2d. per unit, with the standing variation for coal price fluctuations, plus 33⅓ per cent.

Bradford.—Mains Extensions.—The Electricity Committee recommends further extensions of electricity mains, &c., at an estimated total cost of £10,000.

Brampton (Cumberland). — Proposed Electricity Scheme.—At a recent meeting of the Parish Council a proposed scheme for the introduction of electricity was discussed. It was pointed out that the existing gas company was paying it way, but if an electricity company entered the field, neither undertaking would be remunerative. The Council decided, therefore, not to support the scheme financially, although it would place no obstacles in the way of a purely private company.

Canada.—Electricity for Farmers.—In order to bring electric light and power within reach of a greater number of farmers in Ontario, the Government of that Canadian Province is to grant a bonus of 50 per cent. towards the extension of hydro-electric power transmission lines into new rural areas. Already electric light and power are used in thousands of farm homes throughout Ontario, and one farm in every five has the telephone. —*Lloyd's List.*

Cannock.— Bulk Supply Scheme.—At the last meeting of the Urban District Council it was stated that Mr. Ellis, of Cardiff, the electrical consultant to the authority, had reported upon the proposed agreement with the Wolverhampton Corporation for the supply of electricity in bulk to the Council. The Corporation would lay the cable from Wolverhampton to the Cannock boundary at Wedge's Mills, and the Urban Council would bear the cost of laying the main from the boundary to the proposed transformer station in Queen Street, Cannock. The Urban District Council approved the proposals.

Chester.—Loan.—The Corporation is making application to the Electricity Commissioners for sanction to borrow £52,000. This is required for carrying out the scheme for taking a bulk supply of electricity from H M. Factory at Queensferry.

Continental.—Jugo-Slavia.—The erection of a huge power station at Kostolast, on the Danube, is proposed as a means for supplying electric power to Belgrade, Smederevo, Gotzka, and other towns in Jugo-Slavia.—*British Export Gazette.*

Holland.—As previously foreshadowed a State Commission has now been appointed by Royal Decree to advise the Government in the matter of the supply of electricity throughout Holland. Among the names appear those of representatives of various supply companies and municipal works, and of the President of the Union of the Manufacturers' Association of the Netherlands.

Dover.—Oil Fuel.—As it is estimated by the electrical engineer that oil fuel would raise the station's generating costs by £5,000 a year, the Corporation has decided not to adapt the boilers for oil firing.

Year's Working.—The income of the electricity department for the year ended March 31st last was £39,889, as compared with £30 892 in 1919-20. Working expenses totalled £29 996, as against £23,072, leaving a gross surplus of £9 893 (£7 820) equal to 4·9 per cent. on the capital outlay. The net result was a deficit of £5.463, an improvement on the previous year's debtor balance of £6,247.

Eastbourne. —Loans. — The Finance and General Purposes Committee has recommended application to the Electricity Commissioners for sanction to borrow the following amounts:—£66,000 for electricity extensions; £15,000 for mains, services, transformers, and sub-stations, for three years; and £1,000 excess expenditure incurred in providing a cooling tower at the electricity works.

Electricity District.—North Lancashire and South Cumberland Scheme.—A draft scheme has been prepared for the constitution of a Joint Electricity Authority for North Lancashire, Westmorland, and South Cumberland, and is about to be considered by the various local authorities in the area previous to being placed before the Commissioners on or before July 30th next.

The scheme provides for the generating plant of the five authorised undertakers in the district being transferred to the Joint Electricity Authority, and contains a proposal that 33,000-V main transmission lines should, in the first instance, be constructed between Barrow, Ulverston, Lindale-in-Cartmel, and Lancaster, and from Lindale to Kendal; also that 6 600-V transmission lines should be constructed from Lancaster to Morecambe and Heysham, Lancaster to Galgate, Lindale to Grange, Lindale to Arnside, and Barrow to Dalton.

It is further proposed that the Joint Electricity Authority should establish distributing systems in Arnside, Dalton, Galgate, Grange, Kents Bank, Heysham, Lindale, and Ulverston, and in the areas of other constituent authorities which are prepared to enter into the necessary agreements with the Joint Authority.

The undertaking is likely to effect considerable economy, and make for a cheaper supply of electricity. It is estimated that the completion of the above-mentioned portion of the scheme will result in a saving of coal which alone will more than pay the maintenance, interest and redemption charges on the whole of the transmission lines proposed, and will not only enable the existing undertakers to supply electricity for power and other purposes at prices which they are at present unable to offer, but will also at no very distant date result in a supply for lighting, heating, and power purposes being available in many parts of the district at prices which could not be offered if the supply were generated at small isolated generating stations.

The technical portion of the scheme has been held up to some extent, owing to the negotiations with Messrs. Vickers, Ltd., of Barrow, with regard to the Corporation's taking over the firm's power station not yet having been completed.

It is proposed that the new Authority to be set up shall consist of 30 members, each district having proportionate representation.

Federated Malay States.—Electricity Board.—An Electricity Board has been formed in the Federated Malay States. Generating stations are to be erected near Taiping, Ipoh, Kuala Lumpur, and Seremban. Each town will have its own station, but will be connected with Kuala Lumpur for cases of emergency. It is thought that these plans cannot be brought into operation for some considerable time.—*Reuter's Trade Service* (Singapore).

Glasgow.—Wharf Lighting.—A committee of the Glasgow Corporation has resumed consideration of the proposal to substitute electric lighting for the present system of gas lighting at Mecklands Wharf, and, after discussion and inspection of the wharf, agreed to recommend that the work be proceeded with immediately, and that it be remitted to the electrical engineer to obtain and submit offers therefor.

Loan.—At a meeting of the Electricity Committee, the town clerk made a report regarding the application to the Electricity Commissioners for authority to borrow an additional sum of £1,800,000, and submitted correspondence which he had had with the Commissioners regarding, *inter alia*, the provision to be made for the repayment of the money. The Committee remitted the matter to a sub-committee to make further representations to the Electricity Commissioners regarding the sums to be set aside for sinking fund and depreciation, and with power to adjust those matters with the Commissioners.

Improved Efficiency.—During the year to May 31st, 1921, 187,500.000 units were generated at the various stations of the Corporation electricity department, compared with 176,500,000 in the previous year. Although the number of units generated has increased by over 11 millions, the coal consumed has been reduced by 6,000 tons, the starting of the new power station at Dalmarnock being responsible for the saving. Although definite figures are not yet available, it is stated that the revenue of the department has been increased by approximately £300,000.

Grimsby.—New Powers Conferred.—In its new Act, which has recently been passed by Parliament, the Corporation has secured powers to establish showrooms, to lay electric mains in streets not repairable by the Corporation, to increase the maximum charges for electricity, and revise such charges to supply electricity in bulk in certain cases beyond the Corporation's area of supply, and to charge for electrical energy by any method approved by the Electricity Commissioners other than by the actual amounts of electrical energy supplied, or electrical quality contained in such supply.

Hastings.—Price Increase.—The Town Council has increased the price of electricity for heating and power to 2d. per unit, plus 50 per cent., as from June 30th.

Heston and Isleworth. — Loan Sanctioned. — The Council has received the permission of the Electricity Commissioners to borrow £5,232 for mains, and £210 for switchgear.

Hinckley.—Electricity Supply Area.—It has been intimated to the Rural Council by the Electricity Commissioners that for the present the question of provisionally determining an electricity district which would include that area has been postponed.

Lochaber.—Water-Power Bill.—Considerable discussion took place in the House of Commons, on June 9th on the report stage of the Lochaber Water-Power Bill, which is promoted by a company, with a capital of three million pounds, for the purpose of developing the water power of the River Spey in connection with the production of aluminium. An amendment was moved to safeguard the rights of the counties of Banff, Moray, and Nairn in respect of water power from this river for electricity purposes. Sir W. Mitchell Thompson, on behalf of the Board of Trade, said the production of aluminium and the development of water power were of immense national importance in peace and war. The company's scheme would find work for between 2,000 and 3,000 people. Other interests were amply safeguarded, and he opposed the amendment. The amendment was defeated by 193 votes to 48, and the report stage was concluded.—*Sheffield Daily Telegraph.*

London. — Bethnal Green. — It was stated at a meeting of the Council that, in connection with the schemes for electricity supply in London, Bethnal Green was in a fortunate position. It has no generating station of its own, and the system as laid down on the lines proposed by Sir John Snell, is such that the Council will be able to utilise to the best advantage any bulk supply which may be offered by a joint electricity authority without additional cost.

Holborn.—By the courtesy of the borough surveyor of Holborn and the Metropolitan Electric Supply Co., one or two examples of longitudinal street lighting lanterns (Haydn T. Harrison patents) are to be displayed in use on lamp-posts in Holborn immediately east of Kingsway. It is hoped to keep these in position until after the annual meeting of the I.M.E.A.

Acton.—A failure of the electricity supply occurred in the afternoon of June 10th, causing great inconvenience to local industries and kinemas. The stoppage is stated to have been due to inferior coal supplied to the electricity works and also to the process of conversion to oil fuel being carried out.

Manchuria.—New Works.—The estimates of the South Manchuria Railway Co. for the financial year 1921-22 include the provision of 2,485,961 yen for electrical developments. These include the establishment of an experimental electrical station at Dairen, the erection of a second power station at Dairen, and of a third at Antung, as well as the extension of the Dairen tramway system.

Neath.—Loan.—For the purpose of meeting additional demands for electricity, the Rural District Council has decided to borrow £6,000. It is intended that the works shall be proceeded with during the summer.

Northampton. — Bulk Supplies. — A notice in the *London Gazette* of June 7th announces that the Northampton Electric Light and Power Co., Ltd., is applying to the Electricity Commissioners for permission to give bulk supplies of electricity to the Wellingborough Electric Supply Co., Ltd., and the Rushden and District Electric Supply Co., Ltd., and for authority to carry out the necessary works for this purpose.

Sheffield. — Proposed Price Reduction. — The decreased generating costs per unit brought about by increased efficiency and greater output has enabled the electricity department to keep the price of electricity for lighting at a comparatively low figure. A special Committee on Charges now recommends that reductions be made in the price of energy supplied for power purposes. It is proposed that, after the June quarter, the 150 per cent. increase, placed upon the price of energy supplied previously at less than 2d. per unit, be reduced to 125 per cent. Further reductions will be made as soon as they are justified.

Southwold.— Undertaking Changes Hands.— The undertaking formerly owned by the Coast Development Co. has now been taken over by Edmundson's Electricity Corporation, and it is hoped, by the installation of new plant, to be able to extend the supply to a considerable extent.

Thornton Dale (Yorks.).—Electric Lighting Scheme.—The Pickering Transport Co., of Pickering, is promoting a scheme for the installation of electric lighting plant for Thornton Dale, and it is proposed that when established with the assistance of this company's capital, the undertaking shall be taken over by some special lighting company, or by the local authority. Water power is available, but the company proposes to have two sources of generation. Two thousand £1 shares are to be issued, and a board of directors have been appointed, with an Advisory Committee, Messrs. Walker & Hulton are the engineers, and Mr. F. Pope, of Pickering, is acting as secretary *pro tem.*

Torquay.—Consultant's Report.—The Town Council considered, on June 7th, a report from Mr. E. T. Ruthven Murray, consulting expert, on the possible installation of additional plant on the present site of the power station at Beacon Quay. He states there is no possibility of providing even one additional boiler in the boiler house, nor is it possible to install a boiler in the small space outside the building indicated as a possible site. The only feasible scheme is to increase the output of the existing boilers and to bring into regular use the two boilers which, owing to their position, can only be used with difficulty. The Council had already been advised to convert these two boilers to burn oil fuel, which would increase the output without accentuating the difficulty of coal delivery. He strongly advises the Council to consider forthwith the provision of a supply from another source, with a view to this becoming available in from three to four years' time. Very large economies in production cost would result from the installation of modern plant upon a suitable site, and the increase in output and the improved load factor of the supply which would result from the development of the domestic and power loads would ensure the plant operating under greatly improved conditions.

West Riding.—Electricity Inquiry Costs.—It was stated at a Conference of the West Riding District Councils' Association, held in Leeds on June 7th, that the cost of briefing counsel to put forward the Association's views at the recent electricity inquiry was about £300. It was proposed to recover this amount by a levy of three guineas upon each of the authorities comprising the Association. A delegate from Hunslet protested against this course, and condemned the action of the executive in defending private enterprise as against public ownership. He suggested facetiously that the cost of counsel should be recovered from the Yorkshire E.P. Co. It was ultimately decided to call for a subscription of two guineas from the constituent Councils.

Worcester. — Year's Working.—The total revenue accruing to the Corporation's electricity undertaking during the year ended March 31st last, was £41,179, as compared with £33,116 in 1919-20. The working expenses amounted to £27.236, as against £19,835 in the previous period; the gross profit thus amounted to £13,943, equal to 6·8 per cent. of the capital expended, as compared with £13,281 in the previous year. After payment of loan interest and other capital charges the net result was a profit of £1,657, more than double last year's figure—£762. An interesting feature of the Worcester undertaking is the Powick hydro-electric works. The output from this source rose from 263,020 units in 1919-20 to 913,881 in 1920-21, out of total outputs of 3,000,063 and 3,663,349 units respectively. The overall cost of production is greatly reduced by this means.

The city electrical engineer (Mr. C. M. Shaw, M.I E E.) states that, as the result of having suitable stokers, large quantities of pit mound refuse have been employed in maintaining supplies during the coal stoppage, and it has been found possible to resume the full tramway service.

Wrexham.—Bulk Supply.—Reporting that the electricity undertaking had incurred a loss of £2,227 on the past year's working, the Mayor stated, on June 7th, that it was hoped to redeem this within 18 months of the commencement of a bulk supply from the North Wales Power Co. The converting and transforming plant necessary was estimated to cost £100,000. The old plant would be sold, and the money thus obtained would extinguish the outstanding debt.

TRAMWAY AND RAILWAY NOTES.

Birmingham.—Effect of Fare Increase.—The chairman of the Tramways Committee recently stated that since the coal stoppage the weekly earnings had dropped from an average of £33,000 to £31,000. The receipts, although the largest on record, had not come up to the estimates. The effect of the higher fares was to increase the total receipts by £300,000, although there was a falling off in the number of passengers carried of 7,000,000. About £175,000 had been spent during the year in renewing tramway tracks, and it was anticipated that by the end of the year the majority of tramway routes would be in excellent condition.

Bournemouth.—Proposed Increased Charge.—At a meeting of the Town Council, on June 3rd, a letter was read from the Bournemouth and Poole Electricity Supply Co., reminding the Council that the date of revision of the contract under which the company supplies power to the tramways was imminent. The date is July 1st, 1922, and the company asked that an increased charge should be agreed to immediately. The application was not granted.

Bradford.—Track Renewals.—Application is to be made for power to borrow sums for tramway track renewals, and for the construction of cars, as follows:—Permanent way: Manchester Road, £51 490; Cheapside, £5,793; Church Bank, £8,749; Thornton, £14,248; and Birkenshaw, £21,399. Cars: £89,491. Total, £192,170.

Canada.—Battery Railway Car.—The Canadian National Railways are trying out the storage battery type of car on the line running between Trenton and Belleville, Ont., and the officials state that the initial performance of this car gives considerable promise. On the initial run out from Toronto 140·2 miles were run without recharging, in addition to which a demonstration was given of shunting two private cars weighing 208,000 lb. The car is equipped with an Edison battery of 250 cells, type A-12, with a normal capacity of 450 Ah. The actual amount of energy used over 108 miles of this trip was 49 kWh, which works out at 14 Wh per ton mile—considerably less than the figure obtaining in tramway-car operation.—*Electrical News.*

Continental.—Switzerland.—The Federal Council has approved of a loan of 100,000,000 fr. for the electrification of the Federal Railways. The loan will be taken up by a combination of Swiss banks at 6 per cent. for a period of 10 years.

Huddersfield.—New Repair Wagon.—A number of improvements have been embodied in the new tower wagon lately put into service by the tramway department of the Huddersfield Corporation. The chassis is one of the Karrier Co.'s, of Huddersfield, while the special body has been built by the Corporation. Not only is the working platform on the tower capable of being raised and lowered, but it can be rotated by suitable gearing. The railings fitted to its four sides are also collapsible when required, so that the vehicle can pass under low bridges without lowering the tower. Another feature of the body is that the covered cah contains two rows of seats, so that provision is made for the conveyance of the repairing staff in addition to the driver. There is also a large locker at the rear for the storage of tools and equipment.

London.—L.C.C. Tramways.—On June 16th, an improved service between the Victoria Embankment and South London was put into operation by the Highways Committee. One improvement effected is the cessation of the arrangement terminating several services at Blackfriars and Savoy Street (Strand). These services will now be connected up and operated as circular services. Another feature of the new arrangement is that fares will be slightly reduced on several routes.

Philippines. — Railway Electrification. — With regard to the plans of the Manila Railroad Co. for the use of electric motive power on its road, the bulletin of the Philippine Government Commercial Agency in New York City states that the electrical power will be developed from the Agno River, in central Luzon, which is believed to possess a potential capacity of from 12,000 to 15,000 h.p. A thorongh topographical survey of the entire water-power site is being undertaken, and early reports of the survey would seem strongly to point to the feasibility of the project.—*Electrical Review* (Chicago).

Sunderland.—Year's Working.—The report of the general manager of the Corporation tramway department for the year ended March 31st last records a total income from all sources of £158,165, as against £149,442 in the previous year. Working expenses amounted to £136,668, as compared with £108,079, leaving a gross profit of £21,497 (£41,363). After payment of capital charges, a net profit of £8,017 was carried to appropriation account. This compares with a sum of £29,181 transferred in the previous year. The number of car-miles run increased from 1,597,525 to 1,647,618.

New Track.—The Town Council has decided to spend £6,768 in order to double the track in Ryhope Road between Spelter Works Road and Grangetown terminus. Another £2,550 will be expended on making an additional entrance to the Wheat Sheaf Car Depôt *via* Dundas Street to North Bridge Street. Other expenses connected with the latter item—such as paving, &c.—will cost £1,400. On the question of economy these matters were referred to the Finance Committee of the Corporation, which has now reported that it considers the works of vital importance and urgency.

Swansea.—Track Repairs.—The general manager of the Swansea Tramways Co., having called the attention of the Corporation Tramways Committee to the large sums being paid for repairs to the permanent ways, the borough engineer, Mr. J. R. Heath, has been instructed to make the best arrangement possible for an alteration of the working of the staff and the bringing about of a reduction. Mr. Heath reported that the tramway track was in fair condition considering that it was 16 or 18 years old.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—New Wireless Station.—A wireless telegraph receiving station, fitted with apparatus capable of receiving messages over a distance of 12,500 miles, has been erected at the Observatory at Perth, W.A., says *The Times*.

The number of radio stations operated and controlled in the Commonwealth was stated by the Minister of Defence recently to be 20, exclusive of naval stations at Garden Island, Jervis Bay (N.S.W.), and Williamstown. The most powerful stations were those at Perth and Sydney, which had a radius of action of 2,000 miles normally. The Port Darwin station had a radius of 600 miles during daylight. The other stations in the tropical areas were at Broome, Wyndham, Port Moresby, Thursday Island, and Cooktown, with similar radii to that of Darwin station; Misima (300 miles), Samarai (400 miles), and Townsville (1,500 miles). In addition to the stations in the Commonwealth, there were eight under the jurisdiction of the Administrator of the New Guinea territory.

Telephone Meters.—The Postmaster-General (Mr. Wise) is in favour of attaching meters to telephone circuits provided that one can be obtained that will operate reliably. The Noble meter is being tested at the State engineer's office at the Sydney G.P.O., but the department has not decided to adopt it

Canada.—New Wireless Stations.—In order that Northern Manitoba may be brought into direct communication with the other part of the province, it has been recommended that 12 wireless stations be immediately installed, at a cost of £11,000. One big station has already been built at the Pas, says *The Times*.

India.—Ships' Wireless.—The Government of India is discussing with various pnblic authorities the desirability of compelling shipping of practically all classes to install wireless telegraph apparatus. According to *The Times Trade Supplement*, it is not improbable that sailing ships will for the present be excluded from the legislation which is being drawn up, as will also small steamers engaged in "smooth-water" voyages.

Magnetic Storms.—The sunspots which accompanied the magnetic disturbances in May are now impotent specks, but last week the observatory at Skansen, Stockholm, announced the discovery of new spots on the sun, and electrical disturbances, followed by violent thunderstorms occurred in Switzerland on June 5th and 6th.

South America.—French Concession.—We are informed by the Department of Overseas Trade that the French *Vie Financière* reports that the Compagnie Générale de T.S.F. has concluded a contract for a period of 30 years with the Government of Ecuador for the working of the telephones, telegraphs, and wireless service in that State. The Government of Ecuador will pay the company an annual subsidy of 430,000 sucres (about 1,200,000 fr.), which will be increased in the event of any extension of the system. The company will deduct from the gross receipts the sums necessary for the working of the lines, for the payment of interest on the capital invested in the concern, and for the sinking fund. The State will have a share in the net profits. The telephonic apparatus will be automatic and constructed on a system which has been perfected by French experts. The telegraphic and wireless apparatus will also be on French models. The engineer who is in charge of the enterprise in Ecuador, considers that it will be possible to find in the country itself almost the whole of the necessary staff, as there are a number of excellent engineers in the Republic.

The Telegraph Service.—New Continental Circuit.—A direct telegraph circuit between London and Pragne has been opened for traffic.

The Telephone Service.—London-Paris Circuit.—In order to stop exchange speculation between Paris, London, and other capitals, the *Matin* is urging the anthorities to come to an agreement with the British and other Governments to put an end to the monopolising of international telephone lines whereby exchange speculators are able to make quick deals when exchange rates in Paris and London show a wide difference in price. The *Matin* urges that the same rate should prevail at the same moment in both cities. The method of operation of the speculators, the paper adds, is to put in as many calls as possible every day, thus keeping the lines to themselves during the day.—*Financial Times*.

United States.—New Chicago Post Office.—The new Post Office building at Chicago, the construction of which has just been begun, will have a roof upon which mail aeroplanes will be able to alight and to "take off." The building will also be connected by miniature underground electric railways with all the principal railway termini in the city, and by means of moving bands mail sacks will be carried all over the building.—*The Times*.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia. — Melbourne. — August 10th. Victorian Railways. 250 core-type impedance bonds for power signalling, with a capacity of 1,000 amperes per rail; also 50 miles of solid insulated copper wire, No. 14 Brown & Sharpe gauge, and 50 miles of solid insulated copper wire, 16 standard gauge.

July 27th. Victorian Railways. Incandescent lamps for electric car lighting: 24,000 metal filament, 46 W, 116 V; 4,000 carbon filament, 32 W, 140 V. 5-h.p. electric motor, controller and resistances, or, alternatively, 5-h.p. electric motor and equipment.*

August 31st. Electricity Commissioners. Steelwork for power station buildings, roof covering, &c.; water-tube boilers, stokers, fans, &c.; platforms and ladders, steel chimneys, flues and dampers, sooting and dust extraction equipment, ash handling plant. (June 3rd.)

August 17th. 3,000 sets of renewals for caustic soda primary cells.

August 30th. Board of Works. Four electrical centrifugal pumps, each with a capacity of twelve million gallons daily.

September 7th. Victorian Railways. Sixteen sets of air-brake equipment, 450 to 600 V, d.c., for single-deck tramcars.—*Reuter's Trade Service* (Melbourne).

Tasmania.—P.M.G.'s Department. July 11th. Switchboard material (Schedule T. 317). (June 3rd.)

Shire of Hampden (Victoria).—August 17th. Boiler-house plant, steam-driven electricity generators, transformers, meters, switchgear, cables, poles. Specifications from Mr. H C. Ingleton, Shire Hall, Camperdown, Victoria.—*Tenders.*

Bury.—June 22nd. Installation of wires and fittings for the electric lighting from the public supply of 92 houses in the Walmersley district. Specification, Mr. S. J. Watson, Electricity Works, Bury.

Belgium.—June 29th. The Belgian Post and Telegraph authorities at La Salle, Madeleine, Brussels, call for a quantity of cable heads. Copies of the specification (Cahier des Charges Special No. 618) can be obtained from the above address for 90 centimes.

Edinburgh.—June 22nd. Corporation. Electric lighting installations for houses under the Gorgie housing scheme. Specifications from Burgh Engineer.

July 11th. Electricity Supply Department. H.p. steam pipes and valves. Specification 33. (See this issue.)

Jugo-Slavia.—June 29th. Minister of Posts and Telegraphs. 18,000 kg. of g.i. wire, 80,000 curved carriers, and 80,000 porcelain insulators.*

Kirk Sandall.—June 22nd. Installation of electric light at the temporary Council School. Specifications from West Riding Education Architect, County Hall, Wakefield.

Llandaff and Dinas Powis.—June 22nd. Rural District Council. E.h.p. feeder, with switchgear sub-station equipment complete. (June 10th.)

London.—Islington.—July 4th. Electricity Committee. H.p. switchgear, flame carbons. (June 3rd.)

L.C.C.—July 11th. One 8,000-kW steam turbo-alternator and exciter, condensing plant, &c. ; seven 1,000-kW rotary converters, static transformers and accessories. (June 10th.)

Manchester.—June 21st. Education Committee. Electric lighting installations at Plymouth Grove and Upper Jackson Street Municipal Schools. Specifications, &c., from the Education Offices, Deansgate, Manchester.

June 21st. Tramways Committee. Points, tongues, crossings, and hardened-steel centres. From Mr. J. M. McElroy, general manager, Corporation Tramways, 55, Piccadilly, Manchester.

June 28th. Electricity Committee. Supply of cable requirements during six months ending December 31st, 1921. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall, Manchester.

June 28th. Electricity Department. 27,000 yards weldless-steel spigot and socket tubes. (See this issue.)

New Zealand.—Wellington.—June 28th. Public Works Department. Ten s.p. oil-filled transformers for the conversion of three-phase energy at 50 cycles, the voltage ratio being 50,000/11,000, for Waikato power scheme.*

June 28th. Supply and delivery at Lyttelton of two 50-kVA, two 100-kVA, and two 200-kVA condensers in connection with the Lake Coleridge electric power supply (Section 116).*

July 31st. Wairoa Electric Power Board. (*a*) Transformers, four 200-kVA, 11,000/1,900 single-phase units ; (*b*) Insulators, 11,000 V and 3,000 V ; (*c*) Air-break switches, 11,000 V and 3,000 V ; (*d*) Fuses, 11,000 V and 3,000 V ; (*e*) Lightning arresters and choke coils, 11,000 V and 3,000 V ; (*f*) Accessories as per schedule. Tenders to the office of Messrs. Hay & Vickerman, Wellington.*

August 9th. Public Works Department. Suspension-type porcelain insulators for the Waikato power scheme.*

Pontypridd.—Board of Guardians. June 23rd. Three months' supply of electrical material. Mr. Wm. Spickett, Clerk, Union Offices, Pontypridd.

South Africa.—July 5th. Electrification of Capetown-Simonstown and Durban-Maritzburg railway lines.

Transvaal.—Rand Water Board. September 9th. Erection of a complete installation of mechanical or other filters capable of filtering 5½ million gallons of water per 24 hours at the Vereeniging main pumping Station (Contract No. 232). Copies of the contract documents may be obtained from the Chief Engineer, Rand Water Board, Johannesburg, upon a deposit of three guineas.*

Barberton.—July 29th. Municipal Council. Plant in connection with the proposed scheme for the supply of electricity :—Two steam boilers, two 75-kW steam-driven alternators, switchboard, and instruments, steel chimney piping, feed pumps, cables, &c., steel poles, conductors, &c., transformers, house service meters, &c. Specifications, £2 2s., from Prof. W. Buchanan, 75, Louis Botha Avenue, Johannesburg.

Sudan.—June 30th. Sudan Government. Pumping machinery, consisting of Diesel or semi-Diesel engines and direct-coupled centrifugal pumps, capable of lifting 1,200 litres of water per second against a static head varying between 2·5 and 8 metres. Machinery must be delivered at Khartoum North by February 28th, 1922. Specifications, drawings, and conditions of tender may be seen at the office of the Sudan Agent, War Office, Cairo, Egypt. Tenders to Superintending Engineer, Department of Agriculture, Sudan Government, Atbara.—*Reuter's Trade Service.*

Trimdon.—June 11th. Electric light extension from Trimdon Grange to Trimdon Village, including the lighting of Trimdon Village with electricity. Specification, Mr. T. W. Wilkinson, Clerk to the Council, 24, South View, Trimdon Grange, S.O. Deposit, £2 2s. (returnable).

Uruguay.—Monte Video.—August 18th. State Electricity Works. Steel petroleum tank, Worthington duplex steam pump for oil, 250 metres steel tubing.*

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—Generating plant for the Morwell power scheme. The *Manchester Guardian* says the accepted contract of Messrs. Metropolitan-Vickers Electrical Co., Ltd., is for five 12,500-kW turbo-alternators ; the surface condensers will be made in Victoria, while an American firm will supply the switchgear and transformers ; delivery of the first set has been promised in four months, with completion in 17 months.

Bedford.—Maintenance of school lighting for six months for Bedford Education Committee, Gollings & Ayres.

Belgium.—Seven concerns, among them three British—the British Insulated & Helsby Cables, Ltd., W. T. Henley's Telegraph Works Co., Ltd., and the Metropolitan-Vickers Electrical Co., Ltd., last week submitted tenders to the Belgian Post and Telegraph authorities in Brussels for the supply of a quantity of telephone cable. The tenders ranged from 355,926 fr. to 1,334,644 fr., the lowest being that of the Société Electricité et Mécanique, of Brussels.

Bradford.—The Electricity Committee recommends the purchase from the Ministry of Munitions of the electrical plant, switchgear and cables, installed at the Phœnix Dynamo Works of the English Electric Co., Ltd., at Thornbury, Bradford. The price is £2,370.

Electricity Committee :—

John Spencer, Ltd.—Supply of steam piping for works, Valley Road, £213.
Clay Cross Co., Ltd.—Cast-iron piping, for cooling towers, £730.

Tramways Committee :—

Cammell, Laird & Co., Ltd.—75 Siemens open-hearth nickel chrome steel axles, £611.
Thermit, Ltd.—500 Thermit welding portions, at 19s. 6d. each, plus 25 per cent.
Taylor & Parsons, Ltd.—48 dozen Dreadnought files, at 54s. per dozen.

Doncaster.—Electricity Committee. Circulating-water piping at the generating station—Brightside Foundry and Engineering Co., Ltd., £1,289.

Manchester.—Electricity Committee. Accepted. Park Royal Engineering Works, Ltd., for the supply of high-pressure cubicles (sub-station) for 12 months.

Staffordshire, Wolverhampton and Dudley Joint Committee for Tuberculosis.—We understand that while the tenders mentioned under this heading in our last issue have been considered, it is not correct to say that they have been accepted. The installation concerned (Prestwood Sanatorium) will be of exceptional interest, owing to the use of water power for generating electricity for lighting, power, and heating the water used in and about the institution. The scheme has been designed throughout by Messrs. Henry Lea & Son, of Birmingham.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Friday, June 17th. At Albemarle Street, W. At 9 p.m. Lecture on "Chemical Combination and the Structure of the Molecule," by Sir J. J. Thomson, F.R.S.

Batti-Wallahs' Society.—Monday, June 20th. At the Holborn Restaurant, W.C. At 1 p.m. Last luncheon of the session.

Faraday Society.—Wednesday, June 22nd. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

Physical Society of London.—Friday, June 24th. At the Imperial College of Science, South Kensington. At 5 p.m. Ordinary meeting.

Report on the Electrical Cable Industry.—A report of a Sub-committee to the Standing Committee on Trusts, just issued, deals with the electrical cable industry (Cmd. 1332. Price 1d.). We are unable to deal with it in this issue ; but, briefly, the report states that the prosperity of the industry is largely due to the Cable Makers' Association, which, by its organisation and research, initiated and has maintained a high standard of quality, thus securing the confidence of buyers both in this country and abroad. There is no evidence that the Association has acted unreasonably, and there was a marked absence of hostility towards the Association on the part both of users and of non-associated firms. The Sub-committee finds that while non-associated firms are able to produce equally reliable cables at prices about 10 per cent. lower than those of associated firms, the largest purchasers, as a rule, are content to pay the additional price as in the nature of an insurance against breakdown and a guarantee of durability.

RAILWAY ELECTRIFICATION IN CENTRAL EUROPE.

By S. PARKER SMITH, D.Sc.

In the issue of March 5th, 1921, of the *Electric Railway Journal*, an article by E. C. Zehme, a Privatdozent in Berlin, appeared under the above heading.* In this article the following statements were made :—

> It has been customary to consider Germany, Switzerland, Austria, and Sweden, as the advocates of the single-phase system, but they are not so to-day. Only Switzerland and Austria are extending their single-phase roads at present, whereas no definite conclusions have as yet been reached as to the standard system in Germany, Sweden, Norway, and Holland, and even in Italy.
>
> Recently doubts have been advanced from several sides as to the practicability of the single-phase system for the main railroads of Germany. . . . Nevertheless, the authorities still manifest a preference for the single-phase system, and have decided to call an International Congress this year in Germany to go over the whole matter, presumably hoping that the present view-point of the Prussian State Railways with regard to the system will be justified.
>
> The Swedish State Railways plan to electrify additional lines, principally in the South, and primarily for passenger traffic. Here the question of system has again been studied very carefully. . . . Although the single-phase system is estimated to be somewhat more economical than the other, the difference is small, and is being considered in connection with the inductive disturbances in telegraph and telephone lines caused by the alternating-current operation. A special commission on this subject has studied the phenomena carefully, together with the remedy for the trouble, and has presented a long report. This is unfavourable to the single-phase system.

That these allegations do not appear to be well founded, as far as Germany and Sweden are concerned, would appear from the following refutations :—

An official announcement appears in the *Deutsche Allgemeine Zeitung* of May 14th, 1921, of which a translation is given below :—

The Electrification of Railways.

> In the American technical paper *Electric Railway Journal*, a Privatdozent, E. C. Zehme, of Berlin, published an article entitled "Electrification in Central Europe," in which, among other things, it was stated that Germany had not yet finally decided what system to adopt for electric railways, and, in order to settle this question, intended to call shortly an international congress. These statements are not correct. The German National Railway Administration has, like the railway administrations of the several German States before it, as far as electrified lines are concerned, always regarded the simple single-phase current as the only system to be considered for its long-distance railways, and has never, not even temporarily, deviated from this standpoint. As all the existing long distance railways of the German National Railway Administration are operated with single-phase current, so also the single-phase current alone has been considered for the electrification of further sections. Under these circumstances, there is also no object in calling a congress to discuss the question of the systems. Though in February last there was an exchange of opinions between the Railway Administration and well-known outside experts on questions of electrification, this was chiefly in connection with the question of supply.

The following statement was also supplied by Mr. F. Ofverholm, the chief electrical engineer of the Swedish State Railways :—

> I have now got the number of March 5th, 1921, of the *Electric Railway Journal*, and found the article by Mr. Zehme. This article is not correct at all. First the total length of the electrified railroads in Sweden is now 260 miles, out of which only 20 miles is direct current, and the other 240 all single phase.
>
> Then Mr Zehme states that the report about the disturbances in telegraph and telephone lines was unfavourable for single-phase. I have sent you that report with letter of September 3rd, 1920, and you can judge for yourself. I think you will find the contrary. At the end of this year we shall have 400 miles of single phase roads and the old 20 miles of d.c. roads in this country. The statement that we are not extending our single-phase roads is, therefore, surely not correct.

In these days when the "battle of the systems" is so much to the fore-front, misleading statements such as those quoted from Herr Zehme's article should be carefully avoided. The issues at stake are far too important for all countries, to allow such mis-statements to pass uncorrected.

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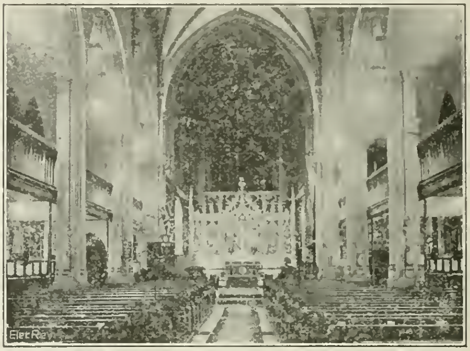
* The article was quoted in the Electrical Review of May 6th, 1921, p. 574.

NOTES.

Luncheon to Mr. Hughes.—The Rt. Hon. W. M. Hughes, the Prime Minister of the Commonwealth of Australia, will be the chief guest at a public luncheon to be given in his honour by the British Empire Producers' Organisation, at the Hotel Victoria, on Wednesday, the 22nd inst. The Chairman of Council of the Organisation, Mr. Ben H. Morgan, will take the chair. Early application for tickets, price 10s. 6d. each, should be made to the Secretary, 5, Old Queen Street, S.W. 1.

Church Lighting.—The lighting of a church presents to the illuminating engineer a problem which is difficult on account of various reasons. In an edifice of this nature, special care must be taken not to offend the susceptibilities of those who look with some apprehension upon the advent of "modernism" in connection with religion. It is therefore necessary to choose a system which combines efficiency with unobtrusiveness. Messrs. W. T. Henley's Telegraph Works Co., Ltd., have sent us photographs of two installations which Messrs. Stanley Gaynor & Co., of Cardiff, have recently completed at Bath, using the Henley wiring system and Holophane fittings. The above illustration shows the lighting of St. Saviour's Church, Bath, which, as far as the exigencies of reproduction permit, shows very clearly the effectiveness of the work.



London Electricity Statistics.—The London County Council Electricity Supply Returns (1918-20), just published, give some interesting statistics.

The summary of units sold by the undertakings in the Administrative County of London affords a record of the progress of these concerns. We find that (taking round figures) for 1919 the municipal undertakings sold 168 million against the companies' 244 million kWh. As regards the increase of units sold from 1913 to 1919, among the municipalities Woolwich shows the biggest increase, being 209 per cent.; Fulham comes next with 76 per cent., then Stepney with 75 per cent. Among the companies, the South Metropolitan Co. tops the list with 135 per cent. increase, the County of London Co. coming next with 65 per cent.

Coming to the extra-London area, the number of units sold by the municipalities in 1919 was 117 million, and by the companies 72 million kWh.

If we take the whole of the area of Greater London, we find that the units sold by the municipal undertakings were 285 million, and the companies' sale 312 million kWh.

As regards the general progress in the Administrative County area, the total of units sold by all undertakings shows a good upward tendency. In 1907 the total units were 185 millions, rising to 319 millions in 1913, and to 412 million kWh in 1912. We look, however, to see this rise assume a precipitous gradient in the near future when the supply undertakers of London are given full scope for their ambitions and the interlinkers are allowed to work out in reality those dazzling dreams now only on paper.

The Conjoint Board of Scientific Societies.—The fourth report of the Board shows that it has received evidence that scientific investigation is being seriously hampered by the heavy cost involved in the publication of results. An exceptional number of papers is being communicated to the scientific societies including many held up during the war, while the resources of the societies which have not increased, are insufficient at present prices, to publish even the normal pre-war number. The country is thus in danger of being seriously handicapped at a time when the re-habilitation of industry is in most serious need of scientific assistance. Much of the report is occupied with a short abstract of the third report of the Committee on the Water Power of the Empire. It is shown that too little is being done to ascertain the total resources, or to secure uniformity in investigation and record. It is urged that steps should be taken to convene an Imperial Water Power Conference in London, at which various Dominions and the dependencies of the Empire should be represented. The outcome of such a conference might well be the creation of an Imperial Water Power Board, with extensive powers to carry out a comprehensive policy for stimulating, co-ordinating and, where necessary, assisting development throughout the Empire.

X-Ray Photographic Exhibition.—An exhibition of X-ray photographs has been opened at the premises of the Royal Photographic Society; it has been arranged by the Röntgen Society, and will remain open for the whole of this month.

Automatic Hydro-electric Plant.—In a recent article the *Electrical World* gave some interesting particulars of the working of an automatic hydro-electric plant at Cedar Rapids, Iowa. This plant, owned by the Iowa Railway and Light Co., has been in operation for three-and-a-half years, and its success has been so marked, and it is so much more reliable than hand-controlled stations, that the future policy of the company will be to equip all present plant with automatic control, and all new developments will be automatic. It is estimated that from $3,600 to $4,800 has been saved on labour charges alone. The station has an output of about 7,500 000 kWh per year, and the average annual maintenance and operation charge has only been $178, resulting in a cost for delivered power of ·45 cent per kWh. With the article appears a table of particulars of a number of automatically-operated stations which have been built or are in course of construction. One of these, completed in 1919, is that of the Ontario (Cal.) Power Co. This has a capacity of 500 kVA, and power is generated at a pressure of 11,500 V. In this the master starting element is a remote hand-operated switch. The largest plant of this kind, which is being erected by the Washington Power Co., consists of a 12,750-kVA synchronous generator working at a pressure of 4,200 V. This will also be put into operation by a remote hand-operated master switch.

Economy in Collecting Accounts.—According to Mr. J. R. Kaiserman, manager of the Livingston branch of the Montana Power Co., an appreciable saving of time and expense is made if the meter reader makes out the bill and leaves it with the consumer when he calls to read the meter. The system has been in operation for three years with satisfactory results, the average saving being estimated at 2½d. per month per consumer. Details of the system are given in the *Electrical World* of May 28th, 1921.

Melting Non-ferrous Metals.—A correspondent of *Chemical and Metallurgical Engineering* complains that the author of a recently-published article upon the comparative merits of gas-, coke-, coal-, oil- and electrically-heated furnaces chose an example of very indifferent character as a representative electrically-heated furnace plant. The author expressed his satisfaction at finding a gas furnace which would melt a 1,100-lb. charge of brass in 42 minutes the fuel cost being 32·2 c. per 100 lb. The writer of the letter points out, however, that he knows of half-a-dozen plants in which 2,000-lb. charges are electrically melted in less than forty minutes and at a cost of less than 17 c. for power.

Electrically-Propelled Ships.—The British Admiralty, the *Daily Mail* understands, is considering the adoption of electric propulsion as an experiment in one of the four new £9,000,000 battleships, the plans for which are now being decided.

Electron Tubes in Heavy-Power Service.—According to Dr. Albert W. Hull, of the research laboratory, General Electric Co., before the A.I.E.E., at its annual meeting in New York, on May 20th, "One year will see these tubes [electron tubes] in use as kenetron rectifiers for series arc lighting. Five years will see them in sub-stations, replacing rotary converters. In 10 years they will be on electric locomotives, either as rectifiers, allowing the use of direct-current motors, or as variable-frequency alternators, taking their power from a high-tension, direct-current trolley line. Twenty years will see direct-current transmission lines fed through transformers and kenetrons, at any convenient point by alternators of any frequency, and tapped by the same tubes acting as magnetron alternators, as some equivalent pliotron or combination alternator."

Dr. Hull described the new vacuum tube, which is called "magnetron" because the valve control is accomplished by means of a magnetic field. Although the magnetron has been used only for weak currents, he showed a magnetron tube with an anode 4 in. (10 cm.) in diameter and 12 in. (30 cm.) long, which had been operated at 5 kW output. With larger filaments and water cooling, these tubes would be capable of handling hundreds of amperes.—*Electrical World.*

The Batti-Wallahs' Society. — Mr. A. J. Greenly, Honorary Entertainment Secretary, has addressed a letter to the members with regard to the luncheon on June 20th, at the Holborn Restaurant, at 1 o'clock, which marks the close of the luncheons until after the summer holidays. There is to be no speaker; this meeting is reserved for society matters. He invites members to come without fail, and to offer concrete suggestions for furthering the objects of the Society.

Cast-Iron Research.—The Secretary of the Department of Scientific and Industrial Research announces that a licence has been issued by the Board of Trade to the British Cast-Iron Research Association, the secretary of which is Mr. Thomas Vickers, Central House, New Street, Birmingham.

Fire.—Damage amounting to several thousands of pounds was caused by a fire which broke out at the works of the Cable Accessories, Ltd., Dudley Port, recently. Three fire brigades were requisitioned to subdue the outbreak. The damage is covered by insurance.

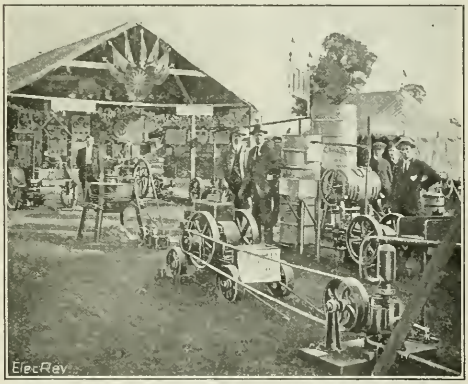
The Theory of Relativity.—On Thursday last week, at the University of Manchester, before an audience of about 1,000 persons, Prof. Albert Einstein gave his first address in this country on his theory of relativity. Before the lecture, the honorary degree of Doctor of Science was conferred on him.—*The Times.*

On Monday evening Prof. Einstein lectured before a very large audience at King's College, London.

Service Notes.—Further ex-officers have been posted to the Defence Force in connection with electric light companies and motor companies. Warrant Telegraphist R. W. Craig has been posted to the *Vulcan*, depôt ship for submarines at Chatham, from the 25th inst. Warrant Electrician P. J. Freeman has been appointed to the *Vernon*, torpedo school ship at Portsmouth, from the 4th inst. Recruiting for the various electrical departments of the Navy and Army is doing very well at the moment, the state of the labour market being favourable to enlistments, as well as the general better conditions of service and better pay in both Army and Navy.

Electrical Farming in Russia.—Strenuous efforts are now being directed to the improvement of Russia's agricultural industries, and one of the latest proposed expedients is the mobilisation for agricultural purposes of the portable electrical field sets that can be spared, it is hoped, by the military department now that the calls on the Army are neither so exacting nor extensive as in the immediately preceding years. These portable sets which were used for searchlights, wireless telegraphy, &c., and which have low-voltage dynamos, will be put to work in the fields in the course of this summer. They may be said to weigh on their carriages close on a ton, and will be able to serve a number of peasant allotments, simultaneously driving thrashers, cutters, and other small machines in the various districts which they will visit. When the season's work is over, they will be returned to the War Department. Thousands of them have been made, and it is asserted that 70 per cent. of them are in good condition for farming purposes.

Electricity in Farming.—The accompanying illustration shows the exhibit of Messrs. J. Bustin's Electrical Works at the recent Oxfordshire Agricultural Show, held at Banbury, and described in our issue of June 3rd. The photograph discloses a large number of applications which can be found for electricity in agricultural work.



Water Power in Greece. — According to the United States Consul-General at Athens, a Swiss engineer has been employed by the Greek Government to investigate the water power in the State of Macedonia, and he has made an interesting report on the subject after a study of the falls of the rivers of Kladovo, Vodena, Niaoussa, lower Aliakmon, and high Aliakmon. Special tables have been prepared showing the estimated power of the falls of Kladovo to be 17,500 h.p.; those of Edessis, 26,000 h.p.; of Niaoussa, 22,000 h.p.; those of the lower Aliakmon, 143,000 h.p.; and those of high Aliakmon as 143,000 h.p. The total water power available from these falls is estimated at about 350,000 h.p.

It is estimated that the exploitation of the falls mentioned above will produce annually about 120,000,000 kWh. The production of electricity from the falls of western Macedonia would be sufficient not only for the motive power and lighting of the three cities of Athens, Piræus, and Saloniki, but also for the motive power of the Larissa railway.

The consumption of electrical energy at Athens and Piræus is about 40,000,000 kWh annually, and at Saloniki 9,000,000 kWh. The plants for the development of the waterfalls would cost approximately between 160,000,000 and 180,000,000 drachmas (£6,000,000 to £7,000,000). On the basis of this expenditure, a kWh would cost from 12 to 13 lepta (1¼d.). As Greece is dependent upon the importation of coal for a large part of its fuel supply, the employment of its water power is of vital importance in the development of the national industries.

The Water Power Resources of Ireland.—A great deal of attention has been directed in Ireland to the newly issued report of the Board of Trade Sub-Committee on water-power resources in that country. Sir John P. Griffith was chairman of the sub-committee, which recommends development as urgent, and states that the most effective and economical method is to construct the necessary works in the channels of the rivers, and not to attempt to seek high falls by the construction of costly head race channels. Detailed investigations were made of the Lower Bann, the Lower Shannon, the Lower Erne, and the Liffey. The investigations show that considerable power is available in these rivers, as well as in the high level lakes in Donegal, Connemara, Kerry, and Wicklow. The development of tidal power should be examined by a Special Commission.

In the Liffey, Dublin City and its adjoining district have at disposal water-power sufficient to provide electricity in excess of that at present supplied by the seven existing generating stations, and there is also a considerable margin of power for future extensions.

The engineers who conducted investigations in respect of the Liffey, Messrs. J. W. Griffith and H. H. Jeffcott, state that six hydro-electric power houses on the river are proposed, the principal sites being at Poulaphouca, Golden Falls, and Salmon Leap. Automatically controlled power stations are proposed at Lockstown, Cloghleagh, and Connell Ford. The installed plant will have a total capacity of 29,600 e.h.p., and the estimated cost of works and plant is £920,000 at present-day prices. The estimated cost is £31 per e.h.p. installed, or £111 per average e.h.p. developed during a year at the power sites. The cost of transmission to Dublin, including transformers, is estimated at £293,000.

Mr. Theodore Stevens, giving evidence before the Subcommittee, dealt with the river Erne, and proposed the construction of a canal or head race over 5½ miles long to carry the water to a power station with a head of 125 feet.

Mr. Stevens's proposals include the erection of four hydro-electric power stations on the river Shannon between Killaloe and Limerick with an installed electrical horse power of 65,900, at a total cost at current prices of £2,834,000, or at the rate of £43 per installed e.h.p. The average annual output obtainable would be 52,500 e.h.p. at a capital cost of £54 per average e.h.p. Similarly he proposes four hydro-electric power stations on the Erne between Beleek and the sea, with an installed electric horse power of 71,300, at a total cost of £2,060,000, or at the rate of £29 per installed e.h.p. The average annual output would be 45,500 e.h.p., at a capital cost of £46 per average e.h.p.

As to the river Bann, Mr. Charles Meik proposes the removal of Toome weir, the dredging of the bar at Toome, and the formation of an improved channel from Lough Neagh to Lough Beg. Total estimated cost £360,000. All the power available could be used by the milling interest of the district.

INSTITUTION NOTES.

Institution of Electrical Engineers. — NORTH-WESTERN CENTRE.—The annual report of the Committee for the session 1920-21 states that eleven general meetings and one lecture were held, at which the average attendance was 110. The membership as at May 25th, 1921, was 1,214, as compared with 984 in the previous year. A memorandum signed by 56 members requests the institution of informal meetings, and the matter is under consideration. The Preston Sub-Section has decided to discontinue its activities, as its meetings have overlapped those of the English Electric Engineering Society, which already embodies most members of the Sub-Section. The newly-elected chairman is Ald. W. Walker, and the vice-chairmen are Messrs. A. S. Barnard and G. A. Juhlin.

Students' Section.—The Committee of the Students' Section of the Centre reports that the average attendance at seven meetings was 40.

Liverpool Sub-Centre.—The Committee reports an increased membership of 73, bringing the total up to 367. Mr. G. H. Nisbett has been elected chairman for the ensuing session.

Institution of Civil Engineers.—A very fine programme has been arranged for the Engineering Conference which is being held on June 28th, 29th and 30th and July 1st under the presidency of Mr. John A. Brodie. On June 28th, Sir George T. Beilby, F.R.S., will deliver the 27th James Forrest Lecture on "Fuel Problems of the Future." Most of the discussions will be of more or less interest to electrical engineers, but mention may be made of those in Section VII, Electricity Works and Power Transmission, presided over by Sir John Snell. On June 29th, Mr. R. O. Kapp will open a discussion on "Low Power-Factor"; Mr. J. Dalziel will deal with "Battery Locomotives" on June 30th; and discussions will take place on July 1st on "The Economic Limits of Distribution from Coal-fired Stations," "Low-voltage Overhead Distribution" (Mr. B. Welbourn) and "The Mechanical Advantages of Electric Locomotives compared with Steam" (Sir Vincent L. Raven, K.B.E.). Among many visits which have been arranged are several to power stations and electrical works. On June 29th Sir Alexander B. W. Kennedy, F.R.S., will exhibit lantern slides reproduced from photographs taken by him of the war area in France and Flanders.

Royal Society of Arts.—The Albert Medal of the Society for 1921 has been awarded by the Council to Prof. John Ambrose Fleming, M.A., D.Sc., F.R.S., in recognition of his many valuable contributions to electrical science and its applications, and especially of his original invention of the thermionic valve, now so largely employed in wireless telegraphy and for other purposes.

American Institute of Electrical Engineers.—At the annual meeting on May 20th, Dr. W. McClellan was elected president for the ensuing year. The vice-presidents were Messrs. W. A. Hall, N. W. Storer, W. A. Del Mar, C. G. Adsit, J. C. Parker, F. W. Springer, H. W. Eales, R. Sibley, O. B. Coldwell, and F. R. Ewart. The managers were Messrs. A. G. Pierce, R. B. Williamson, and H. A. Pratt.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Stockton-on-Tees Town Council has appointed Mr. S. G. MARSTON, of Sunderland, as general works manager at the Electricity Works at a salary of £650 per annum.

Upon resigning his position with the Ascot and District Gas and Electricity Co., Mr. E. J. H. BLUETT, electrical engineer to the company, has been presented with a silver tea set and tray by the directors, and a malacca horn walking stick, suitably engraved, by the staff. Mr. Bluett resigned his position at the end of May in order to enter into partnership with Mr. A. T. Archer in the purchase of the Sunningdale business of Messrs. John Drake & Co., electrical engineers and ironmongers.

Mr. F. H. HOWELL has been appointed London representative of the electrical cooking and heating department of the Falkirk Iron Co., Ltd., at Craven House, Kingsway, W.C.1. For over 15 years Mr. Howell has been on the staff as district and showroom manager for the County of London Electric Supply Co., Ltd., but this included a period of nearly five years in the R.F.A. He has specialised in electric cooking apparatus from a practical as well as selling point of view, and has recently spent several weeks at the Falkirk Iron Works, where "Falco" appliances are designed and manufactured.

Mr. CHARLES H. GASSON, late of the Electrical Engineering & Equipment Co., Ltd., has now taken up the position of sales manager to Messrs. Hamilton & Liddaman, 12, Charing Cross Road, London, W.C.2.

Mr. HAROLD E. WEBB, A.M.I.E.E., who has a long connection with Messrs. Bruce Peebles & Co., Ltd., has been appointed their London manager.

Mr. JAS. BASTIAN has been appointed London representative to the Cantie Switch Co., Ltd., of Nottingham.

It is announced that Mr. WINSTON CHURCHILL has accepted the chairmanship of the Imperial Communications Committee.

Will.—The late Dr. W. J. I. BRUCE, who died a victim to X-ray injuries, left £6,936.

NEW COMPANIES REGISTERED.

Minirisk Co., Ltd. (175,135).—Private company. Registered June 9th. Capital, £1,500 in £1 shares. To carry on the business of lock makers, manufacturers of electrical and other fittings, constructional and electrical engineers, &c., and to adopt an agreement with J. B. Boland and H. V. Barlow. The permanent directors are: J. B. Boland, 33, Sandileigh Avenue, Withington, Manchester; W. S. Mockett, The Orchard, St. Peters, Broadstairs, Kent. Qualification of permanent directors, 200 ordinary shares: of ordinary directors, 100 shares. Remuneration (except managing director, if any) as fixed by the company. Secretary: W. S. Mockett. Registered office: 47, Victoria Street, S.W.

H. G. Osborn, Ltd. (175,127).—Private company. Registered June 9th. Capital, £1,000 in £1 shares. To carry on the business of electrical and mechanical engineers, manufacturers of and dealers in electrical accessories and mechanical novelties, electrical, magnetic, telegraphic, telephonic, and other appliances, &c., and to adopt an agreement with H. G. M. Osborn. The first directors are: H. G. M. Osborn (managing director), "Westfa," Princes Park Avenue, Golder's Green, N.W.11; Mrs. Amy Osborn, "Westfa," Princes Park Avenue, Golder's Green, N.W.11. Registered office. 9, Rathbone Place, Oxford Street, W.1.

Waverley Glass Works, Ltd. (11,748).—Private company. Registered in Edinburgh June 3rd. Capital, £5,000 in £1 shares. To carry on the business of glass manufacturers, blowers, workers, and pressers, decorators, cutters, engravers, and etchers, electricians, &c. The subscribers (each with one share) are: R. Dalzeil, 2, Dalzeil Place, Edinburgh, glass manufacturer; G. F. Walker, 10, Lochside Street, Crossmyloof, Glasgow. The first directors are not named. Solicitors: Mackay & McIntosh, 124, St. Vincent Street, Glasgow.

Victoria Electrical (Manchester), Ltd. (175,145).—Private company. Registered June 9th. Capital, £6,000 in £1 shares. To take over the business of an electrical engineer and contractor, &c., carried on by J. R. Reef as the "Victoria Electrical Co.," in London, Manchester, and elsewhere. The permanent directors are: R. Hodgkinson (managing director), 43, Welbeck Road, Heaton, Bolton; J. R. Marsh, St. Kilda, 1, Lathom Road, Southport; J. R. Reef (managing director), 59, Camp Street, Broughton, Manchester. Qualification, £50. Secretary: J. R. Marsh. Registered office: 27, Berry Street, Buxton Street, London Road, Manchester.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Tees Power Station Co., Ltd.—Satisfaction to the extent of £21,200 on various dates from February 3rd to March 7th, 1921, of trust deed dated May 7th, 1918, securing £600,000.

Hill Bros. (Magnetos), Ltd.—Particulars of £15,000 debentures authorised June 1st, 1921; whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital (if any).

Webb's Crystal Glass Co., Ltd.—Mortgage on Dennis Park Glass Works, Stourbridge; Medway Glass Works, Queenborough, Kent; and Royal Castle Glass Works, Hatton, Tutbury, Derbyshire, dated June 1st, 1921, to secure all moneys due or to become due from company to Lloyds Bank not exceeding £25,000.

W. J. Furse & Co., Ltd. (121,420).—Return dated May 13th, 1921. Capital, £35,000 in £1 shares (9,000 cumulative preference and 26,000 ordinary), 9,000 cumulative preference and 21,029 ordinary shares taken up, £10,735 paid, £19,294 considered as paid. Mortgages and charges: £3,000.

Northallerton Electric Light & Power Co., Ltd. (59,301).—Return dated March 9th, 1921. Capital, £6,500 in 2,900 preference shares of £1 each and 12,000 ordinary shares of 6s. each, 1.151 preference and 4,921 ordinary shares taken up, £2,627 6s. paid. Mortgages and charges: £3,900.

Foster Construction Co., Ltd.—Satisfaction in full on May 6th, 1921, of mortgages dated May 16th and August 9th, 1918, securing all moneys then due or to become due from company to bankers. Mortgage on certain properties at High Street, Plaistow, dated May 7th, 1921, to secure all moneys due or to become due from company to London Joint City and Midland Bank, Ltd., also registered.

Northampton Electric Light & Power Co., Ltd.—Issues on May 10th of £440, on May 23rd of £1,400, and on May 25th, 1921, of £100 second debenture stock, parts of a series already registered.

Aladdin Renew Electric Lamp Corporation, Ltd.—Issues on May 12th and 20th, 1921, of £2,000 debentures, part of a series already registered.

Woods-Gilbert Rail Remodelling Co., Ltd.—Debenture, charged on the company's undertaking and property, present and future, including uncalled capital, dated May 18th, 1921, to secure all moneys due or to become due from company to Barclays Bank, Ltd.

CITY NOTES.

Electric Construction Co., Ltd. The annual general meeting was held on June 9th at Winchester House, E.C., Mr. Philip E. Beachcroft presiding. The chairman expressed the directors' pleasure that they were able to submit accounts which surpassed those of any previous period. The gross profit on manufacturing and contracting for the year under review showed an increase of £44,502. The credit side of the profit and loss account amounted to £169,977, being £41,118 greater than last year. The expenditure aggregated £86,867, being an increase of £24,177. The net profit for 1920-21 was £83,110, an increase of £16,941. It might seem that they had been ultra cautious in not distributing a greater bonus than 2½ per cent. The question, however, had had their most careful consideration, and if times had been normal they would not have hesitated to increase the bonus, but having regard to the prevailing financial and industrial conditions they came to the conclusion that the best interests of the shareholders would be served by making no increase in the distribution. With regard to the balance sheet, stock in trade and work in progress showed an increase of £77,673. It was intended by the Finance Bill, 1921, to grant relief in respect of loss on trading stocks, and although their liability for E.P.D. terminated on March 31st last, they would be entitled to reclaim within certain time limits any loss which might be incurred on stock in hand on that date. Investments showed a reduction of £36,749. This was caused by realisations necessary to finance the larger volume of stock at higher prices, and to complete the important works extensions described last year. On the other hand, cash at bankers was £23,387 greater. On the other side of the account creditors and credit balances were £21,919 greater, but that was accounted for by taxation, their actual trade liabilities being less than a year ago. When they considered the financial stringency which had prevailed necessitating issues of capital by many concerns on very onerous terms, they had every reason to congratulate themselves on the strength of their financial position. If their recommendation was adopted, the general reserve fund would stand at £120,000, and he need not point out that the liberal contributions to that fund in the past had largely contributed to the comparative ease with which they had encountered the trying conditions of the past two years. Regarding the outlook for the new financial year, the statement in the report that recently orders had been difficult to obtain would not have caused surprise, as the industrial conditions throughout the country, in consequence of the coal dispute, were deplorable. He did not consider that this dispute was altogether to be laid at the door of the miners, and he thought that had the coalowners and miners been left to themselves to settle their own differences without the intervention of the Government, the matter would have been settled sooner. As it was, about 3,000,000 (of whom over 1,000,000 were miners) were now unemployed, and their ranks were being increased daily, and unless a speedy peace was attained there was grave risk that many industries in the country, as well as the mines themselves, would to a great extent be irremediably destroyed. Coal had been regarded as the life blood of industry, but the present stoppage of supply had to some extent found its remedy in the use of alternative heating agents. The mine leaders should take cognisance of that fact, and the miners themselves realise that it was more than possible that their source of employment was endangered by the use of oil gases for many, if not all, industrial purposes. Even if the coal dispute were settled there could be no immediate recovery because manufacturers of pig iron, steel, and other staple articles of consumption would be reluctant to resume operations until they were satisfied that they could produce at prices which would compete with foreign manufacturers. Before the country could recapture its export business or meet foreign competition in the home markets lower costs of production were essential, and those could only be brought about by a lower standard of wages and salaries and a lower margin of profit, and by increased output. British taxes, compared with those of other competing countries, were absolutely crushing. They were three times heavier than French ones, and six or seven times those of Germany, and about four times heavier than those of the United States. In the electrical industry the number of inquiries for plant and apparatus indicated that there was a large amount of work waiting to be done, but buyers would not place their orders in the expectation that prices would fall. The result was that new business for the moment was very unsatisfactory, but many factories were employed on orders which were placed several months ago. The chairman finally referred to the death of Sir James Pender.

United Electric Tramways of Montevideo, Ltd. The directors' report for the year ended March, 1921, states that the gross receipts of the tramway system for the year ended October, 1920, were at an exchange of $4.7 to the £, £516,130, an increase of £72,436. Unfortunately operating expenses also showed a continuing increase, mainly due to higher wages and taxation, and were larger during the year by £52,483, leaving a net increase of £19,953, but remittances had been affected by the fall in exchange. The passengers carried numbered 63,220,875, an increase of 8,336,956. The car miles run were 8,830,112, an increase of 1,073,478. Fifteen motor cars and 14 trailer cars have been ordered, and four new cars are being constructed in the company's workshops in Montevideo. This rolling stock should be ready before the end of the year. After providing for administrative expenses and charging £46,539 for debenture interest, the credit balance is £74,907, plus £7,032 brought forward. £5,961 has been put to debenture stock redemption, £2,500 redemption of preference and ordinary capital, £30,000 to renewals and contingencies. An interim dividend at the rate of 6 per cent. per annum, less tax, has been declared on the cumulative preference shares, and a final dividend of like amount has been recommended. It is proposed to pay 4 per cent., less tax, on the ordinary shares for the year, and to carry forward £8,477.

Callender's Cable and Construction Co., Ltd. The report for 1920 shows a balance to the credit of profit and loss account of £182,920. Debenture interest absorbs £13,500, preference dividend £41,000, depreciation of buildings, plant, and machinery £30,000, depreciation of office furniture £500. The balance brought forward was £105,803, and the available balance is £203,723; 15 per cent. (less tax) on the ordinary shares requires £75,000, there is put to reserve for corporation profits tax £7,500, the balance of the new issue expenses £13,122 is written off, and £108,101 is carried forward. During the year covered by the accounts the volume of business increased considerably, and, in spite of enhanced costs of materials and labour and many difficulties in manufacturing, the sum available as profit on the 12 months' operations is in excess of that of any previous year. In June last, new capital was raised to meet the expansion of the company's business and also the outlay on the new buildings and plant at Erith. This new capital was available only in the latter part of the year, and, consequently, the full benefit therefrom was not experienced during the period now under review. So as to bring the capital of the company more into line with other industrial undertakings, the £5 shares, both preference and ordinary, were, in May, 1920, subdivided into five shares of £1 each, and it is believed that this will be of advantage to the shareholders. The relations between the company and its employés have been excellent. A satisfactory arrangement has recently been completed on a sliding scale basis with the workpeople at Erith and Leigh, and it is confidently anticipated that this will prevent labour disputes in the future. It is to be regretted that considerable difficulty has lately been experienced owing to the miners' strike, which rendered it impossible to obtain fresh supplies of fuel. The cost of production, owing to higher wages and shorter working hours, and heavier costs generally, has rendered it difficult to compete in several foreign and overseas markets. It is hoped, however, that the lessened prices of raw materials now current and the recent arrangement with regard to labour will enable the company to restore its foreign trade connections to their former importance. The new workshops referred to in last year's report have now been completed, and the manufacture of e.h.t. cables for 30.000 volts and upwards is proceeding satisfactorily. Important orders have already been received for such cables. The reorganisation of the Picardy works for the manufacture of telephone cables has also been completed, and large contracts have been secured. The Anchor Cable Co., Ltd., has had a busy year, and has secured satisfactory profits.

The French Electrical Industry. Information concerning the electrical industry in France is contained in the annual report of the Compagnie Francaise pour l'Exploitation des Procédés Thomson-Houston for the past year. The report mentions in the first place that the electrical industry is one of those which have suffered the least from the economic crisis following the war. On the whole the production of plant of small capacity has considerably diminished for the time being, but on the other hand, the manufacture of equipment of large size has not slackened. The equipment of waterfalls and the construction of large generating stations are being continued, and the railway companies are now proceeding with the electrification of an important part of their networks. The company has so largely profited from this privileged situation that the total value of its orders in 1920 exceeded by 80 per cent. that of the orders for the preceding year. Coming to consider the company's own manufacturing works, the report states that these have been specialised as follows: Jarville for small alternating current motors, Neuilly for small continuous current motors, Vaugirard and Lecourbe for heavy plant, Suresnes for large apparatus, and Colombes for insulating materials. To these has now to be added the great new works at Saint-Ouen, where a year ago the land resembled a vast racecourse, but is at present occupied by extensive buildings. Operations at this works are already proceeding, the production comprising machines of very large sizes and very high voltage. The Lesquin works, which was destroyed during the war, is being actively reconstructed, and will be provided with a foundry for cast iron, a steel foundry, and a large shop for small electrical apparatus.

The report proceeds to refer to telephony, and mentions in this connection that the company has entered into close relations with the Western Electric Co. of New York, whose importance in telephony is equal to that of the General Electric Co. in the general domain of electricity. The initial agreements which have been reached are so essential that the French company expects to find in this new association a reinforcement of the important facilities at its disposal to ensure the development of telephony in France. On the other hand, the relations of the company with the General Electric Co. are constantly developing and becoming more intimate. As to the question of railway conversion in detail, the report states that the discussions with the Orleans Railway Co. aiming at the electrification of the line from Paris to Orleans have resulted in the beginning of operations. Other negotiations have been made with various firms, and the company has formed, with the co-operation of Schneider & Co. and the Ateliers de Constructions Electriques du Nord et de l'Est, the Société d'Etudes pour l'Electrification des Chemins de Fer in order to prepare for the three participants the submission of schemes to the railway companies and ensure the joint use of their powers in carrying out the work. As was mentioned in a previous issue, the dividend for 1920 is at the rate of 40.70 fr. net for registered shares and 37.80 fr. for bearer shares.

General Electric Co. (U.S.A.). The report of the company for 1920 shows that the value of the orders received was $318,470,438, as compared with $237,623,932 for 1919. At the close of the year the amount of orders unfilled was $111,778,000, as compared with $98,880,000 at the end of 1919. The unprecedented amount of orders received by the company during the first seven months of 1920, plus the unfilled orders at the beginning of the year, resulted in most urgent efforts in a difficult situation to add to the manufacturing facilities. The expenditure for additional land, buildings, machinery, and equipment during 1920 was $31,300,496; as a further addition to the manufacturing capacity of the plants, certain factories with a floor space of 1.768,000 sq. ft. have been leased, with options to purchase. The total factory floor space has been increased from 20,681,000 sq. ft. in 1919 to 24.501,000 sq. ft. in 1920. The amount of sales billed was $275,758,487, an increase of $45,778,504 over 1919. The net result was a profit of $26.460.057, plus income from other sources $8,960,558, less interest and discount on debentures $1.969.111 and interest on notes payable $2,319.216, leaving available for excess profits tax and dividend $31.132.287. Excess profits tax estimated at $9,000,000, dividends $10.656,222, leaving a surplus for the year of $11.476,065. At a special meeting of the stockholders held in March, 1920, authority was given to increase the capital stock of the company from $125.000.000 to $175.000,000. During the year the directors authorised the issue of two special series of 1919 and 1920 debentures known as employés' investment bonds to be sold to employés on the instalment plan by deductions from wages. To these two issues subscriptions have been received from about 12,000 employés totalling $1,031,800. These debentures bear interest at the rate of 7 per cent. per annum. In November, 1920, the directors offered to the employés the privilege of subscribing for from one to ten shares of the company's capital stock, payments to be made on the instalment plan by deductions from wages. The subscription price was $136 per share, and as stated in the circular offering the stock, there will be a credit amounting to $20 per share against the subscription price which will represent a net return substantially the same as that which would be enjoyed by anyone purchasing stock on an instalment plan, paying interest on deferred instalments and receiving cash and stock dividends. The result of this offering was that 30,747, or 36 per cent. of all the employés on the pay roll subscribed for an amount considerably larger than the 50.000 shares offered. In the year 1920 the dividends declared were as follows: Cash dividends 8 per cent., $10,651,306. Stock dividends 4 per cent., $5,437,700. Cash dividends on International Co. preferred stock held by employés $4.916. Total. $16,093,922. It is proposed commencing January 1st, 1921, to separate the balance sheets and financial statements of the General Electric Co. (U.S.A.) and the International General Electric Co. in order more satisfactorily to show the assets, liabilities, and operations of each company.

Richardsons, Westgarth and Co., Ltd. The accounts for 1920 show a profit after providing for estimated liabilities to the Government of £155,635, plus £48,842 brought forward, less two years' preference dividend paid in June, 1920, £42,000; total £162,477. Interest on the 4½ per cent. debenture stock absorbs £15,750, one year's preference dividend £21,000, and the directors propose making the following allocations: Directors' fees £1,700, depreciation for 1920, £45,000; portion of capital expenditure in 1920 written off £25,000, leaving £54,027. The directors propose to pay out of balance two years' dividends on preference shares in addition to one year's dividend paid in December last as above. Preference dividend will then have been paid up to April 30th, 1919. In consequence of inability to obtain coal, the works are practically closed down. Many contracts remain to be completed, but it will be difficult to get further orders until the cost of production has been considerably reduced in regard to both materials and wages.

French Companies. *The Société d'Electro-Chimie de Bozel* intends to pay a dividend at the rate of 22 fr. per share for 1920, as in the preceding year, the net profits having been 1,036,000 fr. and 762,000 fr. in the two years respectively.

The Compagnie d'Electro-chimie et d'Electro-Metallurgie proposes to pay out of net profits of 3,700,000 fr. a dividend at the rate of 40.50 fr. net per share, being the same rate as in 1919, when the net profits were 3.591,000 fr.

The Compagnie d'Electro-Mecanique, after writing off 3,576,000 fr. for depreciation, reports net profits of 3,528,000 fr. for 1920, as against 2,318,000 fr. in 1919. The dividend is to be at the rate of 40 fr. per share, as in the previous year.

The Société L'Appareillage Electrique Industriel Petrier, Tissot & Raybaud, of Lyons, makers of low and high-pressure apparatus, report net profits of 533,000 fr. for 1920, and a dividend of 86 fr. gross per ordinary share. The company expects to be able to remove to its new works in the course of the present year.

Alldays & Onions, Ltd.—Profit on the year's working £7,111, which has been allocated together with the reserves appearing in the last balance sheet to the purposes of meeting depreciation and writing off. It has been found during the past year that the financial condition of the country rendered it advisable to postpone the raising of additional capital until a more favourable opportunity presents itself.

Rees Roturbo Manufacturing Co., Ltd.—Dividend of 8¾ per cent., less tax, on preference for the year 1915, and for nine months ended September 30th, 1916, £5,000 to depreciation reserve, £4,600 to general reserve, £5,000 to a taxation reserve, £4,523 for maintenance of buildings, plant, &c., carrying forward £6,727.

Howard & Bullough, Ltd.—Final dividend on the ordinary shares, making 10 per cent. for the year, transferring to dividend reserve £40,000, carrying forward £50,956.

Manila Electric Railroad & Lighting Corporation.—Dividend of 1½ per cent. for the quarter ending June 30th on the common capital stock.

American Telephone & Telegraph Co.—Dividend of 2½ per cent., less tax, for the quarter.

Canary Islands.—The report of the Société de l'Electricité de Las Palmas for the last financial year shows a loss of 1,139,259 fr.

Belgium.—The report of the Société d'Electricité et de Mecanique (Procédés Thomson-Houston et Carels), of Ghent, for the last financial year shows a profit of 2,722,551 fr.

Waygood-Otis, Ltd.—Dividend of 9 per cent. on the ordinary shares, carrying forward £27,979.

Stock Exchange Notices.—Application has been made to the Committee to allow the following to be officially quoted :—

Metropolitan Electric Supply Co.—£500,000 7½ per cent. extension debenture stock.

Dealings in the following have been specially allowed by the Committee under Temporary Regulation 4 (3) :—

General Electric Co.—£3.500,000 7 per cent. mortgage debenture stock, issued at 92½ per cent., £15 paid and fully paid (varying interest payments), after issue of allotment letters.

Eastern Extension Australasia and China Telegraph Co.—92,794 shares of £10 each, fully paid. Nos. 300,001 to 390,629 and 397,836 to 400,000.

Kaministiquia Power Co.—2,000 shares of $100 each, fully paid, of capital stock; $372,000 thirty-year five per cent. gold bonds, Nos. 876 to 1,000 of $1,000 each; Nos. 1,304 to 1,433. 1,534 to 1,564, 1,569 to 1,584, 1,586 to 1,720, 1,791 to 1,818, and 1,847 to 2,000, of $500 each.

Siemens Bros. & Co.—300,000 10 per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 300,000.

The undermentioned have been ordered to be officially quoted :—

Eastern Extension, Australasia & China Telegraph Co.—92,794 shares of £10 each, fully paid, Nos. 300,001 to 390,629 and 397,836 to 400,000.

Kaministiquia Power Co.—2,000 shares of $100 each, fully paid, of capital stock; $372,000 30-year 5 per cent. gold bonds. Nos. 876 to 1,000, of $1,000 each; Nos. 1,304 to 1,433, 1,534 to 1,564, 1,569 to 1,584, 1,586 to 1,720, 1,791 to 1,818, and 1,847 to 2,000, of $500 each.

British Electric Traction Co., Ltd.—Dividend of 4 per cent. on the ordinary stock for the year, carrying forward £177,318.

Electric & General Investment Co., Ltd.—Dividend at the rate of 6 per cent. per annum (3s. per share), less tax, on preference shares for the six months ending June 30th.

New Issues.—*Johnson & Phillips, Ltd.*—The British, Foreign & Colonial Corporation, Ltd., is inviting applications for £350,000 8 per cent. first mortgage debenture stock at 96 per cent., repayable at par by means of a cumulative sinking fund commencing in 1922 by twenty-three equal annual drawings, the first of which is to be made in 1923 and the last in 1945. The list closes to-morrow, the 18th.

Ruston & Hornsby, Ltd.—Profit for the year ended March 31st, 1921, £108,682, less depreciation £53,002, interest on debentures £25,500, leaving £30,180, plus £37,240 brought forward, making £67,420. Dividends on preference shares absorb £23,500, leaving £43,920. The directors have decided, owing to the stagnation of trade, that it is desirable to conserve the resources of the company and regret they do not recommend the payment of a dividend on the ordinary shares for the past year. The balance £43,920 is carried forward.

Kidderminster & District Electric Lighting & Traction Co., Ltd.—Net receipts for 1920 of lighting undertaking, including payments under guarantee by Shropshire, Worcestershire and Staffordshire Electric Power Co., were £5,304, plus £46 brought forward. After deducting administration and general expenses, and interest on temporary loans, the balance is £2,710. Dividend on cumulative preference shares absorbs £1,500. Dividend of 2½ per cent. on the ordinary for 1920, carrying forward £35.

Penarth Electric Lighting Co., Ltd.—The report for the year ended December 31st last shows total revenue £14,990, working expenses £8,549, balance £6,440. To renewals £2,450. 7½ per cent. dividend on the ordinary shares, carrying forward £2,331.

Hungary.—The report of the Ganz Electrical Co., Budapest, for the last financial year shows a profit of no less than 5,522,262 crowns, as compared with only 1,553,182 crowns in 1919. The dividend is being increased from 5 per cent. to 12 per cent.

Eastern Telegraph Co., Ltd.—Dividend at the rate of 3½ per cent. per annum, less tax, on the preference stock for the June quarter, and an interim dividend of 2½ per cent. on the ordinary stock, free of tax.

Madras Electric Supply Corporation, Ltd.—Dividend of 8 per cent., less tax, on ordinary shares for the year. £15,000 to general reserve, £1,000 to employés' gratuity fund, carrying forward £9,620, subject to excess profits duty (if any).

Merthyr Electric Traction & Lighting Co., Ltd.—Dividend at the rate of 6 per cent. per annum on the ordinary shares, to reserve £1,200, to renewals £5,000; carried forward £1,429.

Globe Telegraph & Trust Co., Ltd.—Further dividend of 3s. per share, less tax, on the preference shares, and 5s. per share net on the ordinary shares.

James Keith & Blackman Co., Ltd.—Dividend on ordinary shares for year ended March, 1921, at the rate of 15 per cent. per annum, free of tax. To reserve £13,000, forward £18,272.

Mackay Companies.—Quarterly dividend of 1¼ per cent., less tax, on common stock.

STOCKS AND SHARES.

TUESDAY EVENING.

MORE interest is taken, in the Stock Exchange markets this week, in cricket than in stocks and shares. Business in the latter is exceedingly quiet. In spite of the reluctance shown by the public to take a hand in the markets, there is still a brisk demand for underwriting of any good issue which comes along. The underwriters of the General Electric Company's 3½ million pounds' 7 per cent. debenture stock were left with 43 per cent. of their obligations. In a couple of days it was assumed that many of the weaker underwriters had cleared out of their holdings, at prices ranging from 4½ discount to about a point more. As soon as the air cleared of the underwriting stags, the price promptly improved to 3 discount, and, with the prospect of money becoming cheaper, this stock will probably advance to its issue price of 93. At 90 it may be deemed a cheap investment.

Another newcomer to the markets this week is the 10 per cent. preference share of the Siemens Company. The shares were given away to the holders of the ordinary in the proportion of one preference for five ordinary held. The new preference shares began at 20s. 6d.-21s. 6d. Considering that the company is paying 10 per cent. free of tax on its ordinary shares, these 10 per cent. preference shares at anything like 21s. 6d. certainly look cheap, offering a return of 9¼ per cent. on the money. As soon as the Siemens' holders who wish to take their profit have divested themselves of their preferences, the quotation will stand a good chance of improvement. As already mentioned, the North Metropolitan Electric and the Pernambuco Tramways both have new issues in immediate contemplation.

Activity in Underground Electric Railways stocks and shares has somewhat subsided as compared with that which ruled a week ago. Nevertheless, prices continue firm, and London Electric Railways shares have come into some little favour on the basis of 55s. The bulk of the shares are owned by the Underground Electric Railways of London, and there is not much floating supply in the Stock Exchange market. Last year's dividend was 1⅛ per cent., *i.e.*, 2s. 3d. per share on the £10 fully-paid share. Thus they offer a small return on money invested, which is more than the Underground Electric £10 shares themselves do, although the two stand at nearly the same prices. There is, however, more market in the latter than in the former, and this, of course, accounts for something in the matter of market quotation. The interest in the various traction issues has quieted down again, and there is not much change in London & Suburban Traction at 7s. 6d., nor in the ordinary at 2s. 6d. The company's 4½ per cent. first mortgage debenture stock changed hands last week at 44½, but the 5 per cent. "A" debenture stock, which is now quoted 68, has not been negotiated in the Stock Exchange since last August, when a buyer paid 61.

British Electric Traction ordinary is a little better at 35½. The 6 per cent. participating preference is quoted at 59, the 5 per cent. debenture at 68, and the 4½ per cent. second debenture stock at 51. The company's report, out this week, shows that the net profit has risen £12,000 to £135,000. The usual dividend of 4 per cent. is paid, and the carry-forward is increased by £20,000 to £177,000. The B.E.T. has sold its £190,000 War Loan, substituting shares, *inter alia*, in Brush Electrical, Electric & General Investment, and Transport Power & Finance. Besides these, the list of investments receives an addition in the shape of about £71,000 in Stoll Picture Productions. It would be useful, as well as interesting, if the chairman at the forthcoming meeting were to say what the company's investments are worth at the current quotations, the report itself affording no information on this head.

Marconi shares have developed weakness, owing to a fair number of shares having been sold by people who had bought them earlier in the year, and who are disappointed at the delay in the settlement between the Government and the company. The price has dropped to 2¼, and the preference are down to the same level. Marconi Marines have fallen to 25s. As we pointed out recently, there is very little doing in the Marconi market nowadays, and, with speculation all but dead, prices yield easily to a little selling pressure.

The only change in the list of home electricity companies is a rise to 5¼ in Westminsters. The manufacturing group is almost equally quiet. General Electric preference drooped to 17s., the 6½ per cents. and the 7½ per cents. both standing at the same level. Henley's are 1/16 down at 1⅜. Edison-Swan first preference gave way to 17s. A sensational fall—in price at all events—in City Services shares lowered the quotation 80 points to 200, the preferred at 57½ being about 10 points down. This slump came about on the notification that the company would in future pay its Common share dividends in stock instead of cash. Newcastle-on-Tyne 7 per cent. preference shares are better at 19s. 6d.

Anglo-American Telegraph deferred has risen 2 points to 83½. Great Northerns are lower at 25⅝. United River Plate Telephones eased off to 6, and West India & Panama are lower at 10s.

The Government of Mexico has noted that it intends to resume payment of interest on its foreign debt on July 1st. This brought about a rise in Mexican Government bonds, but did not affect prices in the Utility market. Mexico Tramways firsts are better at 52½, but Mexican Light firsts at 74½ show a dollar fall. Brazil Tractions are 1½ down at 34½. Anglo-Argentine Tramways continue to improve. British Columbia stocks are steady. There has been some demand for the 4½ per cent. Vancouver debenture, without, however, finding any response, sellers refusing to part with their holdings.

Although rubber is still about 8½d. per lb., the market in the Stock Exchange is slightly better, owing to the fact of the deliveries of the produce once more being in excess of the landings. Engineering shares are quietly firm, with Babcock & Wilcox 1/16 up at 2⅜. It is taken for granted that there will be a resumption of work in the coal trade next week. With business as quiet in the Stock Exchange as it is at the present time, men are inclined to ask whether this eagerly-anticipated resumption will have any noticeable effect after all in strengthening prices throughout the markets.

In our lists of quotations we have brought the dividend-payments up to date, as far as possible. The varying times at which different companies close their books render it impossible to adopt a strictly uniform plan. The Edison-Swan Company, to take one example, paid its last dividend in November, 1919, when the distribution for that year was 10 per cent. The India Rubber Company paid 6d. a year ago, and nothing since. The Anglo-Argentine Tramways is clearing off on its second preference shares. Marconi shareholders received 1s. last December, and 8s. in the previous half year, when the capital was much less. The instances are quoted to give an idea of the difficulty which confronts the effort to do the work accurately. They may serve to recall the entreaty, "Don't shoot the man at the piano, because he's doing his best."

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1919.	Dividend 1920.	Price June 14, 1921.	Rise or fall.	Yield, p.c.
Brompton Ordinary..	12	12	8	—	£10 0 0
Charing Cross Ordinary	7	8	8⅞	—	10 8 8
do. do. do. 4½ Pref...	4½	4½	8	—	7 10 8
Chelsea..	4	5	8½	—	9 4 8
City of London	18	14	1 3/16	—	11 16 0
do. do. 6 per cent. Pref...	6	6	17/-	—	7 1 2
County of London	8	8	8⅛	—	9 17 0
do. do. 6 per cent. Pref...	6	6	6⅛	—	7 7 8
Kensington Ordinary	7	9	4⅛	—	10 18 2
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref...	6	6	2¾	—	10 18 2
Metropolitan..	6	7	8½	—	10 0 0
do. 4½ per cent. Pref. ..	4½	4½	2 15/16	—	7 18 2
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	6	7	2½	—	9 2 10
South Metropolitan Pref... ..	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	5¼	—	9 10 6

Telegraphs and Telephones.

	Dividend 1919.	Dividend 1920.	Price June 14, 1921.	Rise or fall.	Yield, p.c.
Anglo-Am. Tel. Pref.	6	6	83½	+2	7 3 9
do. Def...	1½	1½	17½	—	8 11 6
Chile Telephone	6	6	5¼	—	5 6 8
Cuba Sub. Ord.	7	7	7½	—	9 6 8
Eastern Extension	10	10	16⅝	—	6 3 2
Eastern Tel. Ord.	10	10	167½	—	5 19 5
Globe Tel. and T. Ord.	10	10	16⅝	—	6 0 4
do. do. Pref.	6	6	9¼	—	6 9 9
Great Northern Tel.	22	24	26⅜	— ⅜	8 11 6
Indo-European	10	10	85	—	7 2 10
Marconi	25	25	2¼	— 1/16	—
Oriental Telephone Ord.	12	12	2 9/16	—	*6 13 0
United R. Plate Tel.	8	8	6	— ⅛	6 13 4
West India and Panama	Nil	Nil	½	— 1/16	Nil.
Western Telegraph..	10	10	16⅞	—	*6 18 6

Home Rails.

	Dividend 1919.	Dividend 1920.	Price June 14, 1921.	Rise or fall.	Yield, p.c.
Central London Ord. Assented ..	4	4	45½	—	8 16 10
Metropolitan	1¼	1½	28½	—	6 17 8
do. District	Nil	Nil	20	+1	Nil
Underground Electric Ordinary ..	Nil	Nil	2¾	—	Nil
do. do. "A" ..	Nil	Nil	7/6	—	Nil
do. do. Income ..	4	2	80½	+1	2 9 4

Foreign Trams, &c.

	Dividend 1919.	Dividend 1920.	Price June 14, 1921.	Rise or fall.	Yield, p.c.
Anglo-Arg. Trams, First Pref. ..	5½	12½	2 13/16	+ 1/16	9 15 6
do. do. 2nd Pref. ..	Nil	5½	8⅛	—	8 16 0
do. do. 5 % Deb. ..	5	5	66½	+2	7 15 0
Brazil Tractions	Nil	Nil	34½	—1½	Nil
British Columbia Elec. Rly. Pfce.	5	6	66	—	8 18 6
do. do. Preferred	5	6	68½	—	*8 15 0
do. do. Deferred	3	8	61½	—	*11 17 6
do. do. Deb. ..	4½	4½	69½	—	7 2 10
Mexico Trams 5 per cent. Bonds..	Nil	Nil	52½	+1	Nil
do. 6 per cent. Bonds..	Nil	Nil	23½	—	Nil
Mexican Light Common	Nil	Nil	11½	—	Nil
do. Pref.	Nil	Nil	18½	—	Nil
do. 1st Bonds	Nil	Nil	74½	—1	Nil

Manufacturing Companies.

	Dividend 1919.	Dividend 1920.	Price June 14, 1921.	Rise or fall.	Yield, p.c.
Babcock & Wilcox	15	16	2⅜	+ 1/16	6 14 6
British Aluminium Ord.	10	10	16/3	—	12 6 2
British Insulated Ord.	15	10	1 9/16	—	9 12 0
Callenders	15	15	1½	—	10 0 0
" 6½ Pref.	6½	6½	17/6	—	7 8 7
Crompton Ord.	10	10	16/3	—	12 6
Edison-Swan	10	10	11/3	—	—
do. do. 6 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	17/6	—	11 8 6
English Electric	8	8	12/-	—	13 6 8
Do. Pref.	6	6	14/6	—	8 5 8
Gen. Elec. Pref.	6½	6½	17/-	—6d.	7 13 0
do. Ord.	10	10	1 1/16	—	*9 8 2
Henley	15	15	1⅜	— 1/16	10 18 2
do. 4½ Pref.	4½	4½	8¼	—	6 18 6
India-Rubber	10	10	13/16	—	—
Met.-Vickers Pref.	8	8	1 13/16	—	8 16 10
Siemens Ord.	10	10	23/3	—	*8 12 0
Telegraph Con.	20	20	20½	—	*6 17 0

*Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, June 14th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	10d.	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	"	£65	..
a Bisulphide of Carbon	"	..	..
a Borax	"	£34	..
a Copper Sulphate	"	£33	..
a Potash, Chlorate	per lb.	7d.	..
a " Perchlorate	"	8d.	..
a Shellac	per cwt.	£20 10s.	..
a Sulphur, Sublimed Flowers ..	"	£18	..
a " Lump	"	£16	..
a Soda, Chlorate	per lb.	5d.	..
a " Crystals	per ton	£7	..
a Sodium Bichromate, casks ..	per lb.	9½d.	..
METALS, &c.			
p Babbitt's Metal Ingots	per ton	£95 to £300	..
c Brass (rolled metal 2" to 12" basis)	per lb.	11½d.	..
c " Tubes (solid drawn) ..	"	1/1¾ to 1/2	..
c " Wire, basis	"	11⅞d.	..
c Copper Tubes (solid drawn) ..	"	1/3¾	..
c " Bars (best selected) ..	per ton	£118	..
c " Sheet	"	£116	..
c " Rod	"	£116	..
d " (Electrolytic) Bars ..	"	£79	£1 inc.
d " " Sheets ..	"	£145	..
d " " Wire Rods..	"	£95	£2 inc.
d " " H.C. Wire..	per lb.	11⅞d.	¼d. inc.
f Ebonite Rod	"	3/6	..
f " Sheet..	"	3/-	..
n German Silver Wire	"	2/9	..
h Gutta-percha, fine	"	14/- to 16/-	..
h India-rubber, Para fine	"	11d.	½d. inc.
l Iron Pig (Cleveland Warrants) ..	per ton	Nom.	..
l " Wire, galv. No. 8, P.O. qual.	"	£40	..
g Lead, English Pig	"	£23 5s.	10s. dec.
g Mercury	per bot.	£10 15 to £11	10s. dec.
e Mica (in original cases) small ..	per lb.	4d. to 4/-	..
e " " " medium..	"	6/- to 10/-	..
e " " " large ..	"	12/6 to 25/- & up	..
p Phosphor Bronze, plain castings..	"	1/4 to 1/9	..
p " " rolled bars and rods	"	2/1 to 2/6	..
p " " rolled strip & sheet	"	2/2 to 2/7	..
d Silicium Bronze Wire	per lb.	1/4	..
r Steel, Magnet, in bars	"	1/8	..
n Tin, Block (English)	per ton	£167 to £168	£6 to £7 dec.
n " Wire, Nos. 1 to 16	per lb.	4/-	..
p White Anti-friction Metals ..	per ton	£78 to £300	..

Quotations supplied by—

a	G. Boor & Co.	g	James & Shakespeare.
c	Thos. Bolton & Sons, Ltd.	h	Edward Till & Co.
d	Frederick Smith & Co.	l	Bolling & Lowe.
e	F. Wiggins & Sons.	l	Richard Johnson & Nephew, Ltd.
f	India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.	n	P. Ormiston & Sons.
		p	————
r	W. F. Dennis & Co.		

How to Use Oil Fuel.—In a letter to the *Manchester Guardian*, "Practical" gives some hints to those who have changed, or who contemplate changing, over from coal to oil burning. With regard to burners, the best is the cheapest; if a cheap burner has already been obtained, do not waste time trying to improve it; cut your losses, and buy a good burner—if possible, one with a spraying effect, to obtain the better flame, and not a miniature hosepipe. It is most essential that the apparatus should be provided with proper means for controlling the air, in order to ensure a proper mixture. If the burners have been fixed to a battery of boilers, it would be a paying proposition to install a small compressed-air plant, and thus save a large quantity of the steam which is being used as the oil driver.

The oil after passing through a filter into the gravitation tank should be heated to about 160° F.; a ⅝-in. pipe provided with a controlling valve will be found efficient for heating it. The oil should pass into the tank in a steady flow (not emptied direct out of the barrels), and so maintain an even temperature to ensure a proper atomisation of the oil when leaving the burner.

After an employer has attended to the above, it is the duty of the engineer and fireman to display the necessary intelligence and attention to the plant to obtain the best results. Oil fuel, no doubt, has come to stay if the oil syndicates will deliver at £3 10s. per ton and guarantee constant supplies, if an efficient burner at a reasonable price is used, and, lastly, if proper attention is given by the engineer.

The Metric System Adopted in Japan.—The new Weight and Measure Law, as passed by the Diet, was formally promulgated recently by the Japanese Government, thus rendering Japan one of the metric countries. Simultaneously with the promulgation of the new Law, Director Kitsukawa, of the Weight and Measure Office, gave out a statement, saying that even when the first weight and measure law was framed in 1893, Japan was desirous of adopting the metric system, but the nation was not ready to accept it. When the world war started, however, the necessity of adopting the metric system was keenly felt, and the Government Bill was readily accepted by the Diet.—*Board of Trade Journal.*

THE FAILURE OF METALS UNDER INTERNAL AND PROLONGED STRAIN.

The symposium and general discussion held on the above subject on April 6th at the Institution of Mechanical Engineers must have been unique in the interests represented thereat. It is understood to have been promoted by the Faraday Society, but no less than five of the big engineering societies participated; namely, the Institution of Mechanical Engineers, the Iron and Steel Institute, the Institute of Metals, the North-East Coast Institution of Engineers and Shipbuilders, and the Institution of Engineers and Shipbuilders in Scotland. The result of this co-operation was that data were brought forward and light thrown upon the subject by engineers, metallurgists, physicists, and chemists, although it must be confessed that the contributions of the first of these classes, whose interest in the subject ought to be the keenest of all, were decidedly disappointing. Perhaps the reason for that was the one implied in the speech of Mr. L. Pendred—as a matter of fact, our bridges and other structures do actually stand, and don't spontaneously fall to pieces like some of the specimens described or shown. The engineers should be told that this durability may be more a matter of good fortune than of skill or knowledge—as a matter of fact, it isn't even quite true, as contributions to the discussion bore witness—and seeing that engineers usually employ some five times as much material as they should (disguised by that euphemistic phrase "factor of safety") physicists may reasonably retort that the engineer has still much to learn from molecular physics. The little note alone presented by Mr. John Arnott (of Messrs. J. & G. Weir, Ltd.) was enough to make the most complacent of users wonder what material really *can* be trusted! Here is a standard phosphor bronze bar on the market supposed to be as immaculate as Cæsar's wife, and yet which has had so much cold work put into it for it to attain a high yield point and tensile strength that it is full of incipient yet invisible transverse and longitudinal cracks, which tell their tale to the one who is acute enough to have his suspicions after three minutes' immersion in a mercurous nitrate solution.

One may profitably consider again the examples quoted in two excellent contributions to the discussion coming from America, from Mr. James E. Howard and Mr. Henry S. Rawdon. Thus the former stated that recent examinations of structural shapes have shown the presence of internal strains of compression equivalent to 12,000 lb. per sq. in., which is three-fourths of the usual allowable stress for a compression member in current engineering practice. Seeing that no account is taken of internal strains in structural members exposed to compressive stresses, the fact is noteworthy. Mr. Howard also instanced the transverse fissures that occur in rails as a result of the augmentation in service of original cooling strains, and Mr. Rawdon supported this view by describing actual examples.

Of special interest to electrical engineers were the cases of spontaneous failure of the lead sheathing of telegraph cables brought forward by Mr. L. Archbutt. These were examples of almost pure lead-covered cables which had been laid for periods varying from 9 to 13 years and which had not corroded, but had developed fine cracks that opened out on bending the cable. In other cases the sheathing of cables laid for some 40 years was as good as when first laid. In one instance of failure the cracking had actually led to a breakdown of the insulation. In every case it was found that the cracks were intercrystalline, and that there was a striking difference between the shape and size of the crystals in the defective parts and the sound portion of the sheath. Experiments were made on lengths of sheathing subjected to tensile strain and to vibration, and it was found that such cable was particularly prone to failure. Mr. Archbutt's conclusion was that the long-continued action of a stress in lead, much less than that necessary to cause immediate elongation, will cause the crystals gradually to lose their cohesion and come apart, and the failure is connected with a weak type of crystalline structure.

It will be convenient at this stage to consider the subject in its general aspects, and what follows will be based upon the very lucid introductory review with which the discussion was opened by Dr. W. Rosenhain.

The essential differences between ordinary external and internal stresses are that with the former, generally speaking, the element of time enters only very slightly into the result, and when in a strained metal rupture occurs it takes place across the crystals. In the internal stresses which produce the so-called "season-cracking," the fracture takes place *along the crystal boundaries*, and in these cases the apparent strength depends very largely upon the time during which the stress acts. The action was first observed in brass tubes or cups in which circumferential stresses had been set up in the process of manufacture, but externally-applied stresses may also cause season-cracking, and since 1919 effects have been observed in metals other than brass, such as lead, steel, and aluminium alloys. The mode of origin of internal stresses is tolerably certain: they are the result of unequal changes of dimension in different parts of the same piece of metal, due to either mechanical or thermal causes. The nature of their operation is more obscure. The strains or fractures resulting from these stresses must be of quite a different character from a simple ultimate stress, for fracture can occur far below the ultimate strength of the material. The explanation urged by Dr. Rosenhain is founded on the well-known theory of the existence of an amorphous film between the crystal grains of metals. It is supposed that under the action of long-continued stress this amorphous material will flow like an under-cooled viscous liquid, and this movement may eventually lead to intercrystalline rupture. Motion will, however, only occur if the boundaries of the crystals are smooth and regular; if jagged or irregular, the intercrystalline flow will not take place. Thus the facility with which season-cracking or similar failures take place will depend on the micro-structure of the metal. Strong support was given to this view by the striking photomicrographs shown by Dr. Rosenhain and others, but its acceptability, of course, depends on the evidence for the existence of the hypothetical amorphous film. As to this, Sir James Ewing put forward a very clear and convincing argument on general grounds for the irregular orientation of the molecules at the boundary where one crystal merges into its neighbour. Such irregularity is nothing more than the supposed amorphous layer.

The amorphous boundary explanation was strongly criticised by Dr. W. H. Hatfield, who brought forward evidence that increasing the time of application of stresses does not result in a lower breaking load, which should be the case if viscous flow was the cause of fracture. This evidence was hardly conclusive, and it was supported by the fact that many metals are stressed at high values for indefinite periods without rupture occurring. Here again, however, a determining feature would be the microstructure.

Another explanation of season-cracking ascribes it to corrosion or other forms of chemical action. In Dr. Hatfield's view, such action induces weaknesses in metals already stressed, and thus facilitates rupture. Mr. Harold Moore thought that corrosion would take place in the amorphous film itself, and thus be a prime cause of failure by causing a breakdown at the crystal functions. He brought forward evidence based on the action of ammonia on stressed brass, although in the case of steel the corrosive action would be that induced in the ordinary way by moist air. Dr. Rosenhain, with much force, showed that chemical action although it might sometimes be an important factor or might have an accelerating effect, was not essential to the failure of metals under internal stress.

A contribution by Prof. C. H. Desch established the fact that where metals are subject to chemical or corrosive action, whether of liquids or gases, although it is not true of all reagents, such action frequently advances along the intercrystalline boundaries, and this course is most likely to occur when the metal is in a state of tension. The action of mercury and its salts on strained metals is specially noteworthy, and it may be utilised to demonstrate the existence of strains on incipient fracture otherwise invisible.

We may suitably conclude this very general description of the course of the discussion with a brief reference to one or two of the more striking examples of failure brought forward and not already alluded to. Messrs. Vaudrey and Ballard described the failures—either fire-cracking or season-cracking—which sometimes occur in certain sizes of drawn brass tubes arising from an apparent stratification of the wall of the tubes. This condition arises when a tube is subjected to too large a "sink" in drawing ("sink" is the reduction of internal diameter), without sufficient reduction in thickness, and stratification of the tube may occur on a too-sudden application of heat on annealing. The minute flaws are rendered visible by immersion in an acid solution of mercurous nitrate.

Mr. W. C. Hothersall described the spontaneous cracking on storage which sometimes occurs in the necks of small arm cartridge cases. These cracks were shown to arise as a result of stresses set up in the necks subsequent to semi-annealing, and it was thought that they were mainly set up during the "necking" and "bulleting" operations. The example is the more interesting because mercury is present in the cap composition, and it may have a determining effect in bringing about rupture.

A paper by Mr. O. W. Ellis described some experiences of season-cracking in brass rods obtained during the war. Mr. Ellis's figures are based on the tests made at Woolwich on samples taken from 2,500,000 rods of varying shapes and sizes. It is difficult to generalise from the results, but it may be said that certain consignments of rods of some grades gave quite a high percentage of failures. Rods of square section of certain sizes seemed particularly prone to season-cracking. It was eventually found that low-temperature annealing removed the internal stresses, and enabled rods to be passed as sound which otherwise would have ruptured under the tests. The general question of preventing season-cracking in brass was dealt with in an exhaustive paper read by Mr. Harold Moore and Mr. S. Beckinsale, of the Research Department, Woolwich. These authors have made a systematic study on the reduction of stress by low-temperature annealing in 70/30 brass cold-rolled to 120, 160, and 200 Brinell hardness, in elastically-bent test strips of each hardness initially stressed to 11, 17, and 22 tons per sq. in. maximum tension. Temperatures from 200 deg. to 325 deg. C. were employed. It was found that at the lower temperatures while the rate of reduction of stress is fairly rapid at first it becomes very slow when the stress has been reduced to about one-half, and the higher the initial stress, the longer the time required to reduce it to a given fraction. The harder the brass the more rapidly is a given initial stress reduced at a particular temperature. The experiments left no doubt but that by suitable low-temperature annealing not only can the liability to season-cracking be eliminated, but it can be done without harmful effect to the quality of the brass.

Failure in steel parts or articles is probably less frequent than in brass, and less study has been given to this metal in this regard. Nevertheless, some interesting and striking cases of failure were brought forward. Thus Sir Henry Fowler instanced the deterioration of certain locomotive boiler tubes, the ends of which were found to have become quite brittle. The tubes, owing to war conditions, had been made of inferior steel, and failure appears to have been caused by the concentration in the crystal boundaries of the impurities, notably phosphorus, but why this should have happened is unknown, unless it was the repeated stresses set up during the work of the locomotive. Of the 6,000 tubes in service on the Midland Railway only eight appear to have developed this curious brittleness. Mr. D. Hanson, however, described other types of intercrystalline failure in steel as a result of prolonged stresses which are more common. Thus, several cases have been observed in mild steel boiler plates that have failed in service. In one instance severe cracks developed in a wrapper plate from the combustion chamber of a marine boiler around the edges between the rivet holes. It was found that in the portions which failed the cementite mainly occurred in the form of intercrystalline films. Another similar case quoted was the drum of a water-tube boiler, and a third case a number of plates from a high-pressure marine boiler. Such failures had also been observed in cold drawn steel tubing after use in a nitre bath at 300 deg. C. There were no working stresses in the tube, which evidently had become subject to serious internal stresses as a result of the cold drawing.

Several speakers referred to the failures which sometimes occur in tools and tool steel, and a paper on this aspect of the subject was presented by Mr. J. Neill Greenwood. Hardened steel is in a condition of considerable stress, due primarily to the suppression of allotropic and phase changes causing the metal to occupy a smaller volume than it normally would. Consequently even at ordinary temperatures long-period changes take place involving evolution of heat, change of volume, and so forth, and sometimes the stresses are greater than the normal cohesive forces keeping the steel together—and it flies to pieces. Mr. Greeuwood analysed these internal changes very closely, and he showed how proper tempering may relieve them. He also showed the influence of free carbide and non-metallic inclusions in weakening the steel, and the beneficial influence of manganese and chromium, which reduce internal stress irregularities by making the quenching effect more uniform.

We have not attempted to do anything like justice to the great amount of data and number of opinions brought together in the course of the discussion. It has only been possible to draw attention to some of its outstanding features, and those who desire to give the subject serious study must go to the full report of the discussion, which we understand will be published in due course by the societies which co-operated to organise it.

It remains to say that the meeting which began at 2.30 did not terminate until 10.30, although there were merciful intervals for rest and refreshment, and the successive sessions were presided over by Prof. Alfred W. Porter, Capt. H. Riall Sankey, and Admiral Sir George Goodwin, presidents, respectively of the Faraday Society, Institution of Mechanical Engineers, and Institute of Metals. Illness kept away Dr. J. E. Stead, president of the Iron and Steel Institute, and a telegram was sent to him from the meeting.

RECENT DEVELOPMENTS IN TURBINE PRACTICE.

Discussion at Manchester.

Mr. K. Baumann's paper on the above subject, which was abstracted in our issues of April 15th and 22nd, was discussed by members of the North-Western Centre of the Institution of Electrical Engineers on April 12th.

Prof. G. Stoney described the paper as an epoch-making one, and hoped the author would, after a term of years, or sooner, give them another paper which would continue the good work he was doing. He practically agreed with every point in it, and thought Mr. Baumanu was quite right in saying that the critical speed of the turbine should be near the running speed. The increase in steam pressure, temperature, and vacuum, as well as in size of turbine, was growing steadily with no sign of saturation. Apparently it might go on for ever, but he was afraid they would soon come up against the properties of material in the superheater. The vacuum had steadily improved, and they were now reaching the point where they were coming up against the temperature of cooling water, and until somebody invented some way of getting over the second problem of thermo-dynamics, he did not think they would get a much better vacuum than they had now, which meant that the factor Parsons called K and Mr. Baumann called Sigma, had to be increased and that, of course, had a direct bearing upon the velocity ratio and the B.th.u.'s available. The speaker especially liked Mr. Baumann's rule for the factor of safety—an exceedingly good rule and a safe one—very much better than basing it on the ultimate strength only. The beautiful optical methods, and so forth, of measuring elastic limit were not really commercial. He agreed with Mr. Baumann that four-bearing designs were very much more satisfactory than three-bearing designs as regarded vibration, but confessed that he had a liking for flexible couplings between the turbine and the alternator, although so many were now making long and rigid couplings which were running quite satisfactorily. That was more especially the case with more than two shafts running in line as with tandem alternators or steam turbines. Regarding the vibration of turbine disks, the mathematical solution of the problem was exceedingly difficult and not very satisfactory. Of course, experiments would be expensive to carry out, but he had experimented with rubber disks 7½ in. in diameter, and he had always found that they vibrated on two nodal diameters. He exhibited a model in lead of the shape the disk assumed, and explained that it had a nodal diameter one way and another nodal diameter at right angles. He never succeeded in making his rubber disks vibrate with four nodal diameters, and was considerably surprised to hear that the author said they did so. Mr. Baumann was quite right in thinking that there was a great future for the 3,000 r.p.m. turbine in big power schemes. With an output now of something like 15,000 kW, which they could get at 3,000 r.p.m., the advantage of running at the lower speed of 1,500 r.p.m. was in fact negligible. On the other hand, they had the immense advantage of smaller forgings and costs, and it was quite impossible to get really reliable large forgings. High grade material such as chrome-nickel steel was all right for small articles such as aeroplane and motor car engines, but its use for very large forgings was very doubtful indeed. The difficulty of forging high-grade steels was very great indeed. An impulse turbine would be very much improved if the shrouding was not only riveted, but also brazed on; riveting was always flexible for small movements, and the amount of damage to the shape of the blading was infinitesimal. The author's analysis of the variation of the economical rating under various conditions was most valuable. It was a great pity that turbine makers had not been more candid about breakdowns that had occurred and their causes. It would have greatly increased the rate at which progress had been made if such candour had been more widely prevalent. The ratio of blade height to mean diameter was most important, because it was comparatively easy to make a blade which would stand up against a centrifugal force, but it was much more difficult to make a disk do so. Many troubles might be avoided if two-cylinder designs were more largely adopted for very large sizes, apart entirely from the question of leaving losses. Leaving losses, for the most ordinary sizes, could be quite well dealt with in a single cylinder design by Mr. Baumann's multi-exhaust, which was one of the most radical and greatest improvements in turbine design that had been made of late years.

Mr. H. L. Guy, while applauding the motive which caused the author to pass lightly over the merits of the multi-exhaust, feared that it might result in the principles and properties of that construction being as little understood as his motive. It was not clear from the very brief description of the very novel construction what happened in the inner tiers of blades at the low-pressure end of the machine, and the effect was certainly not appreciated by some of those who took part in the discussion in London. The great advantage of the multi-exhaust construction was that it enabled one to employ a smaller mean diameter for the stages than could be employed for any alternative construction. From that fact a very large number of advantages flowed which not only improved the efficiency of the machine, but very materially affected its speed and reliability. Before Mr. Baumann arrived at the solution of the problem, the machines which the speaker's firm was building for speeds of 3,000 r.p.m. and outputs up to about 6,000 kW were typical of the machines being produced by other makers in this country and other parts of the world. The immediate result of remodelling that line of machine (the principal change consisting of a reduction in the mean diameter of the wheel to about three-quarters of that which they had been using up to that date, in spite of the fact that the output with which the new machine would deal, was increased to three times the output of the old machine), with the consequent changes which had been outlined in the paper, was that the blade stresses were reduced by over 20 per cent., as compared with the blade stresses which had been employed by them for many years. The stresses in the disks were reduced to three-quarters of their old values; the stresses in the diaphragm blade were reduced to two-thirds of the old ones, and the deflections of the diaphragms (because of their very much smaller diameter) were easily reduced to one half of what had been commonly allowed before, and it was possible at small cost to increase appreciably the margin between the running and critical speeds of the turbine. A small vibration occurred at some distance from synchronism between the running and critical speeds, and a smooth-running turbine was obtained. It was also possible, because of the much smaller dimensions, to make of cast steel at a reasonable cost many of the parts which had previously been made of cast iron, and that would result in such machines being able to stand higher temperatures than had commonly been the case. The disks also, because of their much smaller diameter, could be made so stiff that their first critical speed was appreciably above the running speed. There were additional advantages; there were nine counts at least upon which the reliability of the machine could be materially improved; the efficiency was immediately improved and the percentage of loss was materially reduced.

Mr. S. L. Pearce explained that a good deal of the paper was based upon American experience, and as he had had the opportunity last autumn of visiting the States and seeing almost all the large turbine plant that the author had referred to, he could very readily associate himself with the latter's remarks with regard to the frankness with which American engineers had disclosed all their troubles. In connection with very large turbine plant, it was to the United States that they must look, and from the States they could learn a great deal of what to avoid and, possibly, what to adopt. He had met the author in the States and discussed much of the plant they had seen. Generally speaking, one could fairly say that the record of single-shaft machines in the States had not been altogether satisfactory; there had been far too many wheel failures. The first two tables in the paper would well repay ample consideration. Referring to item 20 in Table I, the machine built for the Manchester Corporation by Messrs. Richardsons, Westgarth in conjunction with the Metropolitan-Vickers Co. had an economical rating of 20,000 kW, but the maximum continuous rating of the machine should be 25,000 kW. Item No. 26 in that table was very interesting, especially as it was styled "Proposed practice for 1921." So far as the steam end was concerned, at any rate, that machine would never be built. As regarded the possible size to which single-shaft machines could be carried, namely, 30,000 kW at 1,800 r.p.m., and 35,000 kW at 1,500 r.p.m., personally he thought those sizes were safe—with the particular type of exhaust for which the author was responsible. Dealing with turbine troubles, it seemed that practically in every case the fundamental cause was vibration. It was very important that users and designers should come together, and that there should be a frank exchange of opinion on both sides. One rather radical departure in the modern G.E. designs was in connection with the shaft packing. He formed a very definite opinion that there was a reaction setting in in the States in favour of the reaction type against the single-shaft impulse turbine for very large sets on account of the troubles which had been experienced. At any rate, one of the principal designers in the States, when discussing the Barton machines, said that he would not care to design or manufacture the Barton machines having such a large heat drop as they would have in a single cylinder; further, he thought the economical temperature of the steam should never exceed 700 deg. Mr. Pearce said he saw the 30,000-kW Brush Ljungstrom machine delivered by the General Electric Co. in course of construction, and it was interesting to know that the G.E. engineers did not believe that the thermal economies which were expected to be obtained from that machine would counterbalance the excessively heavy cost of construction. One was surprised to note the small average size of turbines, resulting partly from the fact that all turbines had been included whether for power stations or industrial work. Probably if power stations alone had been taken they would have shown a higher average, though the percentage in favour of the impulse, as against reaction type, might possibly not be quite so high if some of the smaller impulse machines were ruled out. The American Westinghouse Co.'s machines, chiefly of the reaction type, had been freer from trouble than the G.E. machines. The company had built turbines up to 30,000 kW rating in a single cylinder with a sort of semi-double end. It had an impulse wheel and reaction, and those operated from a l.p. double end. But the tendency seemed to be to go in for the purely reaction two-cylinder machine with a double l.p. end. For outputs bigger than 35,000 kW the company had adopted the triple-cylinder cross-compound type, which was really a very interesting machine. The Duquesne Electric Lighting Co.'s station had been built for five 50,000-kW sets of the triple-cylinder cross-compound type, which would show a slightly superior thermal economy to anything else the speaker came across in the States. Their steam pressure was 300 lb. and vacuum 29 in.; with 1 h.p. and 2 l.p. cylinders the steam consumption was 10¼ lb.; 1 h.p. and 1 l.p. 11.2 lb., and 2 l.p. 14 lb. The points in favour of the triple-compound type were that the separate cylinders enabled the high and the l.p. elements to be designed quite independently and, therefore, to the best advantage as regarded speed and mechanical strength. Secondly, a slightly higher thermal efficiency could be got for the combination in comparison with single sets of the same aggregate capacity. Thirdly, the l.p. turbine could be run even if the h.p. cylinder was out of commission. Against the arrangement was the extra capital outlay per kW installed, the extra floor space, and last, but not least, the extreme complication of working. It was a question of balancing the points for and against, but he did not think the requirements of this country were likely to call for 60,000-kW sets, so probably the point would not arise. The Interborough Rapid Transit Co., which was responsible for the introduction of that machine, in its latest extension had reverted to the single-shaft single-cylinder turbine. On the question of the feed water, the author was an optimist, and so far as the total elimination of erosion was concerned he had gone a little too far. It could not be done completely by arranging the feed water in a closed cycle. They must go further than that, and certain arrangements were receiving attention at headquarters. The use of kerosene was first made in this country at Stuart Street; the idea was originally extracted from some German technical production. The Glasgow results given by the author were extremely valuable. If they could get those results in Glasgow the speaker was perfectly certain they would beat them at Barton. The broad conclusion he had come to on British and American practice was that American manufacturers were not so advanced in the development of turbine engineering on sound lines as British manufacturers. He had compared the best plant in each case, and they showed less high percentage efficiencies. He reported on those lines to his committee when he came back from the States, and he sent a copy of that report to a very eminent consulting engineer on the other side of the water, who said: "I agree with you entirely. I regret that I have to do so."

Mr. Newton was in general agreement with Mr. Baumann's opinions. There was still a certain reluctance amongst engineers to accept high-speed turbines; he expressed a very strong preference for the high-speed turbine as being the more reliable. Chrome nickel steel disks showed a very slight percentage of trouble up to about 30 or 36 in. diameter. Larger forgings of the same kind of steel had shown a very great percentage of scrapping in the shops. In one case, out of ten disks eight were scrapped, a most heartbreaking experience. Except for the largest stations, he would choose turbines of from 12,000 to 15,000 kW at 3,000 r.p.m.

Mr. G. A. Juhlin thought that the author's opening remark that there was no advantage to be obtained on the electrical side from high speed was perfectly correct, but development had nevertheless taken place in order to take advantage of the increased economy on the turbine side. British practice headed the list, and the actual development of large sizes started with the 10,000-kW set which was already begun in 1916, but it could not be proceeded with on account of the war. They were in a position to ask the turbine builder to follow the alternator, as they had no difficulty in producing the electrical end so as to absorb the power of any of the turbines that a designer might put forward. He associated himself very strongly with the author's recommendation with regard to factors of safety. That point was of particular interest on the electrical side where they dealt with a high-tensile material such as nickel-chrome-vanadium steel.

Mr. K. Baumann, in reply, pointed out that if a disk vibrated on a four-nodal diameter it meant that the deflection of the disk itself was very small. They had attempted to measure that deflection, but had not been successful. The only conclusion that it was vibrating on a four-nodal diameter was based on work which had been done for them by the greatest authority on the subject, who said there was a possibility of the disk vibrating on a four-nodal diameter. In the States in the Curtis turbine made by the Westinghouse Co. the shrouds of the various blades were brazed together so as to prevent vibration, but he was not sure whether it would pay in their type of turbine; he preferred to get something more substantial. For very large sets the use of two-cylinder designs might be desirable, but in this country they had not arrived at that size under ordinary steam conditions, and with sets such as they were making or modern power stations they were on the right lines as far as single-cylinder construction was concerned. The speaker did not think the power station of the future would contain the 35,000 and 30,000-kW sets of which they had heard a great deal. He had become a little more conservative than he was before he went to the States, and did not think the 50,000-kW turbine was necessary. He would not recommend the development of 50,000-kW machines if that involved a speed of more than 2,000 r.p.m.; future turbine development must be on the lines of increasing the output of the 1,500-r.p.m. machine, and progress in that direction would depend to a certain extent on the output which could be obtained from the alternator at that speed. A 35,000-kW economical rating could be used, but it would be better to go slow in that connection. A modern single-cylinder machine would be very satisfactory, and single-cylinder turbines could be made which did not involve the use of any large diameters; large diameters were responsible for a deal of the trouble in the States—not only from disk vibration, but also trouble resulting from large deflection.

The Magnetic Declination.—According to the report of the Astronomer-Royal, the mean magnetic declination for the year 1920 was 14° 8·7′ W; it is decreasing by 9·5′ a year.

JOINT ELECTRICITY AUTHORITIES.

The West Riding Inquiry.

(Concluded from page 767).

THE POWER COMPANY'S CASE.

Shortly before the adjournment on May 25th, Mr. HUNTER GRAY, K.C., opened the case for the Yorkshire Electric Power Co. He quoted at length from a report of the Conference engineers, and suggested that the facts and figures given there, as a result of close inquiry, relating to the Power Company's undertaking and the existing undertakings of the various local authorities, showed very good reasons why the supply of electrical energy in the area should remain in the hands of the Electric Power Company. He acknowledged the various witnesses' generous references to the work of the company during the course of the inquiry. The attitude of the company was not one of obstruction. It was desirous, within its powers, of helping to better the interests of the community, but it would be absurd for the company to pretend that its first duty was other than to look after the interests of its own shareholders, particularly as certain classes of its investors had been unremunerated for some years. The company believed it was possible to arrive at a much better condition of affairs than existed to-day. The Leeds scheme foreshadowed the demise of the Power Company by slow starvation, and if the company had to choose between such starvation and being brought out at a fair price, he did not think there was much doubt as to its choice. If the Commissioners or the parties came to the conclusion that the Power Company should be bought out under either scheme, the first difficulty would be in arriving at the price. The second, and more serious, difficulty was that of satisfying the company as to the security for the payment of the moneys which might be agreed upon. He had heard nothing in the inquiry which would satisfy the company that a figure approximating the large figure justified could safely be guaranteed to the Power Company. The company was not desirous of parting either with the whole or any part of its undertaking, and he offered three alternative proposals, submitted in order of preference to the company. If none of these was acceptable, the company would consider, under certain circumstances, the transfer of its undertaking.

The three proposals were: (1) That the company was willing and able to undertake the responsibilities of a Joint Electricity Authority in the district; (2) the company was prepared and had formulated its plans to go on under its present powers and also to supply those districts in which there were no authorised distributors; (3) the company was prepared to go on under its present wide, though in some respects not wide enough, powers. He agreed, with regard to the first proposition, that except in name the company could not act in anything but a private capacity, but doing everything which the proposed public Authority would have to do, and it would have to be done under the supervision of the Commissioners. He maintained that this was the most simple and effective solution of the serious difficulty which existed in the district. For twenty years the company had been developing steadily along the lines laid down by the promoters of the schemes as necessary to supply the district with energy.

In answer to a comment by Mr. H. Booth that if the company became the Authority it would have to get Parliamentary powers, Mr. GRAY said that if the Ferrybridge station were built on the scale contemplated in the company's application, it would have the necessary capacity. So far as he knew there was no limitation beyond the fact that under the 1901 Act the company was precluded from supplying in certain districts, including some of the districts represented by Mr. Greene. He imagined the necessary powers could be obtained by special Order of the Commissioners without going to Parliament; but if Parliamentary machinery were necessary, it would be set in motion by the company. He could not recommend the second and third proposals as so desirable as the first. In every respect the Ferrybridge site was suitable. There was ample water supply already, a peculiarly suitable site for the ashes, and a convenient site for the fuel. Some 25,000,000 kWh were at present supplied by the company, and there was every reason to expect a big development of the colliery demand for electricity and a demand for the Port of Goole. Mr. Gray pointed to the engineers' report as having admitted that the desirable alternative to the public Joint Authority suggested was for the Power Company to be appointed the Authority, which, from an engineering point of view, would be a most satisfactory arrangement. For all the practical purposes affecting the interests of the community he contended that it was sound that the Power Company should supply the whole area, and he held that it was only for political reasons—the question of municipal trading as against private trading—that company control was precluded in the view of the Conference.

On May 26th Mr. W. B. WOODHOUSE, engineer and general manager of the company, was in the witness-chair for the greater part of the day, and it was gathered from his evidence that the company's proposal was to extend its own powers and operations and to leave the present authorities in control of their own generating stations. By this means amicable arrangements could be reached which would prove equally effective and would occupy far less time than the establishment of a Joint Electricity Authority. He pointed to the company's past experience in reaching working agreements as proof of his contention.

At the outset Mr. WOODHOUSE stated that the average density of population in the company's area was 0.6 per acre, while in the large boroughs it was 13.7 per acre. The load factor of kWh sent out from the company's system for the year 1920 was 35 per cent. For the year ending March of that year the average cost to the company per kWh sent out of its stations was 0.667d., based on the average price of coal for the period—£1 7s. 4½d. per ton—while the average price charged for energy was 1.452d. per unit.

There were no fewer than fifteen local authorities whose electric lighting orders had been revoked because they did nothing with them, and it was because of that that the Yorkshire Electric Power Company had developed. To overcome the difficulty of distribution, the Electrical Distribution of Yorkshire, Ltd., was formed in 1905, for the purpose of supplying electricity purchased in bulk from the Power Company. Eight local authorities transferred their lighting orders to the company, which also took out additional ones, and it had also power to supply for traction purposes throughout the whole of its area—a power which it considered important. It had working agreements with 40 out of 63 local authorities, as well as with the Bradford Corporation, with which it had co-operated during the war to their mutual satisfaction. There were 31 districts in the company's area.

It proposed to erect a new generating station at Ferrybridge with plant of the capacity of 135,000 kW, and with the assistance of that and the plant of Leeds and Bradford it could supply the whole of the electricity for the area. Mr. Woodhouse enumerated a list of resolutions in support of the scheme from public and private bodies, and added that the company always had been and always would be ready to discuss any scheme with any other interested bodies in the area.

Mr. HUNTER GRAY, K.C. (for the company): Would the company consider parting with the undertaking at a fair price if the Commissioners thought it absolutely necessary?—The company don't wish to sell their undertaking, but they are prepared to continue its development. They have shown by their past work that they are best fitted to deal with this particular area.

Mr. E. WOOLL (for Leeds): The first criticism in your representations is that you don't approve of the area. Have you any objection to it beyond the obvious fact that it involves a certain severance of your undertaking?—No.

You submit that there is no necessity for a Joint Electricity Authority. I should not think you put that forward with very grave conviction?—We do. There is in existence a company which can carry out the duties of a Joint Electricity Authority. The company is in a position to deal with this matter at once, without any delay or any call on the Treasury or on any public service.

Mr. A. T. MILLER, K.C. (for the Conference scheme): Your proposal would leave each large municipality in its present position in control of its own generation?—Yes.

If the Power Company could obtain control of all these generating stations would that be an advantage?—I don't think the present is the time for a change of ownership, and I don't see the necessity for single control of all generating stations. I think all the advantages to be obtained by single control could in practice be obtained by agreement.

You would expect to have no difficulties in the continued existence of generating authorities controlling their own management in Leeds, Bradford, Halifax, Huddersfield, Barnsley, Keighley and these other places?—No. I think our experience shows that these difficulties can be got over.

Mr. A. G. LUPTON, Chairman of the Yorkshire Electric Power Company, gave evidence as to the capital issues of the company and its growth since inception, and was followed by several witnesses, colliery managers, and secretaries, who spoke as consumers for the retention of the Power Company at present. Mr. ARTHUR THOS. THOMPSON, general manager of the Manvers Main Collieries, and also authorised to speak for the South Yorkshire Coal Trade Association, said they thought the municipal schemes altogether too large and not tending either to efficiency or economy, as managed by municipal bodies. They much preferred to get what they wanted from a private firm managed by business people who understood their work.

Mr. J. H. COCKBURN, secretary of the South Yorkshire Coal Trade Association, said it was not practicable and could not reasonably be expected that any electricity authority composed of representatives of local authorities could ever make its scheme pay. It was a gigantic mistake, his association thought, and everyone would be doomed to disappointment.

Mr. H. F. SMITHSON, general manager of the Airedale Collieries, Castleford, was the last witness, and all agreed, in reply to Mr. E. Wooll, for Leeds, that a scheme retaining the company was preferable to one providing for its immediate acquisition.

On Friday—the ninth and last day of the inquiry—Mr. Henry Pickard, chief engineer to the trustees for the Aire and Calder Navigation, Ltd., gave evidence in favour of the Power Company's proposed capital station at Ferrybridge. He said that site was in the heart of the coalfield, plentifully furnished with water supply for condensation, and handy for delivery of coal. A station there would help in the development of the coalfield and of the Port of Goole, to which ships up to 2,000 tonnage could be brought 50 miles inland. In answer to Mr. R. A. Shepherd (for the Yorkshire Power Co.) witness said Esholt was not well placed for coal delivery, and there was practically no flow in the river in the dry season, as against a good flow at Ferrybridge.

In reply to Mr. E. Wooll (for the Leeds scheme) the witness agreed that the coal facilities and water flow were rather better at the South Accommodation Road site at Leeds, but the site was so confined in area that he would not think of erecting a capital station there.

Mr. Roslyn Holiday, J.P., a member of the West Riding County Council, general manager of the Acton Hall Collieries, and chairman (during the war) of the West Yorkshire Coal Supplies Committee, gave evidence on behalf of the West Yorkshire Coal Owners' Association, which had an output of 15,000,000 tons per annum. He pointed out the disadvantages of disturbance of the present electricity supply arrangements, leaving pits under the same control to be in the area of two different district electricity authorities. This would be particularly awkward where pits were electrically connected underground. The coalowners knew there would be extensive mining developments east of Ferrybridge which would require much electrical energy, because as the coal got further east it became non-coking, and therefore the possibility of using gas power from coke-oven waste heat became remote. As business men, the coal owners felt that private enterprise was desirable, because in anything which a business man would not risk his money, obviously it would not be judicious to risk the public rates. Owing to the competition of the South Yorkshire Collieries, the West Yorkshire owners had to look far forward in search of cheap power, and therefore they had put their money into the Electric Power Company, although they knew they might not get a return for a long time. They believed the proposed Ferrybridge station of the Power Company would meet the requirements of industry in the area.

Questioned by the Chairman (Sir John Snell), the witness thought the whole tendency of developments of power for mines was towards electrical power. Winding at present was largely by steam power, but the deeper the shaft the more valuable did electric power become, because its steady drive avoided the strain on the cable caused by the sudden impulses of steam power.

The Position of the County Council.

Mr. J. C. McGrath (for the West Riding County Council) said his clients represented a large proportion of ratepayers and consumers in the area concerned, and they wished to voice their appreciation of the care and trouble taken by the promoters of the respective schemes before the inquiry. It was with regret that the County Council could not agree with either scheme, because it fully realised the need for the utmost development of electricity in the West Riding. The Council held emphatically that the present economic conditions of the country and the character of existing legislation concerning electricity formed an inseparable barrier to the success of either of the schemes propounded, and this affected the Conference scheme in particular because the Conference proposed to take over existing undertakings immediately. One marvelled at the optimism of their case. The industrial conditions of the country were such as to discourage any venture to which was attached even the slightest possibility of any additional burden on the rate or tax payers. It hardly seemed possible for the Joint Authority to buy out the Power Company in these times at a figure which would enable it to supply electricity at a price comparable with that at which the Power Company, with its equipment secured in better times, could supply it. Mr. Miller had suggested that there were no special circumstances in this area which warranted a departure from the rule, as laid down by an Electric Inquiry Committee, in favour of public control; but he (Mr. McGrath) contended that if ever there were special circumstances they were found in the existence of an efficient supply scheme in this area, by way of the Power Company, which had served and was still serving a valuable purpose in the industrial life of the area. Both the schemes, in their essentials, were *ultra vires*, and based on something which could not be found within the four corners of the Statute.

The Chairman: The promoters of both have made it clear that they are dependent on the carrying out of the Government's pledge to pass into law the Electricity Supply Bill.

Mr. McGrath, concluding, said the suggestion of the County Council was that the Commissioners, rather than set up a Joint Electricity Authority in full control, might establish a representative advisory committee for the area to assist the Commissioners.

Sir John Snell pointed out that the intention of the Act in providing for advisory committees was not so much to have local area advisory committees, as to have committees to advise the Commissioners in general. Mr. McGrath said he quite recognised the intention of the Act, but he thought it could be applied in the way he suggested.

The Chairman said the point would be given due consideration by the Commissioners.

General Summing Up.

Mr. Alfred Tylor, urging representation for the railway companies on any authority set up, pointed out that neither the Leeds nor the Conference scheme provided for this, though the railway companies in the area had a rateable value of £885,000 per annum and a consumption of electricity for lighting and small power in the district of 2,000,000 units in 1920. Electrification of the railways in the area might not be so far off as might be thought, and for them to carry out their obligations to the public the supply of cheap and abundant energy was important. The railway companies were prepared to co-operate in whatever scheme might be adopted. None of the lines in the area were yet electrified, but the density of traffic was of a nature similar to that of part of the Lancashire and Yorkshire Co.'s line in Lancashire, which was electrified. Electrification of the lines in the area was not an improbability in the future, and the railway load in that case would be an important factor in the amount of plant to be installed in the capital station. At the same time Mr. Tylor did not suggest that electrification was imminent, and the estimates of Mr. Woodhouse on that ground, in his evidence for the Power Company, should be regarded with due reserve. All things being equal, the railway companies had failed to find any fault with private enterprise electricity supply hitherto or with the supply likely to be given by private enterprise in the future. They recognised the advantages of centralisation as a means of reducing capital costs, and recognised also that centralisation would probably entail some sort of public control. The criticisms put forward at the inquiry on the forms of constitution of the Joint Authority could be met by modifications, but in neither scheme, so far, was there provision for proper representation of the railway companies or other large consumers.

In answer to Sir John Snell, who asked if Mr. Tylor could give a rough indication of the railway traction load for the district, Mr. Tylor said he was advised that the 75,000-kW ultimate load estimated by Mr. Woodhouse seemed to the railway engineers to be very optimistic, even assuming that all the railways in the area became electrified.

The Chairman expressed some surprise to hear this, in view of the present actual railway load in Lancashire.

In response to representations by Mr. Woodhouse that the Distribution Company, which was not proposed to be bought out, should have proper representation on whatever authority might be constituted, the chairman said that was covered by Section 6 of the 1919 Act, providing for the representation of all authorised undertakers in the area.

Mr. J. A. Greene, defining the final attitude of the many smaller local authorities comprising the West Riding District Councils' Association, said his clients did not desire the setting-up of a Joint Electricity Authority at all, but much preferred that the authorities which had generating stations fit to be continued should come to a working agreement with the Electric Power Co., and that, in order to avoid any danger of the company's taking a too purely commercial view of the obligation to the public, there should be an advisory committee comprising elected representatives of all the local authorities in the area, on a proportional basis of population. The most dominant factor to-day in any scheme of electricity supply was the financial factor, and the suggestion he put forward would cost practically nothing. The authorities Mr. Greene represented included in their areas many of the collieries as to which evidence had been given, had a population of some three-quarters of a million, and a rateable value of some 2½ millions sterling, whilst, whatever might be the outcome of the inquiry, the big boroughs had their own electricity supply assured, the smaller authorities were greatly affected by what might happen to the Yorkshire Power Co. The present was not a time at which great expenditure should be incurred, even if it might be said in the future that spending now would have been cheaper in the long run. The establishment of a Joint Electricity Authority under either the Leeds or Conference schemes would mean the setting up of a spending authority, with big public funds behind it, whereas if the matter were largely in the hands of a private company, that body would watch demand closely and develop strictly according to requirements on a really commercial basis.

Sir Harry Haward commented on the fact that Mr. Greene's case seemed to indicate that his smaller authorities admitted themselves to be more vitally interested in the question of supply than any of the bigger authorities, and he had pressed for representation, and yet they were not prepared to bear any share of the financial responsibility.

Mr. Greene maintained that the opposition to the pledging of rates was a solid one. It was all very well to say that it was going to be a mere paper transaction, and that there was not likely to be any call on the rates; but he submitted that the Conference authorities dared not go to the ratepayers and ask: "Will you pay a rate to obtain a supply of electricity?" He contended that the blunt question: "Will you pledge your rates?" had never been put to any of the constituent authorities of the Conference. With regard to the merging of the areas into the Authority, he held that, despite the denials of the promoters, the scheme actually contemplated compulsion on the undertakings to come into the Joint Authority. If it was intended that those which came in voluntarily should be given energy on preferential terms, that would be a vicious principle. Such a threat did not seem to be legal or likely to secure the sanction of the Commissioners. The Joint Authority must deal with the area as a whole. The smaller authorities would strongly object to the Yorkshire Power Co. being bought out at a high price for the theory of giving the supply into the hands of local authorities. The consumers in the area were satisfied that the Power Co. was already supplying energy at as cheap a price as was practicable. He submitted that no case had been made out for either of the schemes.

Mr. Hunter Gray, K.C., summing up the case for the Power Co., pointed to the fact that practically without exception all the parties had acknowledged that the company had carried out its obligations properly, and had given a cheap supply of electricity. He had not lost hope that agreement between the parties and the company would be reached, either in the immediate future or subsequently. It appeared to be agreed that both the Leeds and Conference schemes, as they stood, were impracticable—the one because it depended upon the consent of the Power Co., and the other because it depended upon that and also upon obtaining fresh powers. That the prices charged by the company were not fixed merely with a view to making dividends for the shareholders was proved by the absence of any dividend for 12 years and until five years ago. It had to be recognised that the intention of the Act of 1919 was to secure co-ordination, but the formation of Joint Authorities was optional to the Commissioners, and he submitted that the West Riding was one of the most notable exceptions to the general intention of the Act, so far as concerned the setting-up of such authorities. The Power Co. was willing and able to supply the whole district under the supervision of an advisory committee, without any of the expenditure suggested in the two schemes, but the company should be given that security of tenure which would enable it to obtain capital, so long as it carried out its obligations in an efficient manner. He suggested that in the absence of agreement between all the parties, the best way out of the difficulty was to give the Power Co. the right to complete its Ferrybridge station at once and undertake the supply of the whole district, under the advisory committee suggested by Mr. Greene.

Mr. A. T. Miller, K.C., closing the case for the Conference scheme, submitted that the Leeds scheme had proved to have the support of practically nobody, and the Yorkshire Power Co.'s scheme was hardly a scheme at all. He suggested that if the hopes of agreement broke down it would be impossible for the Commissioners to come to a decision which would be in the best interests of the community. The result of the inquiry would be, he held, to demonstrate that the best solution of the problem was one on the broad lines of the Conference scheme. The inquiry itself was based on the acknowledged necessity of co-ordination and avoidance of waste and lack of economy involved in a large number of generating stations being run separately and independently. The objections of the County Council and the District Councils' Association sprang from a fear of charges on the rates.

Mr. Wooll, concluding the Leeds case, said there was little disagreement between the schemes, but he must repel the criticisms which indicated that the schemes were extravagant. To get the full harvest there must be the necessary initial expenditure. There was undoubtedly a certain measure of demand for the public control of electricity generation, mainly by public bodies, to the west and north-west of the district. The largest and most important single public body in the area—Leeds—was unable to adopt the views of the bodies comprising the Conference, and saw the better results in a judicious combination of the enterprise of public bodies and a private company. So far as there had been any evidence before the inquiry on behalf of the commercial views of the area, those views were unanimously in favour of the encouragement of private enterprise. Neither the Leeds nor the Conference scheme had, for the moment, been able to produce any evidence of commercial or industrial support. On the only commercial evidence called it would be difficult for the Commissioners to do anything to determine the existence of the Power Co. The Leeds scheme had been put forward as a statesmanlike compromise, but two vital principles on which there could be no compromise were the facts that Leeds was determined to retain its electrical autonomy—it would not part with control of its own generating station—and Leeds was opposed to the principle of acquisition of the Power Co.

Sir John Snell: Do you mean they would decline to take a supply in bulk from an outside authority if the company, for instance, were allowed to erect the Ferrybridge capital station and Leeds were not permitted to put up any further station?

Mr. Wooll: Oh, certainly not; on proper terms they would buy if required, but they would not have it unloaded on them.

Sir John Snell: You object to the acquisition of the Power Co., and yet your own scheme provides for it in 42 years?

Mr. Wooll: At the end of 42 years it *may* be acquired, but I regard that as a declaration of non-intention rather than of intention. We recognise that this is an efficient and economical company, and that it is to the interests of the community that it should continue without being acquired on political principles.

The counsel thanked the Commissioners for their patient hearing, and the inquiry was closed.

London & Home Counties Area.

The Electricity Commissioners opened their inquiry into the London electricity supply at the Institution of Electrical Engineers on Tuesday. All the Commissioners were present, namely: Sir John Snell (chairman), Sir Harry Haward (vice-chairman), Mr. H. Booth, Mr. A. Page, and Mr. W. W. Lackie. They were accompanied by Mr. E. W. Hudson (legal adviser).

Mr. Ll. B. Atkinson (president of the I.E.E.) offered the Commissioners a welcome to the Institution building, and the chairman tendered the thanks of the Commissioners to the Council of the Institution.

The notice given by the Commissioners with regard to the holding of the inquiry was then read. In this it was stated that the Commissioners would inquire into the area to be included in the proposed district and the objections and representations which had been made on account of the inclusion in, or exclusion from, the said district of certain areas, and to consider schemes submitted by (*a*) the London County Council, (*b*) the Conference of Local Authorities owning electricity undertakings in Greater London, (*c*) the London Electricity Joint Committee, 1920, Ltd., (*d*) the Metropolitan Borough Council of Poplar, (*e*) the Great Eastern Railway Co., and (*f*) the London Brighton & South Coast Railway Co.

The Chairman said that the schemes would be dealt with in the order given. The first three schemes were much in agreement on some points, but differed with regard to the composition of the joint authority, and other matters of principle, and this measure of agreement would obviate the reiteration of evidence. The Commissioners would sit on Tuesday, Wednesday, Thursday and Friday of each week.

Mr. Craig Henderson, K.C., who appeared on behalf of the L.C.C., then briefly introduced the scheme presented by that body. In doing so he said that the position which the L.C.C. wished to take up was that it regarded it as a duty and a pleasure to assist the Commissioners so far as they could in their difficult task, and looked upon others who were presenting other schemes or lodging objections to schemes put forward, not as opponents, but as helpers in arriving at what would be the best scheme for the London area.

Referring to the interest which the L.C.C. had taken in the question of electricity supply, counsel said that when the Electricity Supply Act, 1919, was passed, in fact before it was passed, the Council at once proceeded to form committees to look into the proposals of the Bill, and see what they could do towards drawing up a scheme which might be suitable. They entered into communication with the Conference of Local Authorities, and with some of the electricity companies in London, with the result that a Committee of Engineers was formed, which drew up what was now the technical scheme of the L.C.C. proposals. Dealing with this, counsel, after mentioning the increase of plant installed in the area delimited by the Commissioners, between 1914 and 1920, namely, about 18,000 kW per annum, and the increased works costs per unit sold as between 1914 and 1920, this being .69d. in the former and 1.55d. in the latter year, said that the outstanding difficulty of the problem was to build new stations and install new plant. The financial conditions existing at the present time were such that to shut down certain stations which otherwise might have been advantageously scrapped and replaced would be impossible, so that the L.C.C. scheme was based on the retention and development of certain existing stations, with the gradual replacement of other stations in the area. When the scheme was originally presented it was contemplated that it might be possible to build one or more new capital stations by the year 1925-26, and the second stage was to be completed by 1930-31, but it had been considered that it would not be advisable for a joint electricity authority to burden itself with the cost of a capital station under present conditions. Therefore, in the supplementary particulars lodged at the request of the Commissioners, the first stage of the scheme was deferred, so that the authority could properly organise the existing facilities in the area to-day as a preliminary stage. The scheme proposed that eventually there should be four new capital stations, each with a capacity of 250,000 kW, and that two existing stations should also be reconstructed on a much larger scale than they were at present. All the new stations would be situated on the Thames, one at Chiswick and the remaining three east of the Blackwall Tunnel; the stations to be reconstructed were also in East London. The engineers responsible for drawing up the scheme had satisfied themselves that to supply the proposed area it was impracticable to work from one station, having regard to the physical conditions regarding mains in the London area. The new station at Chiswick would take the greater part of the western load, whilst the remaining three, together with the reconstructed ones, would supply East London, where the load was heavier.

Coming to the administrative provisions of the scheme, the local authorities were, said counsel, in agreement with the L.C.C., that it was necessary from the outset to have a central body charged with the administration of the electricity supply in the area. There was some diversity of view, however, as to the constitution of that body. The Council suggested that the joint authority should be as small as possible, consistent, of course, with the adequate representation of the different authorities. It was proposed that it should consist of 28 members, or 29 if the chairman were elected from without. Of those the County Council were to have eight representatives, the local authority undertakers six, company undertakers six, purchasing authorities outside the administrative county and other local authorities outside not owning undertakings four, railway companies two, and workers in the industry two. The L.C.C. had in view that they were a very large governing authority in the area, and were the purchasing authority for company undertakings in the area, subject to certain rights. Company undertakings to-day represented a capital expenditure of over 20 millions in the proposed area, and the local authorities 12 millions, making a total of 32 millions. The Council were also trustees for the public in the London area, and as such they should have considerable representation upon this central authority which was to control electricity supply. They proposed to transfer the purchase rights to the joint authority, and to include in the financial provisions a clause that the local authorities should be entitled to give financial assistance to the joint authority, on the lines of a similar clause in the Electricity Supply Bill No. 2. The County Council would be in a position to grant financial assistance also, but this would depend upon the constitution of the authority, and upon the adequate representation of the County Council upon it.

Dealing with the special provisions in the scheme, counsel submitted a number of suggested heads for agreement between companies and the joint authority on the question of purchase. These were not included in the scheme, because the Council could not be a party to any agreement for purchase, since their purchase rights would be handed over to the joint authority. The gist of the suggested agreement was that the authorised company distributors who could be compulsorily acquired by the L.C.C. in 1931 and thereafter at stated periods should agree to transfer their undertakings to the joint authority before 1931. In return for this, the companies would obtain a longer lease of life, because provision was made for leasing the undertakings until such time as the existing plant became obsolete. New plant would meantime be installed and the undertakings worked under the supervision of the joint authority.

With regard to the financial clauses, there was only one which raised a question of principle. This was Clause 58, which provided that the joint authority, for the purpose of meeting administrative expenses which were not properly chargeable to capital, and for the period during which no revenue would be received, should charge them on the supply undertakings existing based on the number of units sold. The question of the levy was the subject of some objection, as the L.C.C. would not pay anything towards these expenses.

Mr. George H. Hume (chairman of the Electricity Committee of the L.C.C.) confirmed the remarks of Mr. Henderson. As to the representation of the L.C.C. on that body, the Council had for many years been safeguarding the interests of the consumers, and they were the only authority which would directly represent the consumer. It was proposed that only the chairman of the joint authority should be paid for his services.

Mr. Hume was cross-examined by counsel and representatives on behalf of a large number of authorities. The Conference of Local Authorities and other municipal bodies represented separately objected to the proportions of the representation.

Watford Urban District Council and Poplar Borough Council asked to be left out of the scheme, as did the Hertfordshire County Council. On the other hand, Surrey wanted to be in, in whole and not in part. As regarded the nine London companies which are associated with the L.C.C. in the technical report, it was suggested that if a long lease, say 60 years, was granted, the necessary capital required by the Joint Authority could be found, the L.C.C. providing the interest. The railway companies, the North Metropolitan Power Co., and the Port of London Authority were all represented to safeguard their interests, and at the close of the cross-examination, the Commissioners put some questions to Mr. Hume.

Mr. J. H. Rider followed, but only a few minutes remained of the day's sitting.

(To be continued.)

REVIEWS.

The Dynamical Theory of Gases. By J. H. Jeans. Pp. 442; 44 figs. London: Cambridge University Press. Price 30s. net.

Most of our readers will already be acquainted with Prof. eans's important book on the dynamical theory of gases. hich first appeared in 1904. A second edition was called for 1916, which was largely rewritten in order to bring the atter up to date, this subject having received a great deal attention from mathematicians and physicists during the terval. A third edition has now appeared, in which conderable emendations have been made in order to keep up ith the growth of knowledge, and the author has added an tirely new chapter on the vexed subject of Quanta, emacing the recent work of Ehrenfest, Sommerfeld, Epstein, d others in this most interesting field of scientific conjecture. is this chapter which will chiefly commend the new edition readers of the original book, and some such brief description of its contents as can be appropriately made here is doubtless what will interest them most.

The lucid style of the author is nowhere more apparent than in his manner of approaching this difficult subject of Quanta, in which the laws of classical mechanics, as enunciated by Newton, are set at naught—or, if not exactly at naught, at considerable discount. The classical mechanics permits of any number of continuous motions for every dynamical system. Quantum mechanics does not. Motions which conform to the classical mechanics, but violate the equations of restrictions imposed by the quantum theory are spoken of as "disallowed" motions. This new principle of quanta has been erected to account for certain anomalies of experience to which the dynamical theory of gases leads up to in a very natural manner. We know that all the molecules of a gas tend to move with the same energy. That is to say that the energy of a gas tends to become equally divided among all its molecules independently of their several weights, so that the heavy ones move slowly and the light ones rapidly. The same is true of vibrations. The tendency is for the short vibrations of a continuous fluid to be performed with the same energy as the long vibrations, and as there are so many more of the former, a vast proportion of the total energy must be accounted for by the smallest vibrations. Thus when the smallest vibrations are infinitesimal, as should occur in a structureless medium such as the æther is supposed to be, all the energy of any material in contact with it should pass from the matter to the æther, and stay there. In the words of our author: "It follows there can be no equilibrium between matter and radiant energy until the matter has lost all its energy by radiation." This, however, is a state of things that does not correspond with fact. It is a fundamental want of correspondence which crops up in a great variety of electrical and optical phenomena, and the difficulty is to discover some theory which will reconcile them all.

One way is to suppose that the æther, though subject to every kind of vibration, does not permit of direct interchange of energy between vibrations of different wave length, and to suppose, further, that such interchange can only be effected by the intermediation of matter in some form, and then only in "quanta," or parcels of a fixed amount; suppositions very difficult to maintain in face of the phenomena of diffraction and interference. On the other hand, photo-electrical phenomena afford powerful evidence in favour of the belief that the idea of a quantum of energy corresponds to something that has actual physical existence.

The theory of quanta is a bud upon the tree of knowledge wherein growth is just now going on at highest intensity. That is what makes the subject so interesting. It may turn out after all that the quantum, like entropy, is merely a mathematical symbol, by help of which correct calculations may be made, one that represents nothing objective in the actual world. That remains to be seen. The molecule is now receiving more attention perhaps than the world itself, if the quality of the minds attending be taken into account, and in the next edition of the book before us it will doubtless be considered necessary to advert to the isotopes present in many of the gases whose atomic weights embrace a fraction. Chlorine, for example, exists in two forms whose chemical properties are the same. One form has an atomic weight of 35 and the other form has an atomic weight of 37. All our chlorine having been derived from the sea contains the two in much the same proportions, so that chemists are agreed that 35.46 is the atomic weight for the mixture. On the subject of the atom one could write on unceasingly, so much is being done to unravel the mystery of its structure. The more that is known of this, the more certain becomes the dynamical theory of gases, and doubtless this book is destined to undergo revision in the light of new facts, at intervals of a few years. Long may the author be spared to make the necessary adjustments. His last sentence in the book: "The field which remains unexplored is incomparably vaster and more important than that which has so far been conquered," shows he has Newton's sense of the endless task ahead.

An Amazing Presumption, or an Outrageous Attack on the Great Panjandrum. By Skepticus. Pp. 164. Manchester: John Heywood, Ltd. Price 5s. net.

This book consists of a report of a series of smoking-room gossips between three individuals having the worthy but commonplace names of Tom, Dick, and Harry. They start a discussion on authority and agree that, in general, authority is intolerant and opposed to progress. In dealing with the special case of educational authorities, they make clear that the professional tribes are for the most part only animated gramophones. This is commonplace to almost every undergraduate who is at all observant. This part of the book seems to be a very feeble reflection of Denis Bradley's famous aspersions on bureaucracy.

Dick then develops his views by confuting to his own great satisfaction, and the expressed admiration of his cronies, the sacred doctrines of "the impossibility of perpetual motion," and "the conservation of energy."

The reviewer tried hard to glean some information or amusement from Dick's discourse, but gave up in despair.

Dick's smoking-room friends finally induce him to allow his notes to be published, with the above book as the result.

In the opinion of the reviewer he was ill-advised.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

14,815. "Thermodynamic gas generating systems." A. César and E. Franchimont. May 27th. (Belgium, August 20th, 1920.)

14,816. "Means for receiving alternating current electric signals." F. E. Pernot. May 27th.

14,822. "Terminal connection for electric cable, &c." C. A. W. Drury and S. W. Drury. May 27th.

14,849. "Electric connections or couplings." O. T. Banks. May 28th.

14,872. "Telephone call distribution system." G. Deakin and Western Electric Co., Ltd. May 28th.

14,884 "Remote control systems." W. J. Rickets and E. A. V. Sanftleben. May 28th.

14,895. "Electric horns, &c., for motor vehicles." W. F. M. Rose. May 28th.

14,918. "Electric glow lamps." R. L. Woosnam. May 30th.

14,954 "Synchronised non-synchronou machines." Campagnie Générale Electrique. May 30th. (France, October 27th, 1920.)

14,966. "Thermionic valves for reception of wireless signals." C F. Phillips. May 30th.

14,975. "Disconnecting electrical cable joint-box fittings." W. E. Kidner. May 30th.

14,977. "Synchronised non-synchronous machines" Compagnie Générale Electrique May 30th. (France, March 23rd.)

14,979 "Wireless signalling systems." British Thomson-Houston Co., Ltd. (General Electric Co.). May 30th

14,980 "Dynamo-electric machinery." F. Murgatroyd. May 30th.

14,996. "High-frequency electric generators." G. Krawinkel. May 30th.

15,009 "Electrical water-heating attachments." F. H. Austen and E. C. Young. May 30th.

15,028. "Electric induction motors and electrical controlling devices." M. Walker. May 31st.

15,047. "Process for electrolytic refining of tin." W. P. Thompson (W. J. Aitkens). May 31st.

15,062. "Electro-magnetic wave signalling systems." M. Latour. May 31st. (France, December 8th, 1915.)

15,075. "Alternating-current electrical instruments." E. W. Hill and G. F. Shotter. May 31st.

15,090 "Guard devices for conductor rails of electric railways." D. Robinson. May 31st.

15,115. "Copying-telegraphs." M. H. Petersen. May 31st. (Norway, June 17th, 1920.)

15,117. "Synchronous electric motors." Siemens-Schuckertwerke. May 31st. (Germany, July 26th, 1920.)

15,128. "Electric arc-welding machines." British Thomson-Houston Co., Ltd. (General Electric Co.). May 31st.

15,164. "Electric ignition systems." H. L. Curzons. June 1st.

15,171. "Electric, &c., motors." G. F. D. Campbell, W. Heap and J. Meredith. June 1st.

15,182. "Quick make and break electric switch." J. W. Johnson and R. W. Scott. June 1st.

15,209. "Semi-automatic electric signalling." L. R. Gleason and V. Swettenham. June 1st.

15,223. "Magnetos." J H. Runbaken. June 1st.

15,232. "Vapour lamps." E. J. Cleburne and W. H Cleburne. June 1st.

15,245. "Electric commutators for ignition systems of internal-combustion engines." D. A. V. Rist. June 1st.

15,256 "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. June 1st. (United States, June 18th, 1920.)

15,261. "Resistance units." Mickelwright, Ltd., and W R. Mickelwright. June 2nd.

15,265. "Electric burglar alarm." A Hynes. June 2nd.

15,283. "Dynamometers." Kapella, Ltd., and F. W. Preston. June 2nd.

15,284 "Wind dynamos." F. A. Wilkinson. June 2nd.

15,285. "Gear-cases of tramcars." T C. Winfield. June 2nd.

15,294 "Electric resistances." G. Pelletier and F. Pellin. June 2nd. (France, June 22nd, 1920.)

15,310. "Electrical means for transmitting and reproducing sound." A. F. Sykes. June 2nd.

15,316. "Valve transmission circuits for wireless telegraphy." H. Morris-Airey and L. G. Preston and G. Shearing. June 2nd.

15,324 "Apparatus for propelling conveyor trucks with electric drive." Siemens-Schuckertwerke. June 2nd. (Germany, June 2nd, 1920.)

15,341. "Electric alarms." A. W. Amos, A. I. Lloyd and W. E. Lloyd June 2nd.

15,342. "Attachment for sparking-plugs." L. E. Gilbert. June 2nd.

15,355. "Medical battery." T. Draper, G. G. Goodman and C. G W. Nye. June 2nd.

15,362. "Joining insulated electric conductors." Naamlooze Vennootschap Electriciteit Maatschappij Electrostoom. June 2nd. (Holland, June 5th, 1920.)

15,380. "Electrical relays." N. Robinson. June 3rd.

15,401. "Junction box for electric mains and protecting cover for terminals, cut-outs, &c." G. Tempini. June 3rd. (Italy, June 9th, 1920.)

15,402. "Fuse-box safety plug for low-voltage electric cable installations." G. Tempini. June 3rd. (Italy, March 5th.)

15,430. "Electric switch operating mechanism." British Thomson-Houston Co., Ltd. (General Electric Co.). June 3rd.

15,431. "Electric contact fingers." British Thomson-Houston Co., Ltd. (General Electric Co.). June 3rd.

15,435. "Electrodes, welding rods, and soldering sticks." Alloy Welding Processes, Ltd., and E. H. Jones. June 3rd.

15,440 "Radio-telegraphic transmitting stations." J. Bethenod June 3rd. (France, September 14th, 1920.)

15,446. "Telegraph systems." F. G. Creed and Creed & Co., Ltd. June 3rd

15,447. "Electric arc lamps." R Rigby. June 3rd.

15,459. "Joining insulated electric conductors." Naamlooze Vennootschap Electriciteits Maatschappij Electrostoom. June 3rd. (Holland, December 20th, 1920.)

15,460. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. June 3rd. (United States, June 30th, 1920.)

15,461. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. June 3rd. (United States, June 17th, 1920.)

15,462. "Signalling systems for use with electric staff systems on railways." W. A R. Richards. June 4th

15,485. "Spark-plug." O Troya. June 4th.

15,495. "Electrically indicating combined effect of two independent measuring factors or elements J E. Lea June 4th.

15,503. "Cable clamps" C W. Kemper and J T Kemper June 4th

15,520. "Electric measuring-instruments." British Thomson-Houston Co. Ltd. (General Electric Co.). June 4th

15,521. "Electric switch contact fingers." British Thomson-Houston Co. Ltd. (General Electric Co.). June 4th.

15,532 "Electric heating elements." C. B. Gresham and H. W Sullivan. June 4th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

1,742. "Couplings for electric heaters." Soc, Anon. Dite "Calor." January 24th, 1918. (122,840.)

23,069. "Electric signalling telegraphs." W. F. Grafton and A D. Jones. September 10th, 1919. (163,351.)

27,471. "Chassis of trackless tramway cars," G. A. Bishop and R. A. Chadwick. November 7th, 1919. (163,355.)

27,905. "Means for transmitting signals over electric supply circuits." P Trichard. November 11th, 1919. (Convention date not granted.) (135,194.)

28,649. "Electric baling-presses." J. H. Hindle and T. Hindle. November 19th, 1919. (163,365.)

29,629. "Water-tight electric light fittings." I. Kornfield and P. Etchepare. November 21st, 1919. (163,367.)

31,067. "Socket fittings for pin-and-socket connectors for electric circuits." L. M. Waterhouse, H. F. McLaughlin, and Simplex Conduits, Ltd. December 11th, 1919. (163,371.)

31,262. "Variable resistances, dimmers, or cut-offs for electrical installations." L. A. Gow. December 13th, 1919. (163,373.)

32,022. "Wall-plugs and like electric fittings." G. F. Ostins. October 5th, 1920. (163,382.)

1920.

404. "Spark-plugs." R. R. Hill January 6th, 1920. (163,387.)

1,610. "Brush-holders for dynamo-electric machines." W F Grafton. January 17th, 1920. (163,398.)

2,084 "Electro-magnetic switches." British Thomson-Houston Co., Ltd. (General Electric Co.). January 22nd, 1920. (163,407.)

3,454 "Electric plug fittings." W. E. Evans and D W. Dant. February 4th, 1920. (163,413.)

3,517. "Driving of dynamos." E. W. Scammel and S. H. Van Abbott February 5th, 1920. (163,414.)

3,750. "Railway signalling systems." A. E. Hudd, Automatic Telephone Manufacturing Co., Ltd. February 7th, 1920. (Cognate application 14,318, 20.) (163,418.)

3,836. "Automatic fire-alarm systems." R. G. Evans and C Thomas. February 7th, 1920. (163,419.)

3,889. "Time-limit relays, circuit breakers, or the like." A. Reyrolle & Co., Ltd., B. H. Leeson and J. Mirrey. February 9th, 1920. (163,420.)

4,104. "Means for supply of electric current to railway and like vehicles from the tracks." W. T. Jones. February 10th, 1920. (163,426.)

4,274. "Transmitters for wireless telegraphy and telephony." A. K. Macrorie, H. Morris-Airey and G. Shearing. February 11th, 1920. (163,118.)

4,454. "Wind-power electricity-generation plant." E. H. Jones and P. Burns. February 13th, 1920. (163,442.)

4,494 "Controlling devices for alternating electric current of variable frequency." British Thomson-Houston Co., Ltd., and H. W. Taylor. February 13th, 1920. (163,444.)

4,583. "Crystal detectors of electric currents" H. M. Dowsett. February 14th, 1920. (163,448.)

4,681. "Control of the excitation of dynamo-electric machines." British Thomson-Houston Co., Ltd., and F. H. Clough. February 16th, 1920. (163,454.)

4,739. "Valve transmitters for wireless telegraphy and telephony." A. K. Macrorie and G. Shearing. February 16th, 1920. (163,458.)

4,799. "Wireless communication." W. H. Eccles and J. H. Vincent. February 17th, 1920. (163,462.)

4,887. "Connectors for electric insulators." G. V. Twiss. February 17th, 1920. (163,467.)

5,007. "Electric incandescent lamps." F. Brighouse February 19th, 1920. (163,478.)

5,093. "Electric ignition devices for lighting torches and the like" H. Schlaich. February 19th, 1919. (139,205.)

5,161. "Electric switches." H. D. Pyne. February 20th, 1920 (163,486.)

5,172. "Detection of high-frequency electric signalling currents." British Thomson-Houston Co., Ltd. (General Electric Co.). February 20th, 1920. (163,487.)

5,178. "Switch and means for locking same for use in connection with the ignition circuit of an internal-combustion engine and the like." W. Howlett. February 20th, 1920. (163,488.)

5,715. "Multi step thermionic amplifiers." M I Pupin. February 4th, 1918. (139,494.)

5,783. "Signalling apparatus for use in mine shafts." R Blunt and H F. Mitchell. February 26th, 1920 (162,850.)

6,347. "Magnetos." E F Férat. February 18th, 1918. (Addition to 139,781.) (139,782.)

7,020 "Electric heater" P. J. H Bernard. March 8th, 1920 (163,525.)

7,176. "Electron-discharge devices." J. E. Lilienfeld. December 12th, 1919. (155,554.)

7,911 "Condensing steam electric locomotive." D. M. Ramsay and J. W. Wood. March 17th, 1920 (163,538.)

8,488. "Magneto-electric machine having a fixed permanent magnet and a fixed armature." L. N. Reddie (C. Olivette & Co.). March 22nd, 1920 (163,548.)

9,099 "Radio receiving systems." Western Electric Co., Ltd. January 5th, 1916. (141,040.)

9,223. "Signalling by high-frequency currents, as in wireless telephony." Western Electric Co., Ltd. May 18th, 1914. (141,047.)

9,337. "Electrical fuse holders." F. Shergold and A. H. Maxwell. March 31st, 1920. (163,562.)

13,053. "Electric switches and the like." T. Watson. May 11th, 1920. (163,590.)

14,268. "Machines for laying-up or twinning conductors for dry-core or other electric cables." W. T. Henley's Telegraph Works Co., Ltd., and H. Savage. May 25th, 1920. (163,594.)

16,403. "Telephone transmitters." Miessner Inventions Corporation. June 23rd, 1919. (146,105.)

17,530. "Rotary current distributors." J. A. Holm. June 28th, 1920. (163,609.)

18,686. "Sparking-plugs." A. L. Schmitz. July 5th, 1919. (146,824.)

18,691. "Electric controllers." Entz Motor Patents Corporation. July 18th, 1917. (146,829.)

18,831. "Starting and stopping devices for the electromotors of compressors, pumps, and so forth." J. Hulster. July 8th, 1914 (146,897.)

19,006. "Electric transforming apparatus for use with measuring-instruments." Compagnie pour La Fabrication des Compteurs et Matériel d'Usines a Gaz. May 8th, 1919 (147,048.)

19,228. "Automatic electric generating apparatus." Silent Valve Motor Corporation. September 15th, 1913 (147,166.)

19,937. "Manufacture of composite conductors for dynamo-electric machines and other electrical apparatus." Siemens-Schuckertwerke Ges. December 29th, 1917 (Addition to 147,571.) (147,885.)

20,045 "Interrupters for use in electric ignition systems." C. Rouquet April 26th, 1919 (148,141.)

20,263 "Contact fingers for electric motor controllers." Constructions Electriques De Belgique (Soc. Anon.). March 18th, 1919. (148,345.)

22,369 "Electric motor starting device for internal-combustion engines." R Bosch Akt.-Ges. September 22nd, 1919. (151,587.)

34,794. "Electric fuse fittings." A N. Penman. December 9th, 1920. (163,652.)

1921.

668 "Polyphase transformer with switch-connected tapping points fo changing the ratio of transformation." Bergmann-Elektricitats Werke Akt Ges. October 22nd, 1917. (156,672.)

5,614 "Electrically-heated muffle furnaces." Akt.-Ges Brown, Boveri Cie. February 18th, 1920. (159,195.)

10,261. "Variable rheostats and the like devices." L. A Gow. Decemb 13th, 1919. (Divided application on 163,373.) (163,600.)

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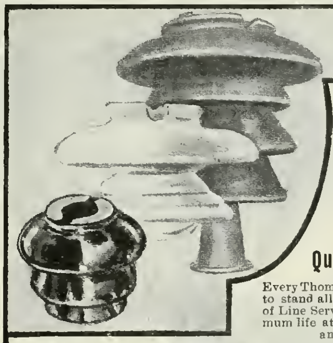

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3rd racks up one tooth only.

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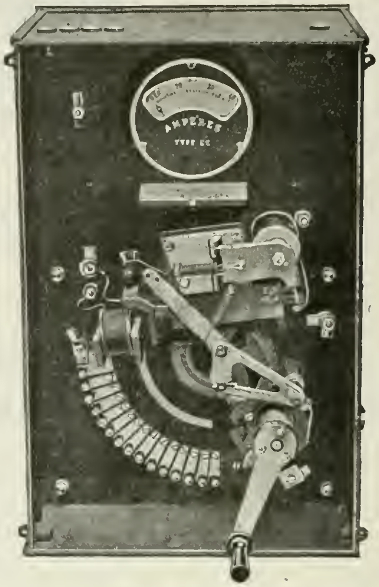

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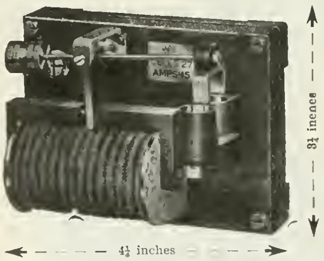

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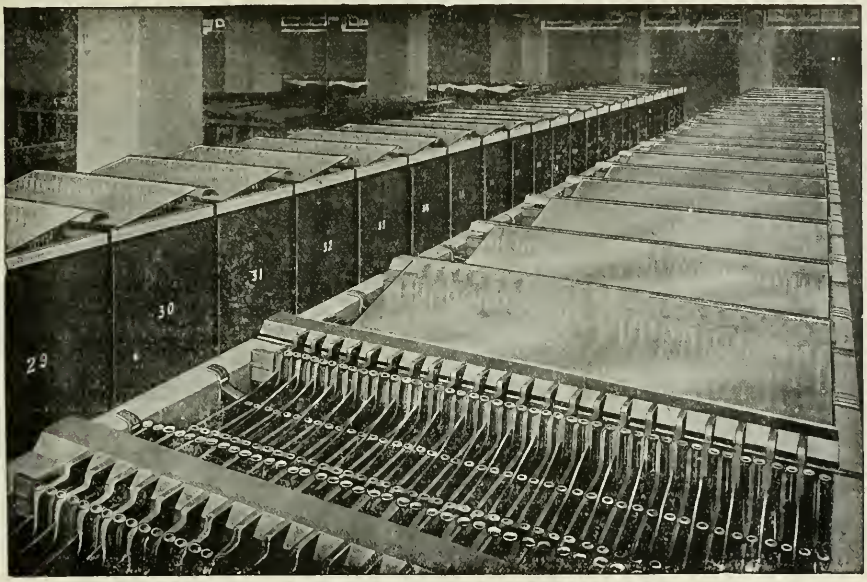

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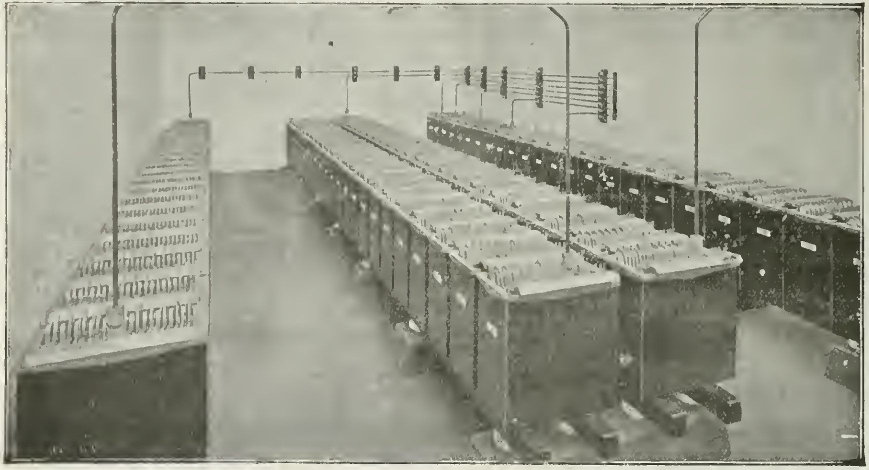

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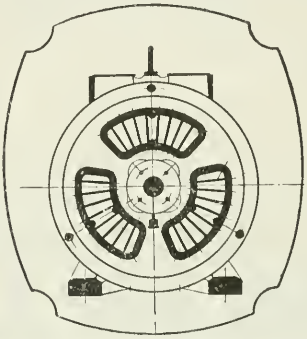

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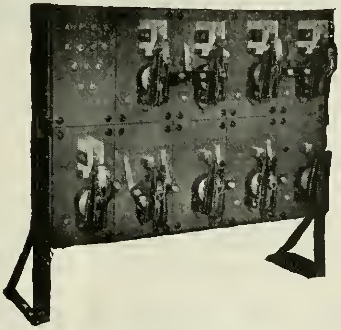

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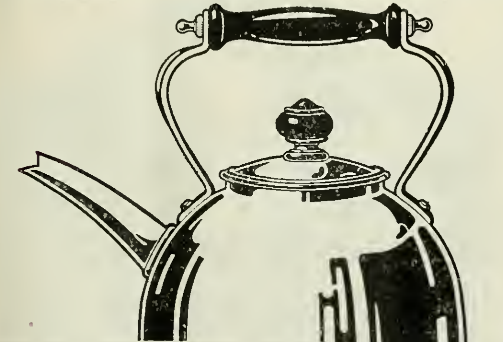

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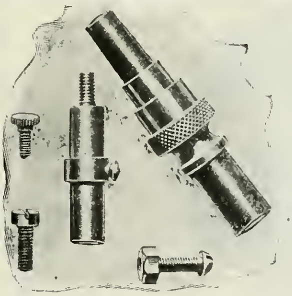

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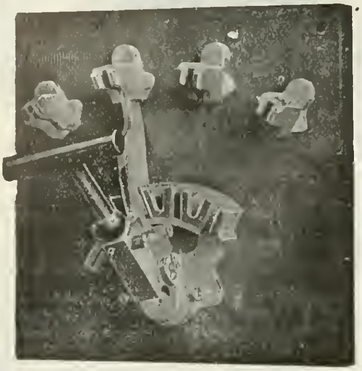

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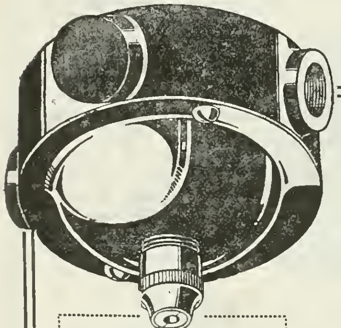

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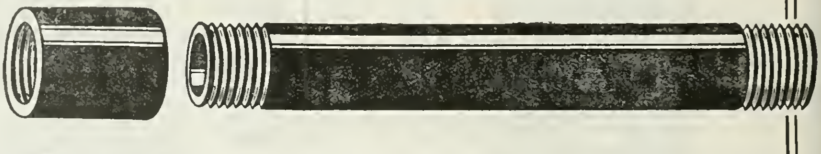

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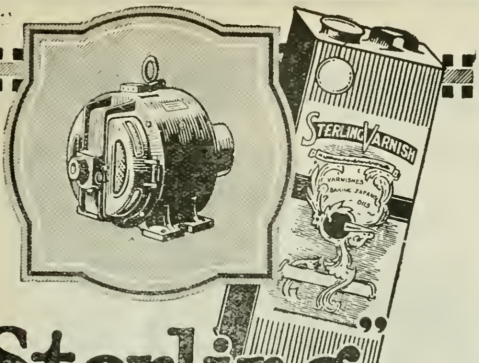

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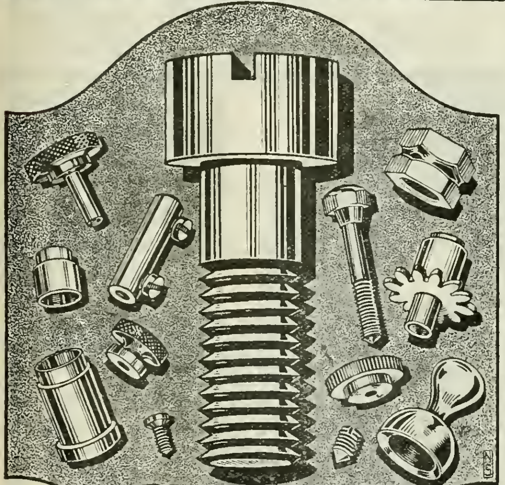

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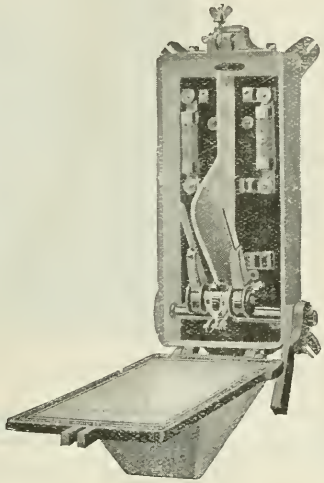

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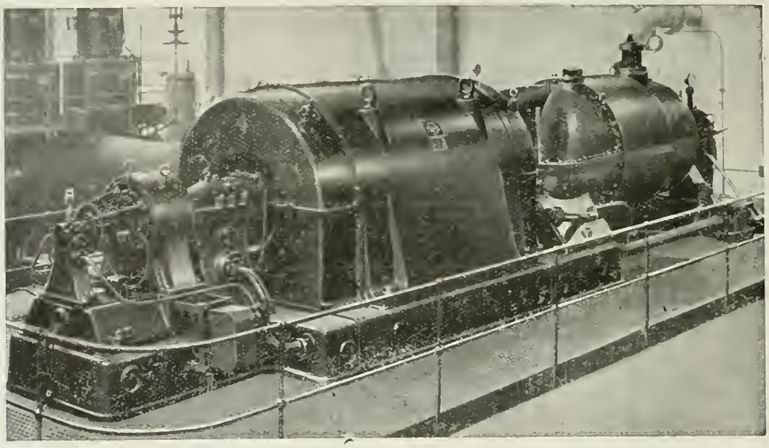

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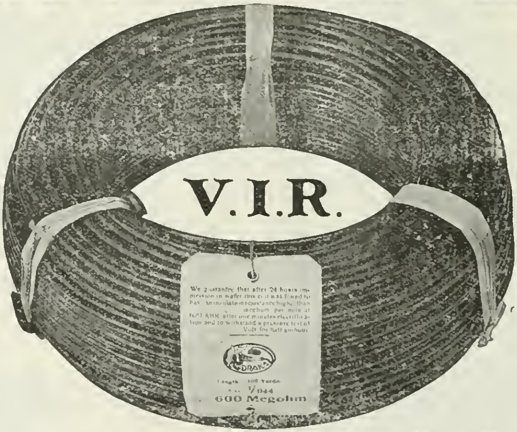

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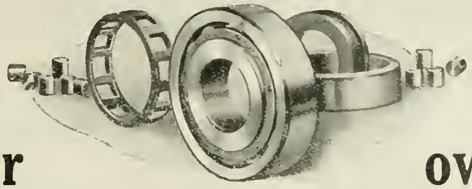

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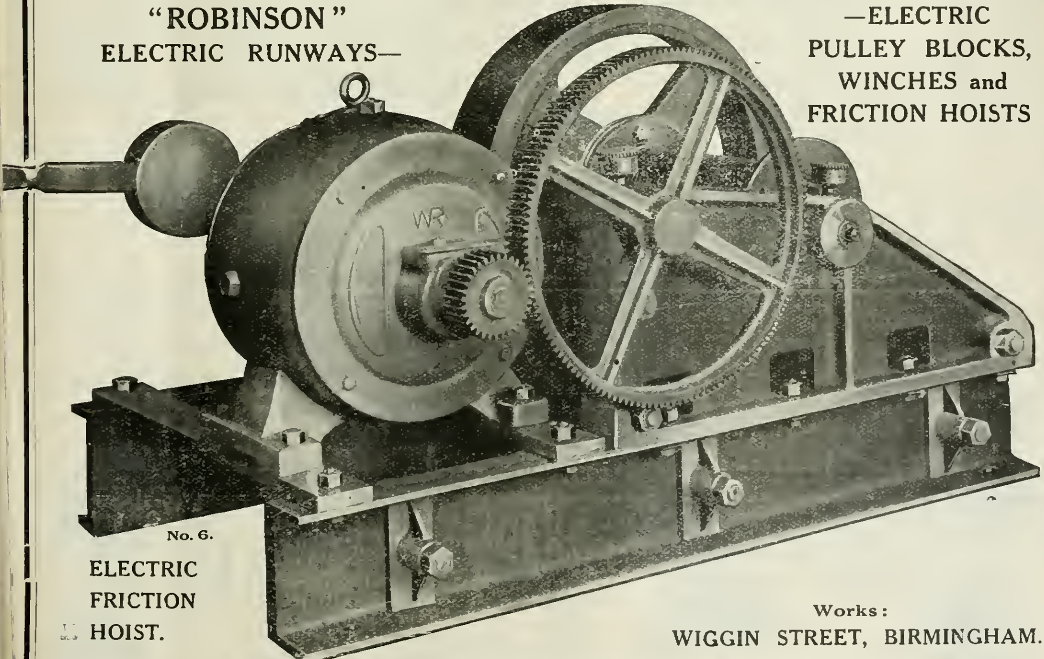

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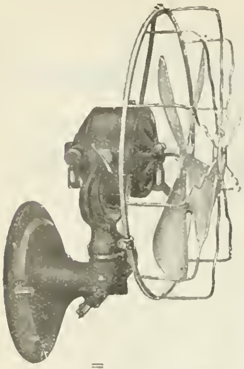

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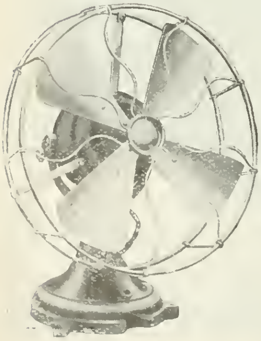

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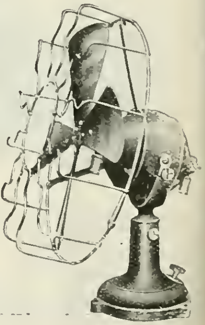

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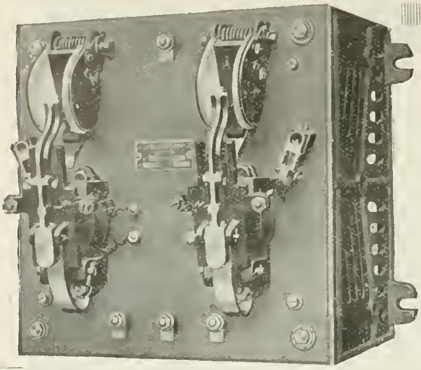

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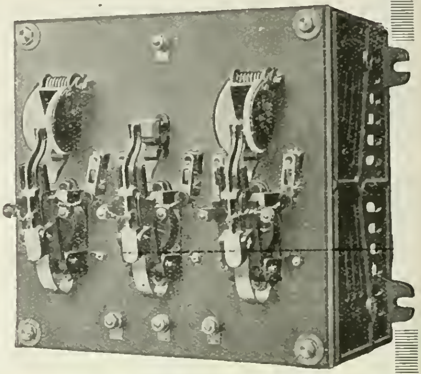

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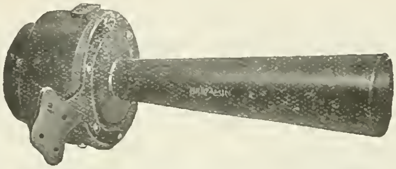

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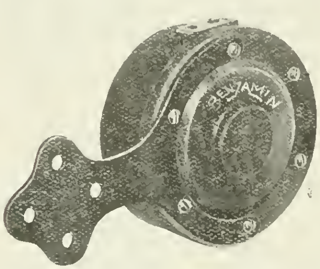

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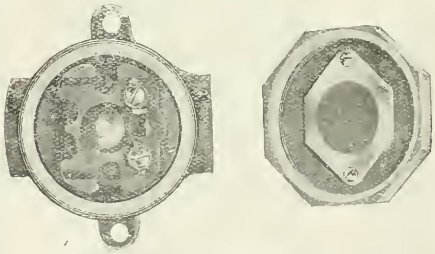

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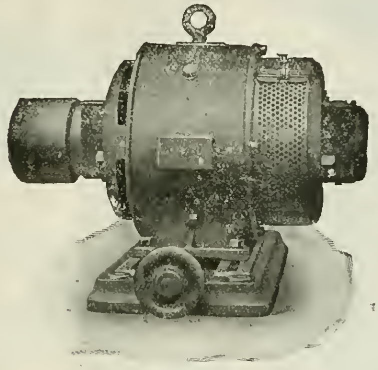

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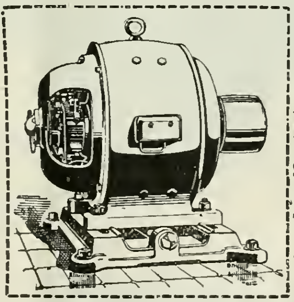

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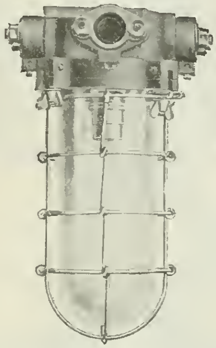

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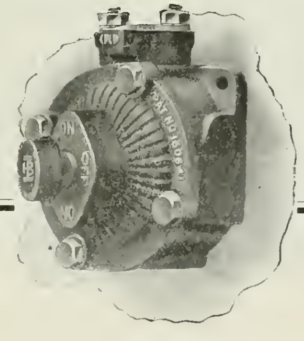

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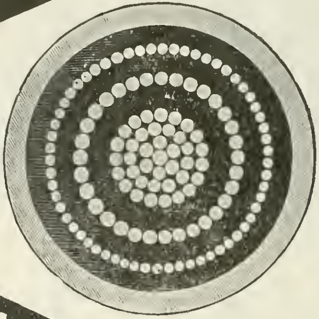

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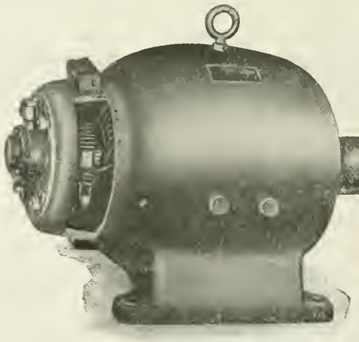

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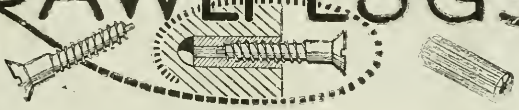

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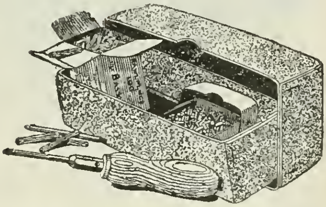

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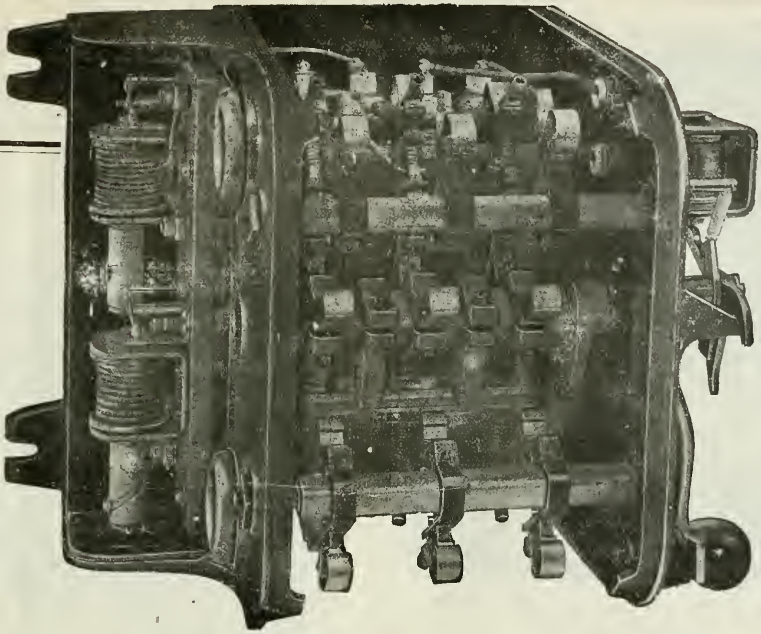

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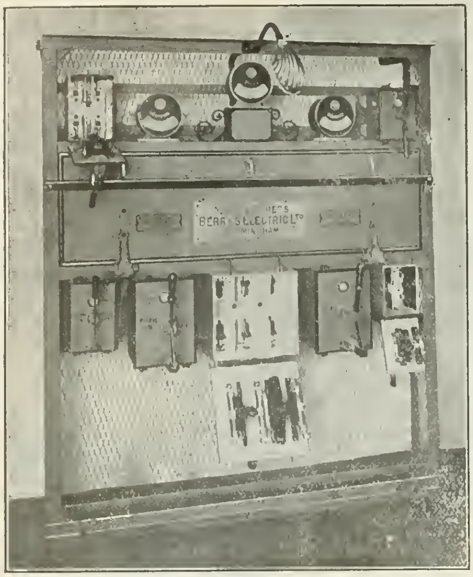

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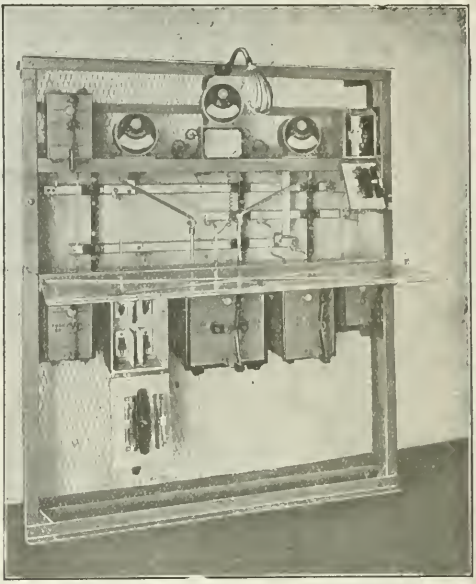

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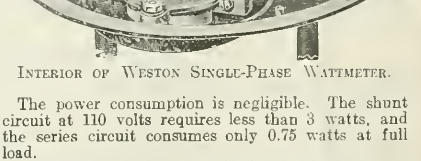

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VOL. LXXXVIII. JUNE 24, 1921. No. 2,274

ELECTRICAL REVIEW.

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THE TRADE BAROMETER.

THOUGH the signs on the horizon of improvement of the world trade situation may appear little larger than a man's hand, it is a matter for gratification that they exist at all. It is believed by some that the worst stage has been passed through, and that with the gradual restoration of confidence between all peoples and the improvement of relations between all the different classes engaged in industry we shall make progress toward better things.

We write at a moment when little is known as to the effect of the ballot of the miners against resuming work on the offered terms, and while the ballot of the engineering workers regarding the employers' modified proposals is being taken, but we have little fear of the ultimate result in these matters if it is recognised that the future existence of these industries is at stake and that decreased costs and greater production are vital if the sacrifice of British export trade is to be prevented. In various districts the pits are being opened for the men to return to work at revised terms if so inclined, and we believe that the strike will gradually fail—or perhaps suddenly, judging from the tone of the speech delivered by Mr. Hodges on Tuesday. It is stated that in certain parts of the United Kingdom there is a more satisfactory booking of engineering trade orders in contemplation of a renewal of fuel supplies as the miners drift back to work. In this department of industry as well as in the iron and steel trade it is anticipated that orders will come in far more rapidly as purchasers can feel that lower prices are at hand; one Press report from Sheffield says that high-speed steel makers are anticipating something like a revival of trade in the autumn.

Turning to the electrical branches of trade, several encouraging reports have been issued lately. In that published by Callenders' Cable Co. reference is made to the happy relations that have been brought into being between the company and its employés. The reason for this optimism is that a satisfactory arrangement has been completed on a sliding-scale basis with the workpeople at Erith and Leigh, which it is confidently anticipated will prevent labour disputes in future. The cost of production has made it more difficult for the company to compete in several foreign and overseas markets, but it is hoped that the reduced prices of raw materials now obtaining and the recent arrangement with regard to labour will enable the company to restore its foreign trade connections to that leading position which, as our readers are well aware, it occupied for so long a period. That those responsible for the control of the concern are not content with the mere expression of pious hopes that improvement will turn up, but are willing to make worthy efforts to secure the fulfilment of such hopes, is shown by the fact that Sir T. O. Callender, the managing director, has during recent months paid a visit to India, where he has been strengthening the position of his company's interests. In our opinion, those of our manufacturers who are alert and observant in the overseas markets and are willing personally or by worthy deputy to visit prospective trade centres, in spite of the state of affairs at home, are not only doing a good thing for themselves and their shareholders, but are rendering most valuable service to the nation by preparing employment for thousands of workpeople for years to come. The Callender agents are active in Australia and South Africa, and are securing large orders, while the South American market, with all its great opportunities, has amply justified, by the orders secured, the recent opening of a branch there. Unsettlement generally and exchange disparities have hampered activity in the Near East, but even here Sir Tom Callender looks forward to a resumption of the Continental business at no distant date. It is not possible to compete with the German on the Continent now, but in his opinion this state of things is not going to continue. It is distinctly encouraging to note his reference to the general increase of business, enabling him and his co-directors to approach the remainder of the year with confidence.

The chairman of the Electric Construction Co., Ltd., in a speech which we reported last week, remarked that in the electrical industry the number of inquiries for plant and apparatus indicated that there was a large amount of work waiting to be done, but buyers were holding their hand in the expectation of a fall in prices. He also said that before the country could recapture its export business or meet foreign competition, lower costs of production were essential. He further alluded to the crushingly heavy burden of taxation which has to be borne by our manufacturers, far more onerous than the burden carried by the foreign manufacturers with whom we are in competition. It seems ridiculous that those who are reported to have won the war against Militarism should also have to labour under so severe a handicap from taxation, directly or indirectly, caused by the war.

We may quote one other leading manufacturer's opinion regarding the situation, namely, that of Mr. H. C. Levis, who at the meeting of the British Thomson-Houston Co., Ltd., after referring to the large volume of orders with which the company started out upon the year 1921, said that the depression with which 1920 ended had continued into 1921, but he could not help feeling that there would be a revival of trade soon after the present strikes were settled. His reason for so thinking was that the number of important inquiries that they were receiving was large. Inquiries indicated contemplated purchases, and there was a great shortage of electrical machinery which must be made up when prospective purchasers were in a better position to finance their requirements.

Next week a meeting of the International Chamber of Commerce is being held in London, to which America is sending 50 delegates, and the chief business is the consideration of the means for the restoration of the world's trade. No doubt a great deal of discussion, of some value, will take place, but the first thing that is essential if United Kingdom industries and trade are to get into satisfactory operation again, is the termination of the miners' and the engineering disputes in such a way as to bring a measure of contentment and a determination to gain a victory over adversity.

The London Electricity Inquiry.

Very early in the course of the inquiry opened last week, it was made clear that the proposal to erect superstations for the supply of electricity to the London area had receded into the distant future, as foreshadowed in our columns. The excessive capital charges have brought about this result. Further, the idea of closing certain existing stations has also been abandoned, for the present, and we are left with nothing but a scheme for linking-up existing generating stations, and adding to the plant in a good many of them, to a total of a quarter of a million kilowatts in all. This stage of development is estimated to last for the next five years, when, after deducting obsolete plant removed from the stations, there would be a total of 557,000 kW to meet a demand of 480,000 kW, with some 75,000 kW in reserve in the smaller and less efficient stations. The whole of the generating plant would be operated under the control of the Joint Electricity Authority at a cost of £50,000 a year. The linking-up mains would cost a million sterling, and the total outlay by the Authority would be £1,050,000 during the first five years (this obviously does not include the cost of new generating plant). The Authority would take over the whole of the generation of energy, and receive the revenue therefrom.

It will be clear from the foregoing that what we have said with regard to the Electricity (Supply) Bill now before Parliament is correct—namely, that the passage of that Bill is absolutely essential to the operations of the proposed Joint Electricity Authority, and that if the Bill be lost, the work of the Inquiry will be completely stultified. Without the financial clauses the Authority is helpless. The matter is of extreme urgency, for until a definite policy of development is formulated progress will be gravely hindered.

The London County Council recently pressed the Government to say definitely whether it proposed to proceed with the Bill or not. The Special Committee on London Electricity Supply reported that the Committee had already incurred considerable expense in preparing schemes, and thought that "unless it is made clear at an early date that there is a reasonable prospect of the additional powers being obtained that are needed for the establishment of a Joint Electricity Authority on an effective footing, we feel that the Council will require to consider very carefully to what extent it will be justified in taking further action and incurring heavy expenditure in connection with the prosecution of its scheme." This point is of interest not only to the London County Council, but to all other interests in London concerned in the Inquiry; further, it is of interest to the proposed Inquiries in other parts of the kingdom. The Government ought certainly to say definitely whether it intends to proceed with the Bill or not. Its silence on this point, and the constant postponement, might mean anything, and certainly have created an atmosphere of great uncertainty. It is obviously unfair of the Government to allow councils, companies, and others to incur heavy expense at the Inquiries if they are to be afterwards rendered inoperative by the withdrawal of the Bill.

One statement made by Mr. J. H. Rider very emphatically in the course of his evidence was very significant as bearing upon the question of the electrification of railways and the desire of the great railway companies to install their own generating plant—namely, that the Joint Electricity Authority can never hope to supply electricity to the railways so cheaply as they can generate it themselves. The reason is that which we have mentioned previously in connection with the comparative possibilities of private and public undertakings—that the latter must provide a sinking fund to repay the borrowed capital invested in the plant. Hence, the railway companies offer not only to generate for themselves, but even to supply energy to the Authority! As the purpose of the Electricity Act of 1919 is to provide a "cheap and abundant" supply of electricity, this is a consideration which cannot be lightly set aside; if the railways can supply it more cheaply than the Authority, the latter will have no right to refuse the offer. But the matter goes further than that. As indicated above, it raises the whole question of private *versus* public generation of electricity; if a cheaper supply can be given by private enterprise, there is no excuse for imposing upon the consumer permanently increased charges merely for the sake of pandering to the municipal ownership idea. As in North Wales and the West Riding, here again in London the evidence appears to support the view that we have put forward—that the true function of the Joint Authorities should be to supervise the supply of electricity and advise the Electricity Commissioners, leaving the main supply to the hands of private enterprise, which is best qualified to deal with it, and the distribution to the existing undertakers.

Effective Co-operation.

For the past quarter of a century we have from time to time urged British electrical manufacturers to combine their forces—not necessarily their businesses—in order to secure many advantages to which they are entitled, but which they could not hope to obtain single-handed. By joint action they could achieve the reform of specifications for contracts which in earlier days sought to impose the idiosyncracies of consulting engineers upon manufacturers down to the last item in the construction of machines—a practice which inevitably tended to increase the cost to the purchaser without ensuring the slightest gain in efficiency or reliability, and was the very negation of standardisation; they could abolish unfair conditions of contract such as those which compelled British manufacturers to work under conditions from which their foreign competitors were free; they could avoid the reckless price-cutting which resulted from unrestricted internal competition, and which led to corresponding cuts in quality in order to attain the absurdly low cost of production implied by the "lowest tender"; they could secure sufficient profits to permit of a fair amount of research, and so on. All these points have been put forward in our pages, for more years than we care to look back upon, but with little success, for individualism is one of the most deeply rooted characteristics of our race, and only in comparatively recent years has it been realised that co-operation is a fundamental necessity of modern manufacturing conditions. Even now there is a vast amount of scope for the development of the principle of mutual assistance and support, but undoubtedly great progress has been made, and the establishment of such great societies as the Federation of British Industries, the British Electrical and Allied Manufacturers' Association, the Electrical Contractors' Association, and similar bodies has been amply justified by the beneficial results which they have obtained.

The objection which is usually advanced against such combinations is that they put up prices unfairly and enable their members to reap exorbitant profits, and there are certain sections of the lay Press which invariably describe them as "trusts," and appear to imagine that thereby they stigmatise these organisations as inimical to the public welfare and worthy to be damned. Even "trusts," however, are not necessarily harmful, and as a matter of fact, the use of this term is usually wholly unjustified—at any rate, in the case of trade associations such as we have in mind. A "trust," in order to become a profiteering body, must first secure a monopoly of the branch of industry concerned, and for this purpose it must not only embrace within its membership all the British manufacturing firms, but also must be protected from foreign competition—conditions which in this country are impossible of attainment. If, then, a trade association neither desires nor is able to eliminate competition and set up an unhealthy standard of profits, this objection falls to the ground, and no other valid criticism remains to be considered.

Our point is admirably illustrated by the report of a sub-committee on the electrical cable industry, of which an abstract appears elsewhere in this issue. It relates almost wholly to the operations of the Cable Makers' Association, which was formed as long ago as 1899, and for a long time remained the only organisation of the kind which had been successfully established in the electrical industry. A perusal of the report will show that all the objects outlined above have been attained by this excellent association, which has achieved a high reputation not only for the cables manufactured by the constituent firms, but also for the sagacity and integrity with which its affairs have been conducted. That ample competition exists to prevent profiteering is made clear by the evidence, but the most significant conclusions of the sub-committee are those which state that there is a "marked absence of hostility towards the association," and that its operations have so raised the standard of quality of "association" cables that purchasers are willing to pay a higher price for them than for other brands; the cable-making industry is prosperous, and British cables have a world-wide reputation for reliability and durability. No higher testimony to the virtues of combination under wise administration could possibly be desired, and we congratulate the Association on its distinguished record of public service and private advantage which has been further endorsed by the election of its most capable and universally esteemed director, Mr. Ll. B. Atkinson, to the office of President of the Institution of Electrical Engineers.

The Question of Workers' Representation.

The question of the representation of labour on Joint Electricity Authorities came up at the Greater London hearing last week. The London County Council administrative scheme includes in the constitution of the Authority provision for two representatives of workers in the industry. It is further specified that these representatives shall be chosen by certain trade unions to be nominated. It seems, however, an open question whether labour can be legitimately included, since the actual Act of 1919 certainly does not specify labour amongst those who should be included in the Authority. The only reference in the Act under which it could come is "other interests."

It will be remembered that labour was specifically included in the constitution of District Boards in the original Bill (which was afterwards discarded), but to include representation of labour in an entirely voluntary body, such as the Joint Electricity Authorities are supposed to be, is another question altogether. Further, the question of including representatives of trade unions on the London Joint Authority has also a special aspect in view of the circumstances in London. It will be remembered that the position of the trade unions in London is that they have given instructions to their members to refuse to connect up installations which have been erected by non-union labour. They have also taken action, similar in effect, with regard to kinema shows where union rules are not observed. The unions interested in the electricity supply industry thus claim the right to use the industry as a lever to enforce their claims in quarters which have nothing whatever to do with the electricity supply industry itself. We are not discussing at the moment the legitimacy or otherwise of such claim, but simply stating the fact as having a bearing upon the inclusion of representatives of these unions on a Joint Electricity Authority. The Joint Electricity Authority when formed will become the Authority which will regulate the development of supply throughout Greater London, and thus be in a position of extensive power and responsibility, its first duty being to maintain uninterrupted supply. Conceivably cases would crop up where the trade unions decided to take drastic action in one direction or another, and it would surely be an anomaly if on the one hand the Joint Electricity Authority were striving to maintain supply, and on the other hand the workers were receiving instructions from one of the trade union members of the Joint Authority to take steps towards stopping the supply.

Whether the appeal case at Hackney will do anything towards settling this awkward situation is still to be seen, but so long as the trade unions claim the right to use the electricity supply industry to settle outside quarrels it would surely be indiscreet to give their representatives a seat on the Joint Authority controlling the supply of London. The principle to which these trade unions have thus committed themselves is a very big one, and may conceivably become, sooner or later, of very serious importance. We quite sympathise with the London County Council in its general wish to secure the interests of the workers in the way mentioned, and we should raise no criticism if it were representation of the workers simply as such, but it is not. It is a question of taking into the Authority representatives of unions which, as we have pointed out, have interest in militant action far beyond the scope of the Joint Electricity Authority.

ELECTRIC VEHICLE PROGRESS AT BIRMINGHAM.

A New Battery-charging Station.

The City Corporation of Birmingham, it is believed, has one of the finest fleets of electric vehicles in the country, and in the collection and removal of house refuse great economies have been effected by the utilisation of electric vehicles in place of horse-drawn wagons.

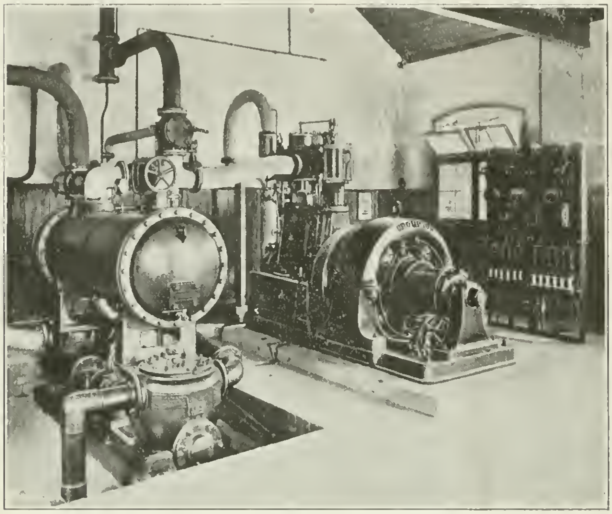

Fig. 1.—Belliss-Crompton 75-kW Generating Set.

The use of a large fleet of such vehicles naturally involves the provision of extensive battery-charging facilities, and the following particulars and illustrations of a plant to provide energy for that purpose, which has been installed by Mr. S. Thomas Pemberton, M.I.E.E., for the Birmingham Corporation Salvage Department, will be of interest.

Prior to the erection of the plant, the steam generated by the burning of refuse at the Corporation Destructor Works at Lifford, King's Norton, was discharged to atmosphere; it is now, however, utilised to generate electricity which is used to charge the vehicle batteries and also to drive motors in connection with the water-softening, tin-bundling, and clinker-screening plant. The saving to the department is enormous, as it will be realised that the electrical energy is produced as what might be termed a by-product from the heat derived from burnt refuse.

An interior view of the power house is shown in fig. 1, which, it will be seen, contains a Belliss & Morcom vertical steam engine direct coupled to a Crompton generator. The exhaust steam is discharged into a surface condenser supplied by Messrs. J. Evans & Son, Ltd., the water for which is obtained from the canal near by. The output of the generating plant is 75 kW.

The interior of one of the garages is illustrated in fig. 2; the equipment in these buildings consists of watt-hour meters and specially constructed cast-iron connection boxes for the purpose of attaching the flexible charging cable to each vehicle, this method being preferable to the use of plugs and sockets, owing, it is claimed, to its being possible to secure a more solid and positive contact therewith.

The third figure shows the vehicle-charging switchboard of the well-known Igranic type, which has already been described in our pages. It is suitable for charging 10 vehicles at once, and two blanks have been left for future extensions. With regard to the remainder of the installation, all the underground cable was supplied by Callender's Cable and Construction Co., Ltd., the wiring was carried out by the Stuart Electric Co., and the power panels and motors were furnished by Messrs. Electromotors, Ltd.

The plant as a whole is sound and comprehensive, and the scheme reflects credit on Mr. James Jackson, superintendent of the Salvage Department, who introduced the idea, and his departmental engineers, Messrs. Codlin and Sainsbury, not forgetting Mr. Pemberton, under whose direction the scheme was carried out. It is interesting to note that the Salvage Committee is so satisfied with the whole lay-out of the job that it proposes to duplicate the plant at another of its destructor works at an early date.

The Salvage Department now has in commission a fleet of 31 Edison $2\frac{1}{2}$-ton vehicles, and one Orwell $3\frac{1}{2}$-tonner, and a report was recently issued dealing with the service of the electric vehicles for the second six months of last year, when 26 Edisons and the one Orwell lorry were operated. Attention is called to the saving which has been effected in the Montague Street area by substituting electric vehicles for horse-drawn wagons in the outlying portions of the area, and by confining the horse traction to the area nearest to the depôt, namely, within a radius of about $1\frac{1}{4}$ miles.

Statistical information has been prepared relating to the combined system of working electric vehicles and horse-drawn wagons in the Montague Street area, which is summarised as follows:—

Item.	Electric vehicles.	Horse wagons.
Number of rounds (one transport unit for each)	6	10
Average interval between each visit (working days)	6·49	6·46
Average number of houses visited per week:		
By one vehicle and four men	2,116	—
By one horse wagon and two men... ...	—	846
By a two-horse wagon and four men to compare with electric vehicle labour ...	—	1,692

From this table it is clear that each electric vehicle working in the outer portion of the Montague Street area, and travelling double the mileage of the horse wagons per day, visits as many houses as approximately $2\frac{1}{2}$ horse wagons visit in their restricted area near the depôt. The cost per house visit is as follows:—

	Per hour per week.
Horse wagons—continuous system—inner area ...	3·22d.
Electric vehicles ,, ,, outer ,, ...	2·94d.
Saving in favour of the electric vehicle per house per week	0·28d.

This represents a saving of £125 per annum for each electric vehicle, but the figure is really greater than this, because if horses had to travel to the areas now served by electric vehicles they would not visit nearly as many houses as they do in the inner area. It is estimated that the saving effected by transferring two horses from long-distance work into the inner areas, or short-distance work, effects a further saving of at least £125 per annum, so that each electric vehicle, directly and indirectly, results in a reduction of the working costs by no less a sum than £250 per year.

The view is expressed that there are distinct spheres of operation for both the horse-drawn and the electric vehicles, and that a reduction in costs can best be obtained by utilising both methods of transport. For the electric vehicle to compete with horse haulage in the inner area, which comprises mainly a poor class of property, from which there is nearly 40 per cent. more refuse (in weight), it is stated that it would be necessary to have a $3\frac{1}{2}$-ton vehicle with a body capacity of 9 cb. yards. Doubts are expressed about whether it will ever be practicable for electric vehicles to collect more than three full loads per normal working day, because the extra loads would involve additional travelling time and, therefore, reduce the loading time now available.

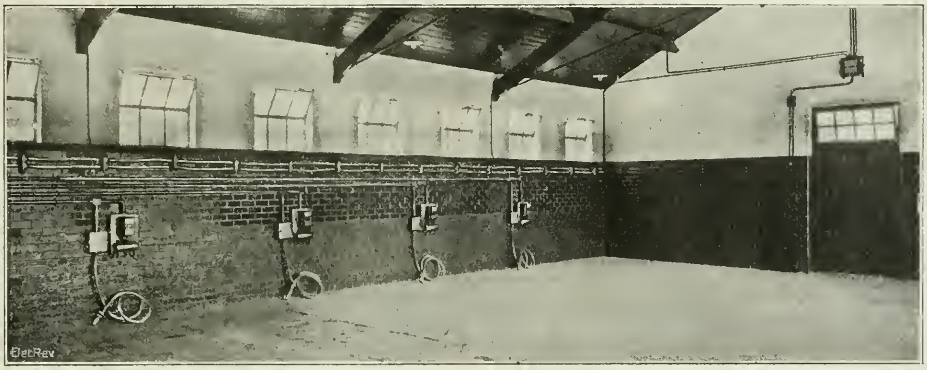
Fig. 2.—Electric Vehicle Charging Garage at Birmingham.

A comparison is made of the working costs of the vehicles operated. These are summarised as follows:—

		Per day worked.	Per ton carried.
26 2½-ton "Edison" vehicles	...	£4 4s. 5·7d.	14/0·81d.
1 3½ ,, "Orwell" vehicle	...	£4 6s. 7·2d.	13/8·17d.

Interest and repayments were calculated on the basis of a seven-years' life, except in the case of the battery of the "Orwell" vehicle, which was depreciated on the basis of a two-years' life.

During the six months under review the "Orwell" vehicle was employed in a district wherein the refuse was of a heavy nature, and the average weight collected per load was two tons, four cwt., three quarters, as against two tons, two cwt., three quarters collected by the "Edison" vehicles, thus making use of the additional strength of the "Orwell" chassis. This accounts for its cost per ton being lower, while its cost per day was higher than that of the "Edison" vehicle.

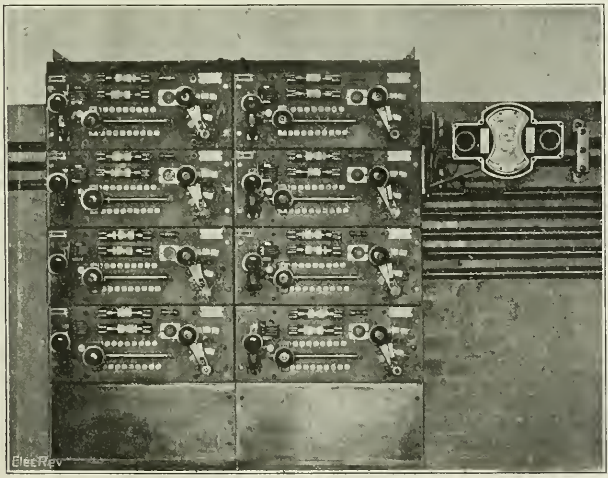
Fig. 3.—Igranic Battery-Charging Switchboard.

The cost for electrical energy for charging the vehicles was as follows:—Edison, 1/0·28d. per ton; Orwell, 11·05d. per ton. These costs are based on a price of 2¾d. per kWh. It has been pointed out to the city electrical engineer that as most of the electrical energy used for charging the electric vehicles is taken from the generating stations at night time, during the "off-peak load" period, a reduction in the price per kWh should be made. The suggestion is being favourably considered, and a reduction of from 30 to 40 per cent. is anticipated.

The following table shows the continuity of work and the percentage of working days lost by both makes of vehicle during the 12 months of last year:—

	One Orwell vehicle.			Edison vehicles.		
Quarter.	Days worked.	Possible working days off work.	%	Days worked	Possible working days off work.	%.
March ...	74	3	3·90	255	28	9·82
June ...	70	—	0·00	751	141·5	15·85
September	77	—	0·00	1,178 5	102·5	8·00
December	76	1	1·30	1,466	194	11·69
Totals...	297	4	1·33	3,650·5	466	11·07

The batteries of both makes of vehicle gave practically no trouble. The time lost by the Edison vehicles was mainly due to temporary difficulties in the supply of certain parts, but Messrs. Edisons have readily and willingly taken such steps as will, it is thought, avoid further trouble.

Since January 1st five new Edison vehicles have been received, and during the coming financial year a generating set is to be installed at the Bolton Park Street depôt, and provision has also been made in the estimates (which have been approved) for one 3½-ton electric vehicle, for which it is hoped a suitably large body can be obtained, which will enable experiments to be made in comparison, not only with the existing vehicles, but also in the inner areas in competition with horse haulage.

"The great results achieved in installing one of the best collection systems in this country, which in many of the districts would not have been practicable with horse haulage, combined with a considerable reduction in working costs, will, I hope and trust," states the superintendent of the Corporation Salvage Department, "permit of a great increase in the use of the 'electrics' when the financial position of the Corporation becomes easier."

TRADE UNIONS AND PROFIT-SHARING AGREEMENTS.

(By a Legal Contributor.)

A case recently decided in the Court of Appeal will be read with great interest by those who are interested in profit-sharing and co-partnership as means of bringing employer and workman together. The trade union objects to these schemes. They are apparently suspect because they tend to make a workman independent of his union, and unamenable to discipline. The question whether, in the existing state of the law, a trade union can prevent one of its members from entering into any such arrangement was considered in Braithwaite *v.* The Amalgamated Society of Carpenters, which is reported in *The Times* of June 14th.

The facts are simple enough. The plaintiff sought an injunction to restrain the defendants from expelling him from their ranks. It was a rule of the union that a member might be fined or expelled if he is "working on a co-partnership system when such system makes provision for the operator's holding a minority of the shares in the concern." The plaintiff had, in fact, become a member of Lever Bros, Ltd., Co-partnership Trust, and because he did so, an attempt was made to expel him on the ground that he had committed a breach of the rule above mentioned. It was contended that no action lay because of Section 4 of the Trade Union Act, 1871, which provides that nothing in the Act is to enable any Court to entertain proceedings instituted with a view to directly enforcing or recovering damages for the breach of an agreement.

In the Court below Mr. Justice Eve had held that on the authority of Chamberlain's Wharf *v.* Smith (1902) 1 Ch. 605, the action could not be maintained, but the Court of Appeal thought otherwise. The Master of the Rolls said: "The plaintiffs do not dispute the validity of the rule; they say they have not done anything to contravene it. It must be an attempt to enforce an agreement by which the defendants agreed to do something. Where is that agreement to be found? In my opinion no such agreement can be found in the rule at all. The only agreement which it implies was the one arising from membership. There must be implied on the part of the member an agreement to comply with the rules, and on the part of the defendant union an agreement to give the member certain benefits so long as he complied with the rules. It seems to me that the answer to the question, apart from authority, is that the defendants *never made any agreement*, but had made it a condition of membership that the plaintiffs should not commit any breach of the rules."

The Master of the Rolls then examined Lord Leverhulme's co-partnership scheme, pointing out that it did not oblige any workman to take shares in the concern, nor was there any provision that the workman should always hold a minority of the shares. In another case, tried at the same time, it was held that one Ashley, a member of the General Union of Operative Carpenters and Joiners could not be expelled from that body because he had joined Lord Leverhulme's premium bonus system.

Lord Justice Younger, in giving judgment, drew attention to the importance of these cases. "For a man to be expelled from his trade union means that he can obtain practically no employment in his own trade. He is in danger of becoming what Lord Justice Fletcher Moulton in another class of case once described as an odd lot in the labour market. Expulsion from the union is a sentence of industrial death."

The moral of this case is that the Court will in effect prevent the expulsion of a member from a union unless it is clearly shown that he has contravened a rule. It will not do for the union official to merely say: "You must not join your employer's co-partnership or profit sharing scheme or I will have you expelled." He must go further, and be in a position to say that to join that particular scheme was to infringe a particular rule by which the workman was bound.

We imagine that it is not by any means beyond the capacity of employers like Lord Leverhulme so to frame the rules of a co-partnership scheme as to avoid clashing with the rules of any union to which their workmen belong.

JOINT ELECTRICITY AUTHORITIES.

(*Continued from page 799.*)

London and Home Counties Inquiry.

On Wednesday, June 15th, Mr. J. H. Rider, who, with Sir Alexander Kennedy, Mr. G. W. Partridge, and Mr. C. H. Wordingham, has prepared the technical scheme embodied in the London County Council's proposals, explained the modifications which had been made in the scheme as originally presented to the Commissioners, and the reasons for them. The Committee of Engineers was formed in May, 1920, Sir A. B. W. Kennedy and Mr. G. W. Partridge being appointed by nine of the companies, Mr. Rider by the L.C.C., and Mr. Wordingham by the Conference of Local Authorities owning electricity works in Greater London. As stated by Mr. Craig Henderson on the opening day, Sir Philip Dawson, on behalf of the railway companies, had approved of the technical scheme. Under the original scheme, the construction of the capital stations already referred to, viz., three on the river Thames east of the Blackwall Tunnel and one in the west at Chiswick, together with the extension of two of the existing stations, was to be taken in hand at an early stage. The two existing stations which are to be extended are Stepney and Deptford. Although this part of the scheme still holds good, it has been decided, in the light of financial conditions, to postpone the construction of capital stations, and to proceed, as the first stage of the scheme, with the linking-up of a certain number of the existing stations, which have been named group stations, to meet the demand until 1925-6, and then to add additional plant in nine or ten of the existing stations to deal with the load for a further period, unless the conditions permit of the construction of the capital stations. The following table gives the group stations which are to be linked up, showing the new plant which is to be added, and the amount of plant it is proposed to scrap, and this linking-up forms the nucleus of the modified proposals as now placed before the Commissioners by the London County Council:—

Station.	Existing plant. kW.	New plant. kW.	Scrapped plant. kW.	Total. kW.
West Ham ...	17,900	10,000	3,900	24,000
Poplar	9,750	6,750	—	16,500
Stepney	16,000	10,000	—	26,000
Shoreditch ...	8,800	5,000	3,800	10,000
Hackney . .	18,200	9,000	1,200	26,000
Walthamstow	5,800	3,300	1,800	7,300
Bow (Charing Cross Co.)	20,400	12,000	6,400	26,000
Bankside (City of London Co.)	30,000	26,000	10,800	45,200
Islington	9,250	5,000	3,250	11,000
St. Pancras (King's Road)	5,500	11,600	—	17,100
St. Marylebone ...	19,000	17,600	2,000	34,600
Grove Road (Central Co.)	20,220	35,000	5,220	50,000
Horseferry Road (Westminster Co.) ...	5,100	3,000	—	8,100
Hammersmith ...	11,400	12,000	2,400	21,000
Wood Lane (Keusington and Notting Hill Co.)	11,900	—	1,600	10,300
Battersea	9,524	5,000	3,024	11,500
Barnes	1,500	3,000	—	4,500
Kiugston	3,240	—	700	2,540
Wimbledon	4,825	3,000	1,325	6,500
Willesden (Metropolitan Co.)	23,000	16,000	9,000	30,000
Uxbridge	6,100	2,000	1,700	6,400
Wandsworth (County Co.)	20,500	6,000	—	26,500
South Metropolitan Co.	17,500	—	1,000	16,500
South London Co. ...	7,000	—	3,500	3,500
London Electric Corporation	44,350	3,500	15,350	32,500
Croydon	5,500	10,000	1,000	14,500
Woolwich (Globe Lane)	10,250	10,000	—	20,250
Gravesend	1,800	7,000	800	8,000
Brimsdown (North Met. Power Co.) . .	12,750	15,000	4,750	23,000
Willesdeu (North Met. Power Co.)	18,500	—	—	18,500
Totals	395,559	246,750	84,519	557,790

In this way it is calculated that the Joint Authority would have at its disposal by 1925, without having spent any money on capital stations, 557,000 kW to meet an estimated demand of 480,000 kW.

The Chairman raised the question of reserve plant, and Mr. Rider pointed to the fact that there would be a number of other stations which could be called upon for assistance to the extent of 75,000 kW, although they would not form part of the linked-up group stations. These he named as Barking, Beckenham, Bermondsey, Bexley, Dartford, Ealing, East Ham, Erith, Finchley, Hampstead, Heston and Isleworth, Hornsey, Ilford, Leyton, Southwark, Bromley, Earls Court (Brompton & Kensington Co.), Chelsea, Chiswick, City Road (County Co.), Egham, Harrow, Surbiton, Tottenham, and Twickenham. He added that a number of stations in the central area had not been taken into account because they were practically in process of being shut down by their present owners. Further, it was pointed out quite clearly that under this linking-up scheme, as the first stage of the comprehensive proposal, a number of stations on the fringe of the area would not be assisted in any way, and that these districts must go on as they were now for some time to come. Under present financial conditions it would be too expensive to lay the necessary mains.

Continuing, Mr. Rider said that if in 1925 it was still found impossible to erect the new capital stations, then it would be possible to extend nine or ten of the existing power stations so that the total plant available would be 760,000 kW. By that time, plans would have to be put in hand for the capital stations owing to the urgency of the increasing demands, whilst no doubt the financial position would be much improved. At present, however, the gain in lower working costs to be obtained from the capital stations would be more than off-set by the higher capital charges. When the whole scheme was completed and the capital stations were working, it was provided that the only existing power stations which would be kept in operation would be Willesden (North Metropolitan Electric Power Co.), St. Marylebone, Grove Road (Central Electric Supply Co.), Hackney, Bow (Charing Cross Co.), and Bankside (City Co.). When that would actually happen he could not say.

The question of leaving out of account some of the "fringe" areas for some time to come was taken up by the Commissioners. Mr. Booth asked what was the object of keeping them in the area if they were not to be assisted from the beginning. Was it Mr. Rider's opinion that a better scheme could be produced by reducing the area?

Mr. Rider said the cost of taking the supply to the extreme areas must be much greater than that of supplying the inner area, utilising the existing stations, and from the engineering point of view, it would be a better scheme to omit some of the outside areas. Some assistance might be given to the outside areas, however, through the railway supply, which the figures he had given had not taken into account.

The Chairman said it was the possibility of getting assistance in the outside areas from the railway supplies that had induced the Commissioners to delimit the area in the way they had.

Mr. Rider said a great deal depended upon the nature of the railway supply.

Discussing the question of costs under the original scheme and the one now proposed, excluding railway supply, it was pointed out that under the revised scheme, the cost per unit delivered to the feeders by authorised distributors, after conversion, would be 1.385d., whereas under the original scheme it would be 1.488d., whilst under the original scheme with the railways included the cost would be 1.377d., all these figures being averages over the whole area for the first stage. In order to make the linking-up scheme work efficiently, it would be necessary to have the central controlling body or Joint Electricity Authority to control the whole of the undertakings, not only as to giving supply, but as to the hours when certain stations should work, where plant should go in, &c., even down to the book-keeping of the generating side of the business. It was for this reason that the expenditure of the Joint Authority was placed at £50,000 per annum, because there would have to be a technical staff to carry out this work of supervision and management.

The chief cross-examination of Mr. Rider on Wednesday came from the promoters of the East London scheme, although on the admission that the outer areas could not be assisted for some time, counsel for the Hertfordshire County Council and the North Metropolitan Power Co. suggested that as it appeared the area was unwieldy, it would improve the position if they were left out.

The point of the cross-examination on behalf of the East London scheme was that by splitting the area delimited by the Commissioners into several smaller ones, a more efficient service would be obtained, at any rate, for industrial London, cheap power being essential to industry. It was put to Mr. Rider that to have a large area such as was proposed in order to bring down the average cost over the whole was not the right way to proceed, when certain of the districts, and those the most important industrial ones, were already supplying energy at a lower rate than the average estimated under the revised scheme.

Mr. Rider, however, stuck to the point of view that there must be a large area, and that all the undertakings in it should come into a common pool for the good of the community as a whole.

Sir Herbert Nield, K.C., for the Hertfordshire County Council, expressed a fear of territorial aggrandisement on the part of the London County Council, and suggested that that was behind the desire to get such a large representation on the Joint Electricity Authority, which would be dominated by the L.C.C.

Mr. Sydney Morse, for the West Kent Electric Power Co., referred to the scheme for the erection of a new power station by that company upon which the Commissioners had deferred their decision. He said the company would want 60,000 kW in a comparatively short time; where was it to come from, under the L.C.C. scheme?

Mr. Rider said that if such a demand were made upon the Joint Electricity Authority steps would be taken to meet it.

On Thursday, June 16th, Mr. Wrottesley, for the Middlesex County Council, endeavoured to get an expression of opinion from Mr. Rider as to parts of the area being cut out, but Mr. Rider was emphatic that some substantial portion of Middlesex must be included. He would not agree to making the boundary of the electricity supply area on the north and west that of the County of London.

The Chairman asked Mr. Morse, on behalf of the West Kent Co. and the County of London Co., to give details, some time during the inquiry, of the developments involving 60,000 kW in the case of West Kent, and of the anticipated developments in the County of London Co.'s area. Although evidence was given at some length with regard to the latter during the inquiry in October (Electrical Review, October 15th and 22nd, 1920) concerning the Barking station, it was not quite sufficiently detailed for the purpose of the present inquiry.

Mr. Morse promised to do this. Continuing his cross-examination of Mr. Rider, he elicited the fact that the site of one of the proposed capital stations the same as that of the old Thames Ironworks, and that it was the same site as that proposed in the scheme which was being placed before the Commissioners by the Great Eastern Railway Co. The available land there was 13 acres; at Chiswick there were 25 acres, and the other two stations at Beckton and Greenwich would be on sites of 16 and 9 acres respectively. The point of Mr. Morse's questions was to compare the proposed new stations with the County of London Co.'s proposed station at Barking, and to that end he went through the relative advantages as regards the usual facilities.

Mr. Rider was reminded that during the October inquiry into the County of London Co.'s application to the Commissioners *re* Barking, he said that new generating plant was required immediately at that time, and that there was need for a new large station as soon as it could be built.

Mr. Rider said he was still of the same opinion if financial conditions permitted, and it was only because after having spent a lot of money the cost per kWh was no cheaper, that he now suggested that the capital stations should not be built at once.

Further questions showed that the total sales of energy in 1925-6, exclusive of railways, would be 960 million units in the whole area, compared with 608 millions, an increase of 352 millions, or 58 per cent. in the six years, equal to 7.8 per cent. annually. Mr. Morse suggested that on the figures of the County of London for 1918-19 and 1919-20, and applying these to the whole area, there would be an increase of 230 per cent. during the coming six years. Similarly it was pointed out that on the basis of the County of London Co.'s own increase in 1918-19 and 1919-20 the increase carried forward six years would amount to 215 per cent., again a very much larger increase than had been allowed for over the whole area by Mr. Rider.

Asked how he proposed to deal with the increasing demand of the County of London Co. up to 1925, Mr. Rider said he would deal with it from City Road, Wandsworth, and Bankside, and if the load should grow beyond the capacity of the available plant in these stations, or if there should be a breakdown, there would be help available from other stations linked up. If the general growth was more rapid than anticipated in the scheme now put forward, it would mean that the second stage would come into operation more quickly.

The Chairman said the Commissioners would require assistance on this matter, because it took a long time to get plant installed, and it would be necessary to put forward a proper scheme dealing with the contingency of a more rapid development than had been assumed, as indicated by the figures put in by the County of London Co. At present there would be available 39,200 kW in the County of London Co.'s stations and 10,000 kW ear-marked at Bankside under an agreement to deal with the County Co.'s load. Supposing that the company's demand increased, as suggested, to a figure for which this plant would not be sufficient, how could it be met?

Mr. Rider said that if the County of London Co. or any other undertaker required more plant, some notice would be given to the Joint Authority, and arrangements would have to be made either for the erection of a capital station or for additional plant to be installed in some of the existing stations, which could be done to the extent of another 190,000 kW.

The Chairman pointed out that the County Co. expected a load of from 40,000 kW to 51,000 kW according to the load factor, in 1924-5.

Mr. Rider said that the curve he had prepared of the estimated increase over the whole area was on a basis which was higher than that which had yet taken place, except during the war period.

The question of the estimates of increase in individual cases was raised, and the chairman said it was most important for the Commissioners to have the estimates from the L.C.C. in each case for comparison with what the individual companies, such as the County Co., said would be the position four or five years hence.

Mr. Rider said his estimate of the County Co.'s load in 1924-5 was 36,700 kW, against the company's figure of 40,000 kW.

The Chairman said that 40,000 kW was on the basis that the company did not make special efforts to increase the demand between now and 1924-5, as it saw no prospect of meeting it without the new Barking station.

Mr. Rider said he had also estimated 20,000 kW for the Romford area of the County Co. by 1931, and the company could have 10,000 kW as soon as the Joint Electricity Authority got to work. That 10,000 kW would be supplied from Stepney, Poplar, West Ham, and East Ham, the linking-up of which would cost £100,000, although the mains would not be laid only for the supply of the 10,000 kW in question. The total cost of the mains for linking-up throughout the whole area was £1,000,000.

Mr. Morse suggested that to have to get the 10,000 kW from four stations was a little complicated.

Mr. Rider agreed, but added that it was quite practicable, and the 10,000 kW would be available within a period of two years, assuming the Joint Electricity Authority got to work at once.

Answering questions with regard to the position of Croydon, Mr. Rider said that it did not form part of the preliminary linking-up scheme, and would only come in ultimately as part of the whole scheme. Nevertheless, the Croydon station would be under the control of the Joint Electricity Authority, and he anticipated that Croydon would be supplied with energy at no higher price than at present. Croydon would receive no benefit until the capital stations were built. Nor would Croydon be any worse off, but meantime it would be under control as part of the general scheme. The same applied to Kingston, Guildford, and some other towns similarly situated on the fringe.

Questions were next put on behalf of the Metropolitan Electric Supply Co., the objection already lodged with the Commissioners being to that company's bulk supply area in Middlesex being included in the scheme, but the company did not object to the area now served by it in the County of London being included.

Mr. Rider said he could not agree to leave out the Metropolitan Co.'s area, because it was within the limits of economical distribution from the Chiswick power station, when that was built.

Mr. G. Spencer Hawes, representing Guildford Corporation, asked for exclusion from financial liability under the scheme, seeing that Guildford would not benefit in any way for a long time.

Mr. Rider's answer was that that was an administrative matter, and must be determined by the Joint Authority. On the question of the cost of energy obtained from the Authority, an authorised distributor could not be asked to pay more than he could generate at for himself. There would, however, be varying tariffs for the energy supplied by the Authority.

Sir Harry Haward asked why there should not be a uniform scale of charge for energy by the Authority based on load factor.

Mr. Rider said it could be done, but it would not be altogether fair, because distance must come into consideration, although primarily the scale would take into account the load factor.

Mr. Craig Henderson, K.C., re-examining Mr. Rider, dealt with the application of various authorities and companies to be left out of the area. Mr. Rider said the Joint Electricity Authority could only supply in bulk to authorised distributors and power companies, and could not compete in any way with an existing authority unless the latter failed in its statutory duties. The whole object of the Joint Authority was to assist and not to compete. As to the County of London Co., it was giving supplies to authorities outside its area, which were putting a strain on the supply within the company's own area, and, moreover, it might be that the Joint Authority would be able to give these outside supplies from more convenient sources.

Discussing the Barking station and Mr. Rider's objection to putting 600,000 kW there, the Chairman asked if Mr. Rider would have the same objection if Barking were restricted to 200,000 kW, or the same size as the proposed Beckton power station of the L.C.C.

Mr. Rider said the position then would be that the cost of transmission from Barking would be a little higher, whilst Beckton would also have an advantage as regarded fuel, because by-products from the coal distillation plant of the Gas Light & Coke Co. would be used.

At the conclusion of his re-examination, Mr. Rider was questioned by Sir Harry Haward as to the reason for his change of opinion as to the need for capital stations, since he gave his evidence on the County Co.'s proposal in October. Surely the financial conditions were no worse now than they were in October, and in fact they were inclined to improve.

Mr. Rider said his change of opinion was not caused by the alteration in prices, but by a more intimate knowledge of the circumstances of the case. Had he known in October what he knew now as to the advantages to be gained by linking-up, he would not then have said that a capital station should be erected as soon as possible. It was not so much a question of alteration of conditions, as an alteration in the knowledge of himself and his colleagues.

Sir Harry Haward pointed out that the County Co. was willing to proceed with the erection of a capital station now, notwithstanding the financial conditions.

Answering questions by Sir Harry Haward, Mr. Rider said that the only capital expenditure in which the Joint Authority would be involved before the capital stations were built, would be £1,050,000 for mains and plant replacement.

Subsequently Sir Harry Haward said it must be made perfectly clear what was to be the position of the Joint Electricity Authority as a separate entity in relation to the existing stations. It was not at all clear to him as the case had been presented so far.

Mr. Rider said a subsequent witness would deal with this point. He himself was not prepared to speak as to the conditions upon which power stations should be taken over by the Joint Authority, but it would have to be a matter of arrangement whether the staffs of the generating stations were paid by the Joint Authority or the authorised distributor.

Sir Harry Haward also put a series of questions as to the revenue of the Joint Authority, because although there was to be an expenditure of £1,050,000 during the first five years, there was no estimate of revenue. So far as he could see, the Joint Authority would be a clearing house.

Mr. Rider replied that as it was the idea that the Joint Authority would take over the whole of the generation side, it followed that it would handle the whole of the revenue from generation.

Mr. Page said it seemed that the Joint Authority was to have all the privileges of ownership without the responsibility.

Discussing the railway supply, Mr. Page said he regretted to see the L.C.C. taking up a timid attitude with regard to this. He elicited from Mr. Rider that, owing to the fact that the Joint Authority, when it came to erect a capital station, would have to put aside a sinking fund, it could never offer the railway companies such a cheap supply as the railway companies could generate for themselves. In fact, the railway companies had intimated to the L.C.C. and the Commissioners that they would prefer to put up their own generating stations and supply the Joint Authority itself.

Mr. Page: And you will lose that complete control of the whole of the generation by the Joint Authority which you have said was so desirable to the success of the scheme?

Mr. Rider admitted that that was so, and added that so long as the Joint Authority had to provide a sinking fund for a comparatively short period, it could never offer the railway companies sufficiently good terms at any time.

Mr. Page, on Friday, June 17th, in continuing his questions as regards railway supply, said that Mr. Rider's evidence on the point had struck at the root of the scheme, and he wished to carry the matter further. He asked whether it was possible to suggest a scheme by which the financial position of the Joint Authority with regard to sinking fund could be improved so that the railway companies could be supplied by the Joint Authority?

Mr. Rider promised to bring forward a scheme. He had not gone into the details of what the railway companies estimated they could do, and his view already given was based on those estimates. The railway load which the Joint Authority might get was estimated at 200,000 kW for the L.B. and S.C. Railway, the South-Eastern Railway, the Great Eastern Railway Co., and the Midland Co. The Great Western, South-Western, and North-Western railways had their own generating stations, and it seemed that the railway companies might erect a number of comparatively small stations, which would not be desirable. The point was that the Commissioners could not refuse permission to railway companies to build stations if they could show that they could generate at a lower price than the Joint Authority could offer.

Passing on to distribution, Mr. Page received the emphatic opinion that the existing distributors were the best people to carry on this work, and not the Joint Authority, provided, of course, that the technical staff of the two bodies were kept separate. Generally speaking, the Joint Authority should have nothing to do with distribution, said Mr. Rider.

Questions were then put as to the position if the load developed more quickly than anticipated and necessitated the building of capital stations earlier than contemplated. Would not the last stage be worse than the first, said Mr. Page, because a large sum of money would have been spent on smaller and less efficient plant in the existing stations?

Mr. Rider did not think there would be much loss of efficiency. Moreover, the installation of this plant would take some time, and the Joint Authority would be able to determine in advance whether it was best to extend the existing stations or build a capital station. Sufficient money had been provided in the expenses of administration of the Joint Authority to provide for a technical staff of sufficient calibre to be able to determine what was the best thing to do at the psychological moment.

Mr. Leckie referred to the opinion of Mr. Rider that more than 10,000 kW could not be transmitted by a single cable, and suggested that that figure was too low.

Mr. Rider said it was based on 33,000 volts, 0.25 sq. in., three core, 220 amps. per phase on a 0.8 power factor. He had not considered 66,000 volts in this connection, but had preferred to keep to what was considered good practice to-day, A cable could not be run at that pressure with safety, at a higher temperature rise than 60 deg. F.

Mr. Lackie said a figure he had was 65 deg. F. temperature rise, 310 amps. per phase, which was about 14,000 kW per cable.

Mr. Rider said some people did run their cables at a higher density, but he preferred not to.

Mr. Lackie contrasted the figures with regard to railway supply, so far as this was taken into account, and asked if Mr. Rider had been in consultation with the railway companies to ascertain what they would be prepared to pay.

Mr. Rider said he had not, but without capital charges he could supply as cheaply as the railway companies could generate. The railway load would improve the load factor of the capital station.

Mr. Lackie suggested that the railway companies and large industrial users might be prepared to pay a somewhat higher price if they were assured of reliability through the capital stations rather than a linking-up policy.

Answering the chairman, Mr. Rider said that £100,000 had been allowed for each of the new sites, that being only for the land and clearing. With regard to railways, he acknowledged that the railway load improved the general supply, and although he agreed with Sir John that it was not wise that the railway companies should be encouraged or even allowed to build their own stations, by the terms of the Act of 1919 the Commissioners were bound to give consent to any other power station unless they could show that an equally cheap and abundant supply could be obtained elsewhere. It all depended on price, however, and he believed the railway companies were sufficiently good business undertakings to take a supply from the Joint Authority if an advantage could be shown.

Sir John Snell followed this up by a reference to sinking fund, which Mr. Rider had previously spoken of as turning the scale against the Joint Authority, and pointed out that the average of the sinking fund was 2½ per cent. on an equated period of 25 years. At present, local authorities could borrow money at 6½ per cent., and they might soon be able to borrow at 6 per cent. He then assumed that railway companies could not borrow at less than 7½ per cent., which should go far towards balancing the difference between the costs of generating by the Joint Authority and a railway company.

Mr. Rider agreed, but added that the railway companies were not bound by statute to set aside anything for depreciation. For instance, they would not depreciate land, whereas the Joint Authority had to pay off the loan in 60 years. Again, there were turbines and boilers which had been in efficient use for longer periods than those allowed for the repayment of the loan. Further, the railway companies could set money aside for depreciation when their finances allowed instead of being compelled to set aside a definite amount every year. As an engineer, he would say that the supply should be given by the party which could give the cheapest and most regular supply, irrespective of whether it was a private company or a public authority. In the case of the Great Eastern Railway Co., he admitted that on the site proposed by that company, which belonged to it, generation could be carried on there for the purposes of the railway company more cheaply than the Joint Authority could give a supply, because the site was at the very point where the load was.

In order to bring the scheme into proper sequence, Sir John put it that there would be 557,000 kW in the existing stations, which would be developed to a total of 756,000 kW, after which steps would be taken to erect capital stations and the existing stations gradually shut down.

Mr. Rider agreed, and said that 225,000 kW of the old plant in the existing stations would gradually be scrapped as the capital stations were developed.

Questions were then asked by Sir John as to how it was proposed to meet the anticipated demand of 60,000 kW in the West Kent area.

Mr. Rider said he did not agree with that estimate of the requirements in the near future. The development in this district during the first stage, however, would be met from the existing stations at Blackwall Point and Woolwich, and future provision must depend upon the circumstances. He reiterated that he assumed the Joint Authority would have a technical staff of sufficient ability to meet the situation from time to time.

The Chairman concluded his questions by saying that, broadly, he took it that the position was that owing to the high costs of capital and plant, Mr. Rider felt it was incumbent to make the most of the existing plant, by making certain additions and linking up to a certain extent. That was the first stage. Then if the rate of growth in any particular locality was quicker than was anticipated in the estimates, there was the flexibility of two alternatives, either to gradually increase interconnection between other stations in support of those already interconnected, or supplement them by adding further plant in certain selected stations, or if it was more economical at the moment to do so, to erect capital stations.

Mr. Rider said that summed up the position exactly as he would wish.

Sir John Snell said the only difficulty he saw about that was that it would take some time to prepare to construct a new capital station.

Mr. Rider said it was not inconceivable that the Joint Authority might have to begin to prepare for the first capital station during the first stage of the organisation. It was impossible to bind the Joint Authority now to any definite line of action. No matter who brought in a scheme at the present time, it might be materially altered in five years.

Mr. C. D. Johnson, Controller of the L.C.C., followed, and was asked only a few questions on the financial side of the scheme by counsel for the L.C.C. Generally speaking, he said, the finance had been estimated on the basis that it would have the rates of the area behind it, and that the income would be the whole income derived from the generation of electricity. The rate at which the money for the new capital stations and other works would be raised had been taken at 6½ per cent.

The cross-examination by counsel for the Conference of Local Authorities and the companies promoting similar schemes was devoted to points of detail. It was not contemplated, said Mr. Johnson, that there would be a flat rate of charge over the whole area, although, unlike the local authorities, the L.C.C. had not considered a system of charging according to zones. Another difference between the two schemes pointed out referred to the meeting of possible deficiencies in the working of the Joint Authority. The L.C.C. proposed to have a reserve fund whilst the local authorities proposed to make a levy to wipe off any deficiency, as it arose, the levy being in proportion to the number of kWh taken by the distributor from the Joint Authority.

Mr. Kennedy, for the companies, speaking on the finance, said the idea was that the companies should advance money to the Joint Authority, and the interest on it would be guaranteed by the L.C.C. under Clause 4 of the Electricity Supply Bill (No. 2) when it became an Act.

Many questions were put by Mr. Donald, for the East London scheme promoters, as to the finance of the scheme.

For the Metropolitan Electric Supply Co. and the North Metropolitan Electric Power Co., it was put to witness that under the scheme, these concerns would be permitted to do what Parliament had already authorised them to do; they would not be benefited in any way, and yet would have to bear a share of the administrative expenses in the early years.

Mr. Johnson's reply to all questions of this character was that everybody in the area would reap the benefit ultimately.

The Inquiry was then adjourned.

Mr. Johnson was re-examined on the morning of Tuesday, June 21st, by Mr. Craig Henderson, K.C. The first point dealt with was the payment for the undertakings by the Joint Electricity Authority in stock, provision for which was made in the financial scheme. As to the Joint Authority becoming a second Metropolitan Water Board, there was no similarity between the two. The Water Board supplied in detail, whereas the Joint Electricity Board would not supply in detail; and the fact was that the administrative expenditure of the Water Board had risen from 8½ per cent. to 10½ per cent. as between 1913 and 1919.

Sir Harry Haward asked what was likely to be the total amount of capital required to meet the needs of Greater London, would it be £50,000,000 in the next 20 years?

Mr. Johnson thought a figure of from £40,000,000 to £50,000,000 would be a reasonable one. Discussing with Sir Harry the relative ability of the railway companies and the Joint Authority to raise capital, Mr. Johnson said this should be 1½ per cent. in favour of the Joint Authority. The whole basis of the scheme was that it should be self-supporting. As to a guarantee of the interest on capital by the L.C.C., he thought this would have a greater effect upon raising money than a guarantee from a number of smaller local authorities. Asked as to the position if the larger outside authorities refused to come in, witness said that although the L.C.C. would prefer the co-operation of the other large authorities, it did not necessarily follow that the L.C.C. would not proceed alone if they held back. If other local authorities refused to pledge their rates as security for the capital required by the Joint Authority, he sympathised with the view put forward at another inquiry before the Commissioners, that such authorities should not have the same favourable terms for bulk supply as those authorities which did pledge the security of their rates.

Reverting to the raising of capital by railway companies and the Joint Authority, Mr. Johnson said the difference in favour of the Joint Authority would depend upon whether the Authority had the security of the rates or only of its undertaking.

Sir Harry Haward mentioned that the Yorkshire Electric Power Co. and the Notts. & Derbyshire Power Co. had put interest and depreciation at 12½ per cent., whereas in the case of the Joint Authority the total, with the rates as security, had been put at 9 per cent. The County of London Co. with regard to its Barking scheme had estimated 11 per cent., including depreciation.

Mr. Johnson said he should have thought capital could have been raised more cheaply than this by companies.

The position of the railway companies was then considered in this connection, and Sir Harry Haward said it seemed hardly likely that the railway companies could raise capital so cheaply as the Joint Authority.

Counsel for the railway companies interposed to the effect that the ability of the railway companies to raise capital on present earning capacity, under Government control, would be materially improved after Government control was removed. That was a material factor in the case from this point of view.

Mr. Johnson's own opinion was that if the Joint Electricity Authority could get to work soon enough it should be able to provide stations which could supply energy to the railway companies as cheaply as the railway companies could generate it for themselves. That opinion was based upon the fact that the cheaper rate at which the Joint Authority could raise capital would more than counterbalance the lower rate of depreciation adopted by the railway companies. At the same time, the period for repayment of loans by the Joint Authority should be made as long as reasonably possible. He did not, however, suggest that a longer period should be granted to the Joint Authority than to the local authorities generally for electricity undertakings, but the period in all cases should be made as long as possible in order to enable electricity to be sold as cheaply as possible.

Sir Harry Haward then pointed out that under the proposed heads of agreement for the purchase of the undertakings by the Joint Authority was the payment of the original capital expenditure properly standing in the books, less depreciation on buildings, plant, and machinery, according to a scale to be settled by the Commissioners.

Mr. Johnson said this was primarily intended to apply to the companies and applied only to generation.

Mr. Craig Henderson, K.C., said the companies were compulsorily purchaseable, but it would be open for any local authority to agree with the Joint Authority for the sale of its generating plant on similar terms. It was not intended to apply the agreement compulsorily to the local authorities.

Sir Harry Haward said the point was whether these terms were considered fair and proper for local authority undertakings.

Mr. Johnson said the L.C.C. had not considered the heads of agreement put forward as applying to local authorities. The basis of the heads of agreement was to give the companies, who were compulsorily purchaseable, an extended tenure of life as distributors.

Sir Harry Haward said the matter had been given so much consideration that he should have thought the L.C.C. would have made up its mind how it would deal with the local authorities. If the terms offered to the companies were to be offered to the local authorities, they seemed extremely favourable.

Mr. Johnson said he should think some arrangement would be come to with the local authorities to take over their capital debt, and not to pay a capital sum for the undertakings.

Sir Harry Haward said that if the Joint Authority paid in stock or cash, for the local authorities' undertakings, the capital would have to be raised at 6½ per cent., and this would place the local authorities in a very favourable position, and, indeed, give the local authorities a profit on the transfer, and would constitute a burden on the Joint Electricity Authority's undertaking.

Mr. Johnson agreed that that should not be done.

Sir Harry Haward then passed to the companies which were to be paid in capital or stock. The companies had raised a large amount of capital at a good deal less than 6½ per cent., and they would derive considerable benefit.

Witness agreed, and Sir Harry Haward then took witness through the financial clauses of the scheme, and pointed out that the Treasury would not allow borrowing by Bills, and it was not proposed to give that power in the Electricity Supply Bill. Criticism was also made of the proposal that the Joint Electricity Authority should have power to borrow up to £1,000,000 without consent. Sir Harry next dealt with the point that many authorities would not get any benefit from the scheme, and invited witness to go into some detail on this.

Mr. Johnson said these authorities on the fringe would get no immediate benefit from the scheme, but by being members of the Joint Authority they were in a sense insuring themselves for the future. The duty of the Authority would be to look ahead and provide for the needs of the whole area, and by this supervision the whole of the undertakings would ultimately benefit, when the scheme was fully developed.

During the course of these questions, Sir Herbert Nield, K.C., remarked that he did not think the Electricity Supply Bill (No. 2) would be saved. This, of course, had a bearing on the possibility of the L.C.C. and the local authorities giving financial assistance to the Joint Authority.

Mr. Page suggested that the better plan seemed to him to be for the Joint Electricity Authority to rent the stations from the existing authorities with the right to install new plant and also with the option of purchasing the station at a later date rather than for the existing authority to continue to run the station and rent new plant from the Joint Authority, as proposed in the scheme.

Mr. Frank Hunt, head of the Estates and Valuation Department of the L.C.C., said that the rateable value of all existing London electricity supply stations, including distributing systems, was £544,000, and the total capacity was 358,000 kW, which worked out at 30s. 5d. per kW. The average assessment of all generating stations in the county was 11s. 3d. per kW. By 1925, he estimated the rateable value would be £356,000. The position would be different when the undertakings were separated, and the whole of the generation placed in one hand and the distribution in another. Generally speaking, there should be no difference in the total contribution, but if the Joint Authority were regarded as quasi-distributor, it might be that the rateable value of the stations would be increased.

Sir John Snell put several questions on this point, and seemed somewhat surprised at the possibility. The Commissioners, he said, did not want to bring about a separation of the ownership of the undertakings which would bring in a larger contribution to the rates and place a heavier burden upon the users of electricity.

Mr. Hunt said the area was within the jurisdiction of four or five different Quarter Sessions, and they did not always agree as to the basis. At the same time, it was a serious risk of increased rates which all undertakings had to face, and it might be hastened by a transfer. It often happened that the rateable value of an undertaking in parts was higher than the rateable value of the undertaking as one whole.

Cross-examination rather indicated that the suggestion of the witness was an indication of the possibility, and that there was nothing to prevent rating authorities attempting to put up the rateable value without the Joint Electricity Authority coming into being and taking over the power stations.

This closed the case for the L.C.C. scheme.

(*To be continued.*)

THE ELECTRICAL CABLE INDUSTRY.

A report prepared by a sub-committee appointed by the Standing Committee on Trusts was published last week, as noted in our columns (Cmd. 1,332, price 1d.). The terms of reference were: To inquire into the existence of any combination of makers of and/or dealers in electrical cables and the materials used in the manufacture thereof, and into the effect which their existence, if found, has upon supplies and prices.

The report states that the electrical cable industry in this country has been a prosperous one for many years, and, unlike many other trades, has not suffered any serious effects from competition from abroad. This may be accounted for by the facts that the trade is highly organised and that British manufacturers enjoy a world-wide reputation for the quality of their products, to which many witnesses have borne testimony. Good quality in this industry both in workmanship and in the use of the best materials is essential if interruptions in electricity supply are to be avoided, and it is on this basis of quality that British manufacturers have been able to secure a steady demand for their productions notwithstanding the considerable competition that exists.

The percentage increase in the price of cables over pre-war prices may be fairly stated as being approximately only 50 per cent. in the case of certain cables for indoor use, and approximately 100 per cent. in the case of heavy underground cables. These percentage increases in prices are moderate when compared with those of many other commodities.

The sub-committee has found no actual combination of firms controlled by one central organisation from the point of view of capital and output, but there are in existence in the trade several associations of which the following are the most important: The Cable Makers' Association, the Telephone Cable Makers' Association, and the High Conductivity Copper Association.

The principal of these is the Cable Makers' Association, which commenced its operations in 1899. The initial object of the association was to nullify the danger of deterioration in the quality of rubber-insulated cables brought about by the severe competition then existing amongst manufacturers. With this end in view the dimensions of conductors and thicknesses of dielectric and lead coverings were standardised, and were generally accepted throughout the industry. In addition to the standardisation of dimensions, tests of performance of the cables, conditions of contract and forms of tender have also been formulated in co-operation with certain other bodies interested in the industry. The policy of the association generally has been to secure standardisation, and with this object it has for some years co-operated with the British Engineering Standards Association. Most of the largest manufacturers of cable in this country are members of the association, and the combined capital of the members represents approximately 80 per cent. of the total involved in the industry, whereas the output of the Association has been represented as being approximately 90 per cent. of the total production of the country. Considerable sums of money have been, and are being, expended on research work by the Association and its members, although the result of the research carried on individually is not always communicated to the remaining members.

A further object of the Association has been to regulate the wages and working conditions in the industry, and a Joint Industrial Council has recently been formed and agreements come to between the Council and the Trade Unions concerned whereby the grading and wages for the various occupations in the industry have been standardised.

The Cable Makers' Association is registered as a trade union, and under the Trade Union Act, 1913, is not permitted to exercise any price regulating functions. Standard prices of cables of specified qualities and grades are, however, agreed upon by the members, and standard price lists are issued from time to time. Maximum discounts are also fixed by agreement, and no member is allowed to sell below the agreed prices or give higher rates of discount than those fixed. Various discounts off the list and catalogue prices are allowed according to the channel of trade, and amongst other inducements offered to buyers may be mentioned an exclusive buyer's bonus of 5 per cent. given to certain purchasers who agree to purchase specified cables exclusively from the members of the Association. Contract rebates varying from 1¼ to 10 per cent. are also given to certain purchasers in consideration of their agreeing to purchase from members of the Association specified net values over a given period. There is in existence an important agreement between the Cable Makers' Association and the Electrical Contractors' Association, whereby the latter association receives further special benefits subject to exclusive buying and other conditions.

The electrical cables industry is not entirely under the control of the Cable Makers' Association, and there are old-established firms of repute outside the association which are in competition. The prices quoted by non-associated firms for types of cable similar to those produced by associated firms may be fairly stated as being generally about 10 per cent. lower than those of the associated firms.

Non-associated firms represent the quality of their productions to be equal to that of associated manufacturers, and various opinions have been expressed by buyers as to their respective merits.

It is abundantly clear to the sub-committee that manufacturers operating outside the association are well able to compete with the associated firms from the point of view of quality, and this is an important point. The outstanding fact remains, however, that the largest users, as a rule, are entirely satisfied with the service rendered by associated firms and are willing to pay a higher price for their products which they regard, rightly or wrongly, as in the nature of an insurance against interruption of electricity supply from failure in service and as a guarantee of durability.

The prosperity of the electrical cable industry has already been referred to, and there is no doubt that this prosperity was largely created by the Cable Makers' Association which, by its organisation and research, initiated and has since maintained a high standard of quality, thus securing the confidence of buyers both in this country and abroad.

The sub-committee has no evidence to show that the association has acted or is acting unreasonably, and it is noteworthy that during the course of the inquiries there has been a marked absence of hostility towards the association both on the part of users and on the part of non-associated firms. Even if there should be any risk of unreasonable action in the future, the public would be sufficiently safeguarded if the recommendations contained in the report of the Committee on Trusts, dated April 24th, 1919, were adopted.

The Telephone Cable Makers' Association is an unofficial (informally constituted) organisation, and distinct from the Cable Makers' Association, although all its members are also members of that association. Prior to 1904, and during the time when the greater part of the telephone service in this country was owned and operated by the National Telephone Company, competition amongst the few manufacturers engaged in the industry was so keen as to make production unremunerative. With a view to obviating this, and also to meeting competition from abroad, three of the principal manufacturers "came together" and were joined by a fourth in 1907. From this time the association may be deemed to have been in existence, although until recently it has been more in the nature of an understanding between the members than a formal association. The output of the association is approximately 95 per cent. of the total in this country, and there is only one firm outside the association able to compete to any appreciable extent.

The Post Office purchases the bulk of the output of the members of the association, and it may, therefore, be said that the operations of the association are principally confined to dealings with this department.

Since the formation of the association, its principal functions have been to arrange selling prices and to allocate to its members orders of an agreed percentage of the total. With regard to this latter function a system was adopted whereby a member, to whom an order had been allotted, was protected by somewhat higher tenders on the part of the remaining members. While this system is still in operation, the sub-committee is informed that, so far as the Post Office is concerned, members now submit uniform prices and that department is at liberty to allot the work where it can be executed with the maximum advantage.

It appears that the Post Office has not always been satisfied as to the reasonableness of the prices submitted by members, and such dissatisfaction was expressed in 1920 consequent upon certain increases which were not considered justifiable. The Post Office discussed the subject with a representative of the association who agreed, with a view to the Department ascertaining whether or not the prices were reasonable to allow an independent accountant to examine the books of one of the members upon the basis of whose costs, it is understood, prices have always been submitted. A certificate was later submitted to the Post Office to the effect that the margin of profit shown in the prices was reasonable. As the result of these negotiations an agreement was arrived at (and is now operating) whereby the price governing cable contracts between the Post Office and the Telephone Cable Makers' Association was to be based upon the ascertained cost of manufacture at an efficient factory plus a certain percentage for manufacturers' profit. The sub-committee has been informed by a representative of the association that the margin of profit agreed upon between the Post Office and the association has never been exceeded since the formation of the association in 1907. The sub-committee has no reason to doubt this statement, nor any evidence to point to any unreasonableness on the part of the association.

The High Conductivity Copper Association is an organisation of manufacturers engaged in the drawing of copper wire for supply to the electrical cable industry. The basic material used in manufacture is wire bars, and the price at which drawn wire is to be sold is settled by the association which decides from time to time what amount is to be added to the price of basic production in order to arrive at the price of wire. The object of the formation of the association, in 1903, was to stabilise prices on the basis of a reasonable profit such as would not be likely to stimulate competition from abroad. The association represents that this policy has been consistently carried out, and that since the war such additions have been made to the margin as would cover only increased costs of production.

The report is signed by Messrs. J. E. Baker, O.B.E., P. J. Agnew, G. W. Bailey, Sir A. F. King, Messrs. C. H. Wordingham, C.B.E., and J. F. Mason.

LEGAL.

Hastings Corporation and The Tramways Co.

Mr. William W. Szlumper, M.Inst.C.E. (of Westminster), as arbitrator, sat at the Surveyors' Institution, Westminster, on June 18th, to hear a point of controversy in the matter of the relighting on the line of tramways on the Front, which the Tramway Co. has to undertake under its Act of last year. The Act authorised the company to erect overhead wires for working the tramways on the Front in lieu of the then existing petrol-electric system. A question has arisen whether it is the duty of the Corporation or the company to supply a new or supplemental cable in connection with the relighting. The Corporation contends that it is the duty of the company; on the other hand, the company says it is not its duty to do so.

Mr. Macmorran, K.C., and Mr. Lawrence Tooth (instructed by Mr. Percy Idle, town clerk of Hastings) appeared for the Corporation, while Mr. Roskill, K.C., and Mr. H. G. Robertson (instructed by Messrs. Ashurst, Morris, Crisp & Co., solicitors, of Lombard Street, E.C.) represented the Tramway Co.

In opening the case, Mr. Macmorran said that the Corporation, in giving up its objection to overhead wires, made an agreement with the Tramway Co. under which the latter was to substitute a new system for the old system of arc lighting. The company was to provide lamps to be placed on its posts and, at its own expense, as the Corporation might require, provide everything for the purpose.

Mr. Roskill submitted that the question to be decided concerned two points of law. The question was not whether the existing cable was sufficient or insufficient, but having regard to the words of the Act of Parliament, whether the liability which it was sought to put upon the company was a liability imposed by the Act. That was a question of law, and he submitted, therefore, that no evidence was admissible on whether the lighting cable of the Corporation was sufficient or insufficient for this or any other system. Apart from that, there was a question of law whether this came within Section 33 of the Tramways Act, 1870, and was subject to arbitration.

Mr. Macmorran contended that in so far as any new cable was necessary it was the duty of the company to supply it; whether it was necessary must depend upon whether the existing system was sufficient or not.

Mr. Roskill said the short point was whether the word "cable" in the section included part of the Corporation's main cable.

The Arbitrator: The position is this, I suppose. Is the company to pay the cost of a cable such as is required by the Corporation? I gather that the lighting which originally existed has now been altered to a different system.

Mr. Roskill: Not at our request. We could adapt. That is not our doing.

The Arbitrator: Exactly, a different system. It comes to this, surely: The Act of Parliament does not put on the company, so far as I can see, an obligation to adopt a different system to that which was in force prior to the passing of the Act. I should like to know at whose instance it was that an alternative, altered, system was agreed to, and surely that will have a material bearing upon Mr. Macmorran's point.

Mr. Macmorran: I am afraid, sir, you have got to interpret the section as it stands, and therefore you cannot go into details of what negotiations took place for the purpose of arriving at this agreement. Section 6 really represents the agreement come to between the parties on the Corporation's opposition, and that agreement has been made a sub-section which is entitled "provision for the protection of the mayor, aldermen, and burgesses of the county borough of Hastings." They were to have some protection against proposals which had been made by the company. The company wanted to remove the restrictions which hitherto had been placed upon it, and in consideration of the Corporation consenting to its proposals these provisions under Section 6 were inserted for the protection of the Corporation. What we say is this: The protection of the Corporation involved the abolition of its existing system of lighting, and substituted something else. That was intended to be done at the expense of the company. Sub-section 3 says: "The company shall at their own expense provide all necessary cable, wires, appliances, and apparatus in connection therewith."

Mr. Roskill submitted that if it was to be left to an arbitrator to decide what was necessary this would have appeared in the section. The clauses were the Corporation's own clauses.

The Arbitrator did not see how they were going to eliminate the word "necessary" as a point of fact.

Mr. C. H. Wordingham, C.B.E., was then called on behalf of the Corporation. He said he had inspected the sea Front, and considered the clauses of the Act of 1903 and 1905. The present system of lighting consisted of an arc lamp on its own special pole. The current was transmitted along the sea front at a pressure of 600 volts, and was transformed down at each post to a pressure suitable for the arc lamp, approximating 50 volts. By switching off and on at a single point there was a double saving of labour. He had read the Act of 1920, and knew it was proposed to make what he might call a new system of lighting on the front; it was a substitution of another complete and different system for the existing system of street lighting. In order that the new system might be equivalent to the old one they must provide for a greater consumption. There must either be a new cable or the existing one must be supplemented. The most economical way would be to supplement the existing cable along a portion of the Front.

In cross-examination by Mr. Roskill, Mr. Wordingham thought the agreement prevented the old arc lamps being put on new standards.

Mr. Roskill: You say the Corporation, through this agreement, seeks for a better system of lighting than it had before?

Mr. Wordingham: No. I am not prepared to say it is a better system. It is a better distributing system, and there are more lamps.

In further cross-examination, Mr. Wordingham did not think the cost entered into the question of the company having to carry out its undertaking.

Mr. Roskill: There is no difficulty in transferring an arc lamp from one standard to another.

Mr. Wordingham: You can't transfer it directly to the standard. You must have a bracket to stand it on.

Mr. Macmorran said this suggestion of his learned friend could not be serious because the Act provided for the substitution of another system of lighting.

This was the case for the Corporation.

Mr. Roskill, in addressing the Arbitrator for the Tramway Co., said the only liability of the company was to make the necessary connections with the new standards. First, the company had to place on the posts and standards erected by it as the Corporation might require, electric lamps in substitution for the existing electric standards and lamps. Next, the company, at its expense, had to provide, fix, and properly connect all necessary cable, wires, appliances, and apparatus in connection therewith. That provision clearly dealt with fitting and not constructive work. The next clause was: "The Corporation shall be entitled to the use of such posts and standards for the said lamps, cables, wires, appliances, and apparatus free of cost." The word "cables," he submitted, in this connection had no reference to the main cable. How could it include the main cable which already belonged to the Corporation? It must be something to the use of which it would be entitled free of cost. There was not a single word in any of the clauses that could be interpreted to mean the provision of a new cable. Further, the company was to remove all these things if required to do so. How could that possibly refer to a main cable?

The Arbitrator: You say the "cable" in this clause means that portion of the attachment between the cable of the Corporation and your lamp standard.

Mr. Roskill: Entirely. That is the whole point.

Mr. Wordingham did not think the attachment from an engineering point of view could be called a cable, for the reason that the current to be carried would be very small.

Mr. Roskill (to the Arbitrator): As this gentleman uses the word "cable," will you ask him if he would say whether it does or does not include something attached to or connected with the standards or posts?

Mr. Wordingham: The cable can be attached to a standard or post, but it cannot be connected to it. It must be connected to the lamp.

The Arbitrator: What you call a cable is some portion of that which lies between the Corporation cable and the lamp?

Mr. Roskill: Yes.

Mr. Roskill then argued at length in support of his contention that this was not a question for arbitration under Section 33 of the Tramways Act, 1870, as the matter in question did not come within its purview.

Mr. Robertson also addressed the Arbitrator on behalf of the Tramway Co.

Mr. Macmorran having replied, the Arbitrator reserved his award, saying he would state it in the form of a special case for the consideration of the High Court, and adding: "Mr. Roskill desires me to put into it his objection to my jurisdiction and his objection to the evidence. Therefore, if my award happens to be in Mr. Roskill's favour, he will have to argue against it."

Infringement of Restriction Orders.

At the Halifax Borough Court on June 13th, three cases were heard in which it was alleged that the restrictions placed upon the use of electricity had been ignored. In the first case the defendants were Messrs. Ollerenshaw, Ltd., spinners. It was stated that this firm's weekly consumption since the Order was made had exceeded by 43 per cent. the average weekly consumption prior to April. The defendants said that they thought they were keeping well within their limits as their machinery had only been running for half the usual periods. They disputed the Corporation inspector's figures for their consumption prior to the Order, and said the error was probably due to the meters. The case was dismissed on payment of 12s. 6d. costs.

Messrs. Samuel Barrett & Son, slaters and plasterers, who were alleged to have used 154 per cent. of their normal consumption, but who stated that their working hours had been reduced by half, were similarly dealt with.

Frank Earnshaw, joiner, was stated to have used 151 per cent. of his normal consumption. He explained, however, that this was due to the fact that he had replaced a 5-h.p. motor by another three times this capacity, but had been given no opportunity to explain the circumstances. The Bench dismissed the case without costs.

Tramcar Driver Fined.

At Bradford, on June 15th, William Henry Wilkinson, a Corporation tramcar driver, was fined 10s. for driving a car to the danger of a policeman on point duty in Wakefield Road. After giving a signal for the car to stop, the constable turned round to attend to other traffic, and he was knocked down by the tramcar. The defendant said he could not pull up in time. The defence was that there had been an error of judgment, but not wilful negligence. The defendant had a good record in the tramway service.

Bastian Electric Co., Ltd.

The petition of W. F. N. May and Another for an order for the compulsory liquidation of this company was mentioned to Mr. Justice P. O. Lawrence in the Companies' Winding-up Court on Tuesday.

Mr. Dighton Pollock said there was a definite proposal to settle the matter, and he understood that that involved the payment of a certain sum, and the only question was as to the date to which the petition should be adjourned to allow of the payment being made.

Mr. Schwabe, K.C., for the company, said he was instructed to say that the matter would be carried through if the petition was allowed to stand over for a fortnight.

His Lordship adjourned the petition accordingly.

Electrical Belt Case.—Important Irish Decision.

In the High Court of Appeal in Ireland, Dublin, before the Lord Chancellor, Lord Justice Ronan and Lord Justice O'Connor, an appeal was heard from an order of Mr. Justice Gordon refusing liberty to issue and serve a writ out of the jurisdiction on Ajax, Ltd., London, the intention being to try in Dublin an action against the company by Edward McPhillips, jeweller, Bundoran, Co. Donegal, who had been supplied with an electrical belt at a cost of £21, and who now alleged that the article was worthless.

Counsel for plaintiff informed their lordships that the belt was intended, he believed, as a cure for kidney disorder. The plaintiff proposed to examine a number of witnesses—electrical engineers and others. Mr. Justice Gordon had refused liberty on the ground that the sum involved was too trivial to justify the bringing of people from England; but this Appeal Court had granted liberty in a claim for £10 10s.

The Lord Chancellor said they were bound to have regard to the convenience of the defendants and the expense that they would have to incur in coming to Dublin. They were receiving constant complaints from English and Scottish mercantile associations that their members had to come to Ireland in small cases at enormous expense. This was a case that could well be tried in the County Court of Middlesex, and they must dismiss the appeal.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Living Expenses Abroad.

Very many engineers, especially those who are in the early days of their career, and who have come to the conclusion that the only way to advancement is by taking up a post abroad, must be grateful to you for your articles on "Living Expenses Abroad," and hope that from time to time they will be added to.

There is, however, one point, and rather an important one too, that has been overlooked, and which the writer thinks should always be stated, and that is the social position of the correspondent.

It must be obvious that a salary which would give comfort and luxury to one type of man would not be enough to make ends meet in the case of another. Take India as an example. A young engineer going out whose position at home is one of more or less humble circumstances, would not expect, and probably could not live, in a manner similar to one whose social position was higher, and consequently if he is good enough to send home data of his living expenses, which are very welcome here, they would not afford much of a guide to a man of the type described to-day rather aptly as the "new poor," who would reasonably expect to live in somewhat different circumstances; or even for the matter of that to a man of any other class.

To send such a man out on a salary based on the lower scale would be unfair to the man himself, and would react on the employer who sent him, as the result could only be that he would very soon become dissatisfied, would necessarily lose caste in the eyes of the natives with whom he came in contact, he would no longer be looked up to as a "Pukka Sahib," and would become yet another link in the chain of lost prestige which is, alas! so prevalent in our Indian Empire of to-day.

A short statement by the correspondent as to his social position (the type of club he belonged to, for example, would enable readers to locate him) would add 100 per cent. to the value of the information, and would be very greatly appreciated.

Ubique.

June 14th, 1921.

The Cost of Living in Spain.

I am anticipating being sent to a village in the neighbourhood of Madrid shortly, to superintend the installation of electrical plant. Could you give me information which might be of assistance to me, such as cost of living, general conditions, &c.

Rover.

June 17th, 1921.

[We have no data bearing directly upon this matter; perhaps our readers will kindly assist our correspondent?—EDS. ELEC. REV.]

Electric Light Wiring Systems.

Referring to the paper read before the National Association of Supervising Electricians, I would like to give your readers my experience of screwed conduit and lead-covered cable.

In one portion of a church building cables were run underground in screwed conduit which was surrounded with cement. This system gave trouble from the very start, as, owing to condensation, the cables were lying in water, and in a week or two burnt out. After this, cementing the ends of the tube up was tried, bringing the cables through airtight bushes, but this was worse still.

Finally the whole of the cable was taken out and lead-covered cable was put in its place. This was done about 17 years ago, and we have not had any trouble since then.

Also, I should like to say that my experience is that wood casing is far cheaper than screwed conduit for ordinary work, and often cheaper than the grip system.

J. M. Ward.

Leeds.
June 14th, 1921.

The paper read before the meeting of the National Association of Supervising Electricians is not of a nature to inspire the general electrical world to confidence in them.

In the first place, it is equivalent to biting one's nose to spite one's face. The supervising electricians depend to a large extent upon the manufacturers of various wiring systems for their daily bread; it is, therefore, to their interests to support the manufacturers, rather than to criticise them, or their products. Particularly noticeable is the criticism shown towards the well-known C.T.S. cable. Some people prefer C.T.S. wire, while others do not, at the same time it will not benefit the Association of Supervising Electricians to condemn C.T.S. cable in a larger degree than any other system.

I would suggest to Mr. Alldread that the reason for the C.T.S. wire cracking at bends and corners is not due to the cable itself, but to its having been installed with unduly sharp bends. Also my experience is that C.T.S. wire is very flexible and is not liable to crack, at bends, when properly installed. Again, I would call his attention to the statement that on horizontal runs sagging is unavoidable; the system is a neat job when properly installed.

Why does Mr. Alldread condemn C.T.S. cable when he admits he has no experience of it? I ask him to answer the last question.

The wiring system to suit all minds and tastes has yet to be born, so the matter is one for the particular person concerned to suit himself; the person who pays the piper generally calls the tune. At the same time, condemning C.T.S. cable more than another system is stupid, and engineers of some standing, and who are broad-minded, can well afford to ignore such discussions, that are all one-sided.

If Mr. T. Hough, another contributor, will kindly read his own article he will notice that he contradicts himself. He states that screwed tube, lead-covered, paper-insulated, lead-covered V.I.R. wood casing, and cab tire, are failures when in damp situations. He then states that in damp situations the only two systems that will stand up to it are cab tire and vulcanised rubber and stranded wire. I cannot say I favour his system of front recessed wood blocks for jointing purposes; warm situations, or exposure to the sun, would soon persuade the bottle wax to leave the job.

In conclusion, I would advise the Association of Supervising Electricians to adhere to the old proverb: "Judge not, that ye be not judged." Or, in any case, to judge fairly.

Two Phase.

June 20th, 1921.

Converting 50-cycle, 1,500-volt, Alternating to Direct Current.

With reference to "K.W.'s" letter under the above heading in your issue of the 10th inst., it is noticeable that he makes no mention of the large mercury arc rectifier, which is acknowledged to be the most suitable converter for such conditions at 1,500 volts d.c. Not only is it capable of dealing with these high pressures, but frequency has no bearing whatever on its operation. On the contrary, with a periodicity of 50 cycles, the efficiency would improve as compared with that obtained at 25 cycles and 1,500 volts d.c., which latter efficiency, as it is, is unapproached by any other form of converter.

M. A. R.

June 15th, 1921.

The Grading of Mains Engineers.

I was very pleased to note that someone had at last "taken up the cudgels" on behalf of the meter engineer. "Meter Engineer?" has summed up the situation quite correctly when he says that meter work has been for years looked upon as an insignificant occupation; and this in spite of the fact that it is upon the *insignificant meter* that an electricity undertaking's revenue depends.

It almost seems as if the meter engineer has, for far too long, hidden his light under a bushel. He certainly doesn't write letters to the technical Press belittling the work and efforts of his fellow workers in the electrical industry. Are we not *all* necessary for the successful working of an undertaking?

Unlike our American cousins, the average English electricity undertaking does not understand, or appears not to understand, how to run a meter department successfully. Incidentally, the best publication on meter engineering, in all its branches and ramifications, is, I am rather sorry to have to confess, American!

As you stated in your leading article of May 2nd, 1919, "every unit not properly metered is a dead loss, in money, to the undertaking." I wonder how many units, and incidentally, how much money, is lost, in this manner, in the course of a year's working, in the average English electricity undertaking.

No meter should be out on circuit without a thorough overhaul and recalibration longer than three years, and this period should vary inversely as the size of the consumer. That is, a large consumer should have his meter, or meters, checked much oftener than a small consumer.

I am afraid that I have let my pen run away with my enthusiasm in the above matter, but I really do think that it is about time that the meterman was recognised as equal to the charge or mains engineer.

Meter work entails just as much technical knowledge as does the position of charge or mains engineer; especially if the man in charge of the meters has the interests of the undertaking at heart.

It is in the hope that I may further the interests of the meter engineer that I am writing this letter, and signing myself,

Another Meter Engineer.

June 19th, 1921.

Re the E.P.E.A. schedule, I should like to point out to your correspondent "Grade 8," and any of those whom his arguments may mislead, that his "constructive" criticism would be more than likely to prove very destructive in its practical application. To try to pack all the executive committees with shift men merely because they were shift men is a suggestion so fundamentally wrong in principle as to be utterly unworthy the second thought of any man calling himself an engineer. The obvious is very seldom the best way of doing anything. The E.P.E.A. is not merely a rob-the-ratepayers association (though that laudable object should never be entirely lost sight of, ratepayers as a class being mostly narrow-minded objectionable persons obsessed with "a narrowing lust of gold"), our Association is an exceedingly complex and delicate machine, the pioneer of its kind, with very far-reaching possibilities in its future; it is not to be lightly delivered into the hands of unskilful or hot-headed operators. The first question for every voter to ask himself is: "Who is the best man for the association?" and then, having got the best men at the head of things, keep them up to their job by continually demanding explanations of wrong actions or inactions. That's your part of the contract, your job isn't finished when you have recorded your vote; if you think it is you will deserve what you will get, which is "nothing." As to methods, attend all the meetings possible, but also by all means take full advantage of the generosity of the "Correspondence" column of the good old ELECTRICAL REVIEW, the "forum" of station men for 20 years past. There is nothing like publicity to "ginger up" public officials. In such a scattered association as ours any real "general" meeting is impossible, the technical Press is the only place for that full and free discussion of those vital problems whose correct solution is essential in order that "the truth shall make you free"—a maxim that should make a particular appeal to engineers who, above all men, spend their lives seeking the ultimate truth. I should like to add also in favour of discussion in the REVIEW that many junior members, rightly or wrongly, fear victimisation if they express their views too freely. I have had several cases brought to my notice, in every case, I am satisfied, purely imaginary, but nevertheless effective.

In my opinion the E.P.E.A. has been most skilfully navigated through some very dangerous storms, but "Grade 8" remains *de*grading and insulting, and a menace to the status of the whole profession.

C. S. W.

June 20th, 1921.

The Lubrication of Ball Bearings.

I was much interested in reading Mr. J. C. Todman's letter in your issue of the 17th inst. It is high time the question raised by your correspondent was fully ventilated, and I hope settled finally. As an expression of personal experience, I consider ball bearings as applied to electric motors, as being little better than an abomination, as compared with a sleeve bearing bush and ring lubrication. A well-made ball bearing equipment, well packed with Stauffer grease, will render the best of service for a long while, provided the situation is suitable. Petroleum jelly, even with graphite admixed, does not meet with my personal approval, though quite good results are obtainable with this when applied to "toy motors." Light machine oil should be barred entirely, as in a very large number of cases "freak pulleys' form part of the motor equipment, and consequent belt tensions frequently militate against satisfactory results. Personally I plump for grease cups and Stauffer grease, to the exclusion of all else, particularly in view of the faulty material and workmanship found generally nowadays, particularly with small single-phase motors.

Walter E. Rogers, A.M.I.E.E.

Shepherds Bush, W. 12.
June 19th, 1921.

Situations Vacant.

I should be obliged if you would give me space in your "Correspondence" column to bring to the notice of station engineers an advertisement which appeared under the heading of "Situations Vacant" in your last issue. It reads:—

"Mains Superintendent, installation and maintenance, h.t. and l.t. networks, supervision mains and meter staff, maps, necessary statistics; also good knowledge turbines, reciprocating sets, water-tube boilers, Weir pumps, &c."

The advertiser then proceeds to conceal his identity under No. 2398!

If he wants a "Chief Assistant Engineer," why not advertise for one? The advertisement as worded gives the impression that he wants a Grade 1 chief assistant at a Grade 3 rate.

Would a knowledge of book-keeping and shorthand be an additional advantage, as the successful applicant could then do the office work in his spare time?

Justitia Fiat.

June 20th, 1921.

BUSINESS NOTES.

Bankruptcy Proceedings.—PHILIP DOWNIE, 355A, Westborough Road, and 88, Ronald Park Avenue, Southend-on-Sea, Essex, electrical engineer and factor.—The receiving order in this matter was made on May 18th on creditor's petition. The statement of affairs shows liabilities to unsecured creditors £491, against assets estimated to realise £367, from which £2 9s. has to be allowed for preferential claims, leaving net assets of £365, or a deficiency of £126. Debtor attributes his position to becoming liable for goods supplied to a limited company, and the failure of that company to pay the accounts. It appears that on April 1st last debtor executed a deed of assignment to a trustee for the benefit of his creditors. He was brought up to the trade of an electrical engineer, and commenced his present business in January, 1920, at 355A, Westborough Road, with £50 savings. The only books of account kept consist of a sales ledger and a duplicate invoice book. Debtor became aware of his position on March 14th last.

FRANCIS EDWARD JAMES PADMORE, Marlborough Road, Nuneaton, Warwickshire, electrical contractor.—The following are creditors in this case:—

Metallic Engineering Co., Ltd.	£133	Wilson, G., & Co.	£15
Parsons, Sherwin & Co., Ltd.	18		

LESLIE PHILIP HOWSE, and GEORGE HARRY BERTRAM SNELL, electrical engineers (trading as Howse & Snell), 6 and 8, Duke Street, Margate. The following are creditors herein:—

Braulik, G.,	£48	Elec. Heating & Hardware Co.	£20
Bligh, S. W.,	356	Anderson Bros.	10
Selyn Electric Co.	169	Bigg, E.,	20
Thanet Advertiser	13	Brown, A.,	42
Gestetner, D.,	41	Rapson's, Ltd.	11
Napier Kimber, Ltd.	139	Hunt, J. W.,	51
Holophane, Ltd.	23	Snell, F. C.,	365
Mann & Overton	140	Chapman, A.,	70
Sloan Electrical Co., Ltd.	57	Bligh, S. W. (for Rice & Sons)	40
Kent Coast Motor Co.	46	Suttie & Suckling	10
Fricker, V. D.,	13	Poxon & Co.	14
Oldby, Ltd.	11	Millsum, care of Maison Elise	24
Rex Imports Co.	24	Cole & Hardie	32
Barratt, G. R.,	12	Dredge, E.,	25
Davis, J. M. (for Commercial Elec Co., Chester)	24	Powell, W. J.,	105
Davis, J. M., as above	13	Jarladium Garage, care of Noble & Co.	47

J. F. LYONS, electrical engineer, Consett.—Trustee (Mr. A. E. Carr, 26, Collingwood Street, Newcastle-on-Tyne), appointed June 11th.

SAML. BECKETT, JUN., electrician, Deane Road, Bolton.—At Bolton Bankruptcy Court, on June 16th, bankrupt was examined on a statement of affairs showing liabilities of £281 and deficiency of £233. During his naval career debtor had experience in electrical work. After his discharge he was out of employment until he had exhausted his out-of-work pay. Then he started on his own account. Until October, 1920, he paid his way, but owing to trade depression the concern ceased to pay. He had been handicapped by the Corporation electricity department's delay in fixing meters. The examination was closed.

Company Liquidations.—SWARREN, LTD.—A petition for the winding-up has been presented to the High Court by the E.S. Co., Ltd. (Proprietors of the Electrical Supplies Co), of 233, Tottenham Court Road, and will be heard in London on June 28th.

BACHELET FLYING TRAIN SYNDICATE, LTD., and BACHELET LEVITATED RAILWAY SYNDICATE, LTD.—Meetings of members are called for July 20th, at 11, Ironmonger Lane, E.C., to hear an account of the winding-up from the liquidator, Sir W. B. Peat.

Dissolutions of Partnership. — RAINBOW MANUFACTURING CO., electrical welders, 75½, New Sumner Street, Birmingham.—Messrs. E. E. Hall & L. J. Austin have dissolved partnership.

S. SHERMAN & SON, gas and electric light fittings manufacturers, general factors, &c., 57, New Compton Street, W.—Messrs. E. E. Evans & E. Sherman have dissolved partership. Mr. Evans will attend to debts.

Trade Announcements.—The agency for the United Kingdom and Colonies for the Atlas Co., Ltd., of Copenhagen, makers of impulse steam turbines steam engines, condensing plant, &c., has been taken over by MR. E. W. DOREY, of Norwich House, Southampton Street, High Holborn, W.C. 1.

MESSRS. W. T. HENLEY'S TELEGRAPH WORKS CO., LTD., Blomfield Street, London Wall, E.C. 2, inform us that they are now producing in large quantities for sale, the "Henley" adhesive tape, which for years has been made practically exclusively for their own use.

THE CREDENDA CONDUITS CO., LTD., are now handling Credenda cables and flexibles, and their new branch at Glasgow carries full stocks of Creda and Credenda lines.

MESSRS. R. M. RADIO, LTD., have removed from Whitefriars Street, E.C., to 5, Regent Square, Gray's Inn Road, W.C. 1.

MR. ARTHUR T. SMITH, A.M.I.E.E., of Albion House, Hanley, Stoke-on-Trent, has recently been appointed agent for the Midland Counties of England for Messrs. Bruce Peebles & Co., Ltd., for the sale of their electrical machinery. The counties covered by the agency are Stafford, Derby, Nottingham, Lincoln, Rutland, Leicester, Warwick, Worcester, and Salop.

Meeting of Creditors.—VIGERS BROS. (Frederick Vigers and C. H. Vigers), Balfour House, London, E.C. 2.—Meeting of creditors held on Tuesday, June 21st, to receive a statement of affairs.

Catalogues and Lists.—Messrs. W. T. Henley's Telegraph Works Co., Ltd., Blomfield Street, London Wall, E.C. 2.—Leaflet 250, giving net trade prices of "Henley (504)" adhesive tape.

Messrs. Guy Chantrill & Co., 6, Norfolk Street, Strand, W.C. 2.—Stock list of motors for 50-cycle, three-phase a.c. 220-440 V. Fully priced.

Messrs. Reavell & Co., Ltd., Ranelagh Works, Ipswich.—Pamphlet No. 42 C, illustrating and describing "Axial" compressors and vacuum pumps especially suitable for electric motor drive.

The Overseas Engineering Co., Ltd., 163-165, Great Portland Street, W. 1.—List No. 63, illustrating and describing the "Garage" current converter for charging accumulators from a.c., and "National" lamp-testing meters. Also list No. 73, dealing with "National" moving-iron and moving-coil volt and ampere meters. Both lists are fully priced.

The General Electric Co., Ltd., Magnet House, Kingsway, W.C. 2.—List No. L2492, giving illustrations and a full description of the "Kingsway II" miners' electric hand lamp. Also charging racks, standing racks, magnetic lock openers and other accessories. All items are fully priced.

Agricultural and General Engineers, Ltd., Central House, Kingsway, W.C. 2.—Publication No. 285, a well-illustrated descriptive catalogue of "Bull" d.c. dynamos and motors and complete lighting sets. The construction is very fully detailed, and the component parts are shown in every case.

The Falkirk Iron Co., Ltd., Falkirk. List No. 251, illustrating and describing "Falco" tailors' electric irons. Priced.

Messrs. Petters, Ltd., Westland Engine Works, Yeovil.—Publication No. 561 (36 pp.). A very full catalogue of "Petter Junior" oil engines, illustrating and describing many types ranging from 2½ to 8 b.h.p. The list is fully priced.

Hart Accumulator Co., Ltd., Stratford, E. 15.—A priced and illustrated leaflet advertising 5-Ah capacity ignition batteries in celluloid cases.

The Manor Works Co., 58, Albert Road, Aston, Birmingham.—A leaflet illustrating examples of sheet-metal pressings in aluminium, steel, brass, silver, &c., for all purposes.

The Photector Co., Ltd., Central Hall, Southall.—Leaflet E 2,030, giving illustrations, particulars, and dimensions of wrought-copper cable sockets. Prices and technical data are included.

Catalogues Wanted.—Catalogues and lists of electrical manufactures, also of oil and gas engines for electric lighting and other purposes, are wanted by Messrs. Bennett & Heron, of South-West Works, 46, Range Road, Whalley Range, Manchester.

Private Meetings.—A. M. Wilmore, trading as the Petlectric Lighting Co., High Street, Bordesley, Birmingham.—At a meeting of creditors a statement of affairs showed liabilities of £342 due to unsecured creditors. The net assets are £148, a deficiency of £194. The debtor made an offer of a composition of 10s. in the £. This was accepted, and a committee of the principal creditors was appointed.

Arthur Gray, electrical engineer, trading as Gray Electric Co., 9, Denmark Street, Charing Cross, W.C.—The creditors were called together recently, at the offices of Messrs. Corfield & Cripwell, Balfour House, Finsbury Pavement, E.C. A statement of affairs was presented showing the position as at June 9th last, and this disclosed liabilities of £664. Of that amount £643 was due to unsecured trade creditors. The assets were estimated to realise £230, or a deficiency of £434. On behalf of the debtor an offer was made of a composition of 5s. in the £, payable as to 1s. 3d. in cash, and the balance by three equal instalments spread over a period of three months each, and guaranteed. The creditors decided to confirm the deed of assignment, and instructed the trustee (Mr. Osborn) to endeavour to obtain a cash offer of 4s. in the £, or, alternatively, 2s. in the £ in cash, and the balance in three months.

Receiver Appointed.—Quead, Ltd., 149, Southwark Bridge Road, London, S.E. 1.—Mr. E. A. Harpham has been appointed receiver and manager on behalf of the debenture-holder.

Tramway Workers' Wages.—As a result of the deliberations of the Joint Industrial Council for the Tramways Industry, an agreement was arrived at on June 16th. This provides that wages shall remain at their present level until the commencement of the first full pay period in August, after which revisions will be made at three-month periods. Taking the present wages as representing an equitable rate while the Ministry of Labour cost-of-living index figures remain at 135 per cent. above the 1914 level, a variation of 1s. per week will be made for each complete rise or fall of five points. For employés under 18 years of age, the variation will be at the rate of 6d. instead of 1s. This arrangement is to stand until December 31st, 1921, and three months' notice to terminate the agreement may be given by either party after this date.

Organised Propaganda.—We are informed that a new organisation, under the title of the Federation of British Propaganda Societies, has been formed, the object of which is to co-ordinate the work of propaganda societies and, as far as possible, prevent overlapping. Already about 15 propaganda societies have expressed their willingness to join. The Duke of Northumberland will act as President, and Sir Henry Birchenough, K.C.M.G., &c., is the treasurer. The general secretary is Mr. David Gilmour, O.B.E., Sicilian House, Southampton Row, London.

New French Companies.—There has been formed at Royan (Charente Inférieure) the Société Anonyme d'Energie Electrique (Force et Lumière) Secteurs de la Seudre, with a capital of 400,000 fr. in 100 fr. shares, 2,000 of which are apportioned to M. Henri Grenet, for his assets, namely, power stations at Royan and Mornac-sur-Seudre; buildings and lands at the latter place; material, tools, concessions, &c. In addition, he has been allotted 70,000 fr. in specie.

Trade with Siam.—The United States was the heaviest contributor of electrical goods and apparatus to Siam during the fiscal year 1919-1920, and it is believed that with greater enterprise Great Britain might easily improve her position. Owing to the fact that no electrical apparatus of any kind is manufactured in Siam, there is a demand for all classes of such goods, with the addition of specialities needed for a tropical country. The import duty on all electrical goods is 3 per cent. *ad valorem.* There are no other restrictions in this trade, and it is not required to have the country of origin stamped upon any articles sold in this kingdom. There has hitherto been no development of hydroelectric power in Siam, and in years with normal rice crops paddy husk is used for fuel, owing to its cheapness and the fact that the cost of oil, coal, and wood is comparatively high, as compared with neighbouring countries.—*Eastern Engineering.*

New Italian Companies.—There has been formed at Milan, with a capital of 1,000,000 lire, the Società "Osram," with the object of trade in and eventually manufacture of electrotechnical articles, and especially Osram, Wotan and A.E.G. glow lamps.

The Società Euganea di Elettricita has been formed in Venice with a capital of 10,000,000 lire. It is an offshoot of the Società Italiana Utilizzazione Forzeidrauliche del Veneto, the Credito Industriale di Venezia, and the Società Adriatica di Elettricita.

The Società Vercellese di Elettricità, with a capital of 6,000,000 lire, has been embodied at Vercelli for the purpose of the manufacture of electrical plant for agricultural uses.

Patents and Licences of Right.—Notice is given that the undermentioned patents were endorsed "Licences of Right" on the dates shown:—

June 9th, 1921.—No. 10898/14 (Van Der Hoorn, L. J.), "Improvements in or relating to electric sale apparatus."

June 10th, 1921.—No. 26187/10 (M. Breslauer), "Improvements in electric current generators." No. 28595/12 (R. Krause), "Improvements in appliances for producing electric oscillations." No. 13129/15 (W. Otto), "Arrangement for producing short unidirected high-tension electric current impulses." No. 11821 (12973/18) (E. Walter), "Improvements in braiding machines." No. 125369 (7217/19) (E. Walter), "Improvements in or relating to braiding machines."

Inquiry.—Makers of or agents for the "Ackermann-Johnson Anchors" for switchboards, are asked for.

Derby Agricultural Show.—At the above show, which is being held from June 28th to July 2nd, the advantages of electricity in farming will again be demonstrated. Messrs. Petters, Ltd., of Yeovil, intend to exhibit a number of examples of their engines and electric lighting and power sets. Among these will be a number of "Petter-Light" sets of various outputs with battery equipments, switchboards, &c.

E.D.A. Activities.—The British Electrical Development Association, Hampden House, 84, Kingsway, W.C. 2, is endeavouring to interest electrical contractors and suppliers of electricity in the use of local newspapers for the furtherance of the electricity campaign. To this end the Association has recently issued a book on the subject (E.D.A. No. 164), which suggests methods and matter to those concerned with local Press advertising. A number of suitable advertisements are reproduced in which are embodied the special points brought out in the text. These advertisements are all illustrated, as the best way of appealing to the public is to please the eye, and the Association is prepared to supply "electros" of these pictures at reasonable prices. Accompanying the book is a sheet of seven advertisements which can be sent to a local newspaper as "copy" for reproduction.

The Director of the Association desires to state that information and inquiries may, in future, be sent under the same cover as circulars. Engineers and managers and others are requested to open and *examine* carefully all sample parcels of publicity matter and other communications from E.D.A. as received.

The Lyons Fair.—The Department of Overseas Trade is informed that, in connection with the Autumn Lyons Fair, an international competition for inventions will be held from October 1st to 15th, in the Palais de la Foire. All apparatus, plans, designs, or models, relating to the following will be eligible for competition:—(*a*) Electric accumulators and electric apparatus; (*b*) textile machines and apparatus; (*c*) automobile and cycle improvements; (*d*) agricultural machines; (*e*) artificial limbs; (*f*) domestic heating; (*g*) apparatus for protection of workers. An entrance fee of 50 fr. will be charged for each invention entered. Applications should be sent in before September 15th to the Société des Inventeurs, 17, Place Bellecour, Lyons.—*Board of Trade Journal.*

Withdrawal from Whitley Council.—The St. Helens Electricity Committee's recommendation to the Town Council to withdraw from the District Council No. 3 (North-Western Area) for the Electricity Supply Industry, has been accepted. The ground upon which this decision was reached was that the Electricity Committee did not think that the Whitley Council was the best method of considering the wages to be paid to its men.

Book Notices.—Circular No. 100 of the U.S. Bureau of Standards, "Nickel" (106 pp.). Washington: Government Printing Office. Price 20 cents.—This is a very comprehensive treatise upon nickel and its alloys. Dealing first with sources and the metallurgy of the subject, it passes to the chemical and physical properties of nickel, dealing exhaustively with its conductivity, magnetic properties, density and other characteristics. The technologic section includes such processes as casting, rolling, forging, welding and electro-deposition. Among the alloys of nickel treated upon in this circular are monel metal, copper-nickel, ferro-nickel (nickel steels), and special acid resisting and electrical alloys. The appendices give definitions of physical terms, U.S. patents on nickel alloys (1900-1920), typical specifications and a bibliography.

"Modern Central Stations." By C. W. Marshall. Pp. x + 112, 25 figs. London: Sir I. Pitman & Sons, Ltd. Price 2s. 6d. net.

"*Journal* of the American Institute of Electrical Engineers." Vol. XL, No. 6, June, 1921. New York: The Institute. $1.

Technologic Paper, No. 188, of the U.S. Bureau of Standards. "Some Properties of White Metal Bearing Alloys at Elevated Temperatures." (16 pp.) Washington: Government Printing Office. Price 5 cents.—This paper describes an apparatus for determining the yield-point and ultimate strength of white metal bearing alloys at temperatures up to 100° C. An apparatus for ascertaining the Brinell hardness of these alloys is also dealt with.

"Pitman's Technical Bookshelf." No. 4, June, 1921. (20 pp.) London: Sir Isaac Pitman & Sons, Ltd.—Many interesting notes and short reviews of books dealing with all branches of technical work are included in this issue, and electrical engineering and its auxiliary subjects receive a great deal of attention.

"The Cost Accountant." Vol. I, No. 1, June, 1921. London: The Institute of Cost and Works Accountants.—This is the first appearance of the recently-formed Institute's official journal which is to be published monthly. Many useful notes appear, as well as articles on accountancy, progress work, and costing.

"Electric Motor Installations: Their Upkeep and Lay-out." (The Vulcan Engineering Manuals.) (112 pp.). Manchester: Vulcan Boiler and General Insurance Co., Ltd. Price 2s. 6d. net.

"The Metropolitan-Vickers Gazette." Vol. VI, No. 98. May, 1921. Articles included in this number of the "Gazette" are "Installation and Operation of M-V Power Transformers," by A. J. Bridge; "Heating and Cooling Curves and their Application to Oil Circuit Breakers," by G. E. Gittens, B.Sc.(Lond.); "Electrical Equipment for Arc Welding"; and two reprinted papers on "The New Management" and "Radiology Applied to the Testing of Materials."

"The Mining Electrical Engineer." Vol. I, No. 9. June, 1921. Manchester: The Association of Mining Electrical Engineers. Price 1s. net. The final number of the first volume contains papers on "Electric Winding," by A. B. Maclean, M.A., B.Sc.; "The Power Requirements of Collieries," by J. M. Heslop; "Oil Fuel for Steam Raising," by H. T. Watson; and an illustrated description of a large underground plant.

Science Abstracts. Sections A and B. Vol. XXIV, Part 5. London: E. and F. N. Spon, Ltd. Price 2s. 6d. net per part.

"*Engineering* Directory." No. 68. May, 1921. (120 pp.) London: *Engineering*, Ltd.—This is the latest edition of the alphabetical and classified list of advertisers in our contemporary, and it possesses the usual features of utility, including glossaries for the use of foreign buyers.

"The *Journal* of the Röntgen Society." Vol. XVII, No. 67. April, 1921. (48 pp.) London: Percy Lund, Humphries & Co., Ltd. Price 5s. net (quarterly).—In this issue is described a new type of X-ray photographic plate, which reduces the time of exposure necessary to one twenty-fifth of the normal. Mr. N. A. Codd's paper on "Increasing the Efficiency of X-ray Tubes by an Improved Design of Coil and Interrupter" is reprinted as is also a lecture by Mr. N. E. Luboshez on "Scattered Radiation and the Use of Intensifying Screens."

"Rate Research." Vol. XIX, No. 9. (14 pp.) New York: National Electric Light Association (Rate Research Department). This issue deals with the papers recently read before the Institution of Electrical Engineers by Messrs. Beauchamp and Blaikie, as well as a number of decisions regarding tariffs in the United States.

"Coal Mines Act: Statutory Rules and Orders, 1921." No. 672. (10 pp. and 5 plates.). London: H.M. Stationery Office. Price 6d. net.—This publication describes and illustrates a number of miners' safety lamps which conform to the "Safety Lamps Order" of April 20th, 1921.

"Useful Tables and Data for the Assistance of Consumers of Wire." Third Edition. London: W. F. Dennis & Co., 70, Queen Victoria Street. Price 2s. 6d. (leather, 3s. 6d.).—This is a handy vest-pocket booklet containing a great amount of information regarding aluminium, steel, iron, copper, bronze, and other wire. Physical and electrical characteristics are fully dealt with, such details as breaking-strain for various sizes, conductivity, weights, &c., being given in table form.

Strike at Birkenhead.—A correspondent states that the electricians at Messrs. Cammell, Laird & Co.'s shipbuilding works, Birkenhead, are on strike owing to the non-reinstatement of the apprentices who participated in the recent electrical trades dispute. The firm contends that the apprentices broke their indentures, and they are not obliged, therefore, to re-employ them. The journeymen members of the Electrical Trades Union have now been on strike nearly five weeks, but there is stated to be a prospect of an early settlement.

Copper and Lead Prices.—Messrs. F. Smith & Co. report June 21st. Copper (electrolytic) bars, sheets, wire rods, and h.c. wire. No change.

Messrs. James & Shakespeare report June 22nd. Copper bars (best selected), sheet and rod, £114, £2 decrease; English pig-lead, £23, 5s. reduction on last week's quotation.

Annual Outing.—The annual outing of the staff and employés of Messrs. Semco, Ltd., took place on Saturday, June 11th. The party went by char-à-bancs from the company's head offices in High Street, Shoreditch, to Egham-on-Thames, the route chosen being *via* Kingston and Hampton Court. Luncheon was served at the Coach and Horses at Egham, and sports followed. There was a cricket match between the Inside and Outside staffs, in which the latter won. Time was then pleasurably occupied on or beside the river. Tea was served later, and during the sitting thanks were accorded to Mr. J. H. Smith, the secretary of the company, who had carried through the day's arrangements. The party returned to town *via* an extended route through Virginia Water and Windsor.

The Bristol, Cardiff, and Swansea staff of the Edison Swan Electric Co., Ltd., held their annual outing on 8th inst., when the Wye Valley was visited by motor-coach. The company numbered about 70. After various sports had been indulged in, tea was served at the Royal George Hotel, an impromptu concert following.

The Engineering Wages Dispute.—The revised terms submitted by the Engineering and the National Employers' Federations to the Trade Unions concerned, for a decision by ballot, are as follows:—With respect to the bonuses of 7½ and 12½ per cent., one-third of these will be withdrawn at the commencement of the first full-pay period in July, one-third in August, and the remainder in September. At the commencement of the first full-pay period in October next, 3s. per week will be deducted from time rates and 7½ per cent. from piecework rates. A further 3s. per week will be deducted from the war bonus of 26s. 6d. when the Ministry of Labour index number arrives at 115 per cent. over the pre-war level; this last reduction is not to be made earlier than the beginning of the first full-pay period in November.

Fusion of Interests in Germany.—The *Kolnische Zeitung* reports a fusion of interests of six railway, tramway, and other carriage-manufacturing companies. The new company is registered in Dusseldorf, and comprises Dessauer Wagonfabrik A.G., Dessau; Dusseldorfer Eisenbahnbedarf vorm. Karl Weyer & Co., Dusseldorf; H. Fuchs, Wagonfabrik A.G., Heidelberg; Siegener Eisenbahnbedarf A.G. Siegen; Wagonfabrik A.G., Uerdingen a/Rh; Wegmann & Co., Cassel.

Works Boys' Club.—Recent extension of welfare work at the Phœnix Dynamo Manufacturing Co., Ltd. (branch of the English Electric Co., Ltd.), Thornbury, Bradford, includes a commodious club for the boy employés, comprising a full-sized Army hut, adjoining the works tennis courts. The opening ceremony was performed last week by Captain Crawshaw, works manager. The club includes a canteen, billiard room, and cold douche. Provision is made for many other games, and the club is fully lighted by electricity. The main hall has a platform with scenic background. At the opening there was a concert by the works orchestra and artistes specially engaged, followed by dancing. A girls' club will shortly follow.

For Sale.—Assets Auctions Co., Ltd., will sell by auction, on June 29th, at 119-121, Newington Causeway, Government surplus telephone and electrical stores. Ormskirk Board of Guardians has for disposal one 50-b.h.p. "National" gas engine, coupled to a "Witton" multipolar 220-v. d.c. dynamo. For particulars see our advertisement pages to-day.

Should Corporation Electrical Engineers Accept Contracts?—This question was raised at the last meeting of Kilmarnock Town Council. The electrical engineer reported that "he had placed the steel work on order, which included columns, roofing, roof trusses, and corrugated iron required for the extension of the car-shed; that Redpath, Brown & Co. quoted £549 for this work, and that being the lowest offer, he had placed the order with them." A member asked whether the Electricity Committee had given the manager power to accept contracts, and objected to any official being allowed to do so. The Provost pointed out that the Committee approved of the engineer's action, but it was agreed that the Electricity Committee alone be given power to settle contracts.

Swedish Telephone Companies.—The plan to fuse the H. T. Cedergren and L. M. Ericsson telephone concerns, proposed by the boards of the companies concerned, was defeated at a general meeting of the Cedergren Co. by a large majority.—*Reuter's Trade Service* (Stockholm).

Germany and the Metal Trade.—It is reported from New York that active steps are being taken by Germany to regain her pre-war ascendancy in the non-ferrous metal markets of the world. S. S. Tuthill, Secretary of the American Zinc Institute, says that the American trade is threatened, and that at present Germany and Belgium are negotiating for a re-establishment of their former trade relations with the metal markets.

LIGHTING AND POWER NOTES.

Accrington.—Proposed Price Increase.—The Town Council, as the outcome of the loss of £13,000 on the electricity undertaking last year, is proposing to increase charges for lighting from 7d., plus 10 per cent. per unit, to 8d. per unit, and to increase the charges for power on a sliding scale. Power users who have paid 1¼d. per unit will have to pay, roughly, 1¾d. The new charges are expected to bring in an extra revenue of £15,000 a year, and they will come into operation next month.

Australia.—Subiaco (W.A.).—The Municipal Council has been unable to meet the demand for electricity, owing to the limited capacity of its plant. At the last meeting of the Council it was decided to raise a loan of £25,000 in order to arrange for a complete change over. The existing plant is totally inadequate, and negotiations have been opened up with the Perth City Council to supply electricity in bulk at low pressure. This will necessitate an alteration of existing arrangements.—*Tenders.*

Sydney (N.S.W.).—The North Sydney Council has asked the Sydney City Council to consider the question of a bulk supply in place of supplies to individuals in the North Sydney district. Reporting upon the matter, Mr. Forbes Mackay, the electrical engineer, thinks that a bulk supply would probably be more remunerative to the City Council than the existing arrangement.

The Morwell Scheme.—A large body of opinion in the country districts of Victoria holds that the Government did not properly investigate the possibilities of generating electrical energy by water power before embarking upon the scheme for generating energy from brown coal at Morwell. Having committed itself to the Morwell scheme, the Government, it is alleged, is placing needless and fatal restrictions upon private enterprise in the development of hydro-electric schemes. The principal desire at the moment is that these restrictions should be removed, so that all schemes that are capable of commercial success may have an equal opportunity of development.

At the instance of the Victorian Farmers' Union, a conference on the subject was held at the rooms of the Employers' Federation in April. The delegates represented a great variety of country interests, including branches of the V.F.U., municipalities, butter factories, irrigation settlements, and country industries generally. Some of the metropolitan municipalities were also represented. The following motion was carried unanimously:—

"That the Government be requested to proceed with the Morwell and Kiewa electrical schemes concurrently, or to withdraw opposition to the Kiewa scheme by private enterprise, and to withdraw all restrictions to the Kiewa company entering into competition with the State enterprise."

In a reply to these criticisms, Sir John Monash said the Morwell scheme had been undertaken under the best possible advice. The commission's engineering staff had a very high standing, and Mr. Merz of Merz & M'Lellan, had investigated all the proposals for the generation of power, and had recommended the Morwell scheme. Mr. Merz having endorsed this view, the Government submitted the scheme to Parliament. Hydro-electric possibilities had been investigated by Mr. A. G. M. Mitchell, the most prominent hydraulic engineer in Australia. His report on the Kiewa scheme showed without doubt that any development in this direction would be premature, and was not to be preferred to the Morwell scheme.—*The Age* (Melbourne).

The Metropolitan-Vickers Contract.—In view of the importance and magnitude of the Morwell scheme, it may be of interest to note a few details relating to the power-station generating plant, the contract for which has been secured by the Metropolitan-Vickers Electrical Co., Ltd.

Five main generating units and one auxiliary unit have been ordered, the aggregate capacity of the plant being 63,100 kW. Each of the main units will have a maximum continuous rating of 12,500 kW, and will run at a speed of 3,000 r.p.m. The auxiliary emergency set will have a maximum continuous rating of 600 kW at 3,000 r.p.m. Steam will be raised in boilers fired with brown coal, having a calorific value of about 6,000 B.th.u. per lb., and will be supplied to the turbines at a normal pressure of 250 lb. per sq. in. gauge and a normal temperature of 630° F. The main turbines will be of the multiple-exhaust type, and will be equipped with self-contained feed-heating systems, the heaters being arranged within the turbine casings, in accordance with the Metropolitan-Vickers standard arrangement, in which the steam used for heating is diverted from the turbine at a pressure of about 5 lb. per sq. in. absolute. The turbines will exhaust into surface condensers, to be made in Australia. Each condenser will have a cooling surface of 17,000 sq. ft., and will be designed to maintain a vacuum of 28 in. at full load when supplied with cooling water at a temperature of 70° F. The condenser auxiliaries will consist of motor-driven vertical centrifugal circulating-water pumps, motor-driven condensate extraction and lift pumps, and steam-operated air ejectors.

Each of the main alternators will be wound for three-phase, 50 periods, 11,000 volts, the specified capacity being obtained at ·9 power factor. The alternators will be ventilated on the closed air-circuit system.

The 600-kW auxiliary turbo-alternator set will be required for starting up the station auxiliaries and for emergency purposes only. The turbine of this unit will be of the back-pressure type, designed to exhaust against a normal pressure of about 1 lb. per sq.-in. gauge. The alternator of the auxiliary set will be wound for three-phase, 50 periods, 400 volts, ·8 power factor.

Aylesbury.—Loan.—The Town Council has applied for a loan of £4,500 for services.

Bedwas.—Bulk Supply.—At a meeting of the District Council a report was submitted by the Lighting Committee recommending the Council to exercise the powers to be conferred by the Electricity Commissioners, and that negotiations be opened up with the South Wales Power Co. and the Bedwas Navigation Colliery Co. for a supply of electricity in bulk and specifications prepared for tenders for the installation of electric lighting in the Bedwas and Machen wards. The clerk said it was proposed only to apply the order to Bedwas and Machen at present, but it would be extended to Trethomas and Maesycwmmer later. It was also intended to install electric lighting in the Council's new houses on the Glebe site, Bedwas.

Belfast.—Loan.—Mr. A. D. Price, Engineering Inspector of the Local Government Board for Ireland, held an inquiry, on June 15th, into the application made by the Corporation for sanction to a loan of £120,000 for the electricity undertaking. The Town Solicitor gave evidence as to the finances of the city, and the need for the loan to meet business requirements, &c. More than the £120,000 required was owed the Corporation, but it took a long time to get it in, and although the Corporation sought an overdraft, it did not follow that interest would have to be paid on that sum. The interest would rise and fall with the income derived from the electrical undertaking. Coal was badly needed, and large stocks absolutely essential. But for the foresight of those responsible for the stock of coal, it was quite possible that the electrical and gas undertakings would have been closed down long ago. Mr. R. G. Geale, city accountant, gave evidence, as did also Mr. T. W. Bloxam, the electrical engineer, and the inquiry closed.

Bexhill.—Year's Working.—The accounts of the Corporation electricity undertaking for the year ended March 31st, 1921, show gross profits of £7,460, an increase of £1,060 on the previous 12 months. After making provision for repayment of loans and income-tax, there is a net profit on the year's working of £639. After writing off a debit balance of £122 on the previous year, a credit of £517 is carried forward.

In view of the appeals for economy in use of electrical energy owing to the coal situation, the Council has decided to abandon the minimum charge for the current half-year.

Berkhamsted.—Overhead Lines.—The Urban District Council has objected to the erection of overhead lines by the Chesham Electric Light and Power Co., Ltd., for the supply of electricity in the parish of Northchurch, on the ground that the poles would be an obstruction and dangerous to the public.

Blackburn.—New Sub-station.—The chairman and vice-chairman of the Electricity Committee have been empowered to acquire a plot of land at Lower Darwen for the erection of an electricity sub station.

Bolton.—Year's Working.—The accounts of the Corporation electricity department for the year ended March 31st last, record a total income from all sources of £273,531, as compared with £200,569 in the previous year. Working expenses totalled £186,350, as against £140,248, leaving a gross profit of £87,181 (£60,321). After payment of capital charges, &c., the result was a net profit of £27,779, comparing favourably with a balance of £19,965 for 1919-20. Of this profit, £24,130 was allotted to expenditure out of revenue, and the balance carried forward. The borough electrical engineer (Mr. W. J. H. Wood) points out that although, on account of increased fuel costs, the cost of generation has increased considerably, this cost is still below 1d. per unit, and at present-day prices the average selling price of 1·55d. per unit is not unreasonable. The number of units sold rose from 24,944,906 to 30,298,980.

Bootle.—Extension of Supply.—The Electric Power and Lighting Committee has resolved to take the necessary steps to obtain the consent of the Electricity Commissioners to the extension of a supply of electricity to the Litherland area, and that the Litherland Council be informed that the Committee suggests that the Council should furnish a guarantee of consumption at a certain figure. The Bootle Council entered into an agreement with the Litherland Council in 1914 to take over the Lighting Order which was to operate until six months after the official termination of the war. The Electric Power and Lighting Committee had a number of demands from Litherland, but in each case it had to get a further order from the Electricity Commissioners. When it was moved in the Bootle Council Chamber that application for a special order be made to the Electricity Commissioners, it was pointed out that one of the firms concerned was so anxious to get a supply that it was willing to lend the Council £3,000.

Bradford.—Lighting Economy.—The Corporation has set up a Special Joint Sub-Committee to inquire into, and report to the Corporation upon, the practicability of suspending street lighting for the three summer months of June, July, and August every year, as a measure of public economy, quite apart from the present question of coal shortage.

Canada.—New Ontario Loan.—A loan of about $22,000,000 (nominally £4,400,000) is expected to be floated for the Province of Ontario in about two or three weeks, according to an announcement made by Mr. Peter Smith, Provincial Treasurer. Mr. Smith indicated that it might be necessary to go to New York to secure at least a part of the loan. The bulk of the funds to be secured will be used for the Hydro-electric Power Commission's purposes.—*Reuter.*

Queenston-Chippawa Canal.—About 7,000 men are at work on the Queenston-Chippawa Canal development for the Ontario Hydro-Electric Power Commission. It is expected that by the beginning of September two 55,000-h.p. generators will be ready for operation. The Commission's plans call for another 55,000 h.p. a few months later, and the ultimate production calculated upon is over half a million h.p. selling at a probable price of $10 per h.p. —*Reuter's Trade Service* (Ottawa).

Development of the St. Lawrence River.—In an elaborate report, made to the International Joint Commission (Canada and the United States) on the deepening of the St. Lawrence for ocean-going vessels, and the development of the power possibilities, the engineering firm of Messrs. Hugh Cooper and Co., of New York, proposes to finance, on behalf of private capitalists, 1,000,000 h.p., and to construct a 30-ft. navigation channel, says the *Montreal Gazette*. The cost of the canalisation would not be more than $30,000,000 each to the Governments of Canada and the United States. The power will cost consumers, exclusive of State and Federal taxes, about $17 per h.p. The first installation, it is proposed, will be on the American side, and will supply 400,000 h.p., 50,000 of which will be available for distribution in Canada, and when the demand exceeds this quantity construction on a Canadian site will commence. The ultimate electrical power that can be produced is stated to be 6,625,000 h.p. This would replace 66,250,000 tons of coal annually, and, by the improvement of the canal system, the present 46 miles of canal and 21 locks can be replaced by 3½ miles of canal and six locks. The cost of this improvement in navigation, and the power development, is estimated at $1,500,000,000.—*Reuter's Trade Service* (Ottawa).

Electrical Smelting in Vancouver.—The managing director of the Canadian Iron and Steel Smelters, Ltd., has announced that British capital has been secured to build and operate a large electric smelter in Vancouver. An initial 50-ton plant will be operating by August. The company has been given 5,000 tons of iron ore by the Provincial Government as an inducement to commence operations.—*Reuter's Trade Service* (Vancouver).

Carlisle.—Report on Undertaking.—The town clerk has been requested to ascertain the terms upon which Mr. Arthur Ellis, of Cardiff, the consulting engineer nominated by the President of the Institution of Electrical Engineers, will undertake to report upon the present position of the electricity undertaking, with his recommendations for meeting the future demands upon the undertaking.—*Carlisle Journal.*

Chesham.—Cheap Lighting.—The Electric Light Co. has offered to supply electric light to the new Council houses at 1s. per week during winter months, and 6d. per week during summer months. Householders are not to be limited to a particular amount.

Continental.—Sweden.—The increased use of electricity in Sweden is shown by the following official figures relating to the years 1917—1919 :—Number of electricity works in 1917, 1,760; in 1918, 1,887; in 1919, 2,057. The total power of the generating plant in the three periods was, respectively, 1,028,758 kW, 1,270,227 kW, and 1,238,215 kW. The power furnished to motors in the three years was 343,273 kW, 362,258 kW, and 410,767 kW. The power supplied to electro-chemical factories was 478,763 kW, 568,386 kW, and 502,833 kW. The number of glow and arc lamps installed was of the former :—3,704,374 in 1917, 3,027,518 in 1918, and 3 610,102 in 1919; of the latter in the same periods : 2,815, 2,152 and 610, showing a steady fall off in their use. The number of motors installed in the three periods was 34,963 in 1917, 29,838 in 1918, and 34,749 in 1919.—*L'Industrie Electrique.*

Russia.—During the year 1920, says a Russian journal, electricity was furnished to Moscow from several stations; namely, the Moscow Government electrical station, the Moscow tramway system station, the Elektroperedatchas, the Glnchovskaya Stantzia, and the Orechov-Zubskaya group. The Moscow Government electrical station was itself of sufficient capacity to supply all the demands of the town, but owing to the scarcity of fuel, the work had to be done by less powerful stations with their available fuel. The estimated requirements of Moscow for 1920 amounted to 80,000,000 kWh. The quantity supplied was 72,000,000 kWh., *i.e.*, 90 per cent. The demand for electricity increased in the later months of 1920. Of the total quantity delivered in Moscow, 44 per cent. was for power purposes, and 56 per cent. for lighting. There was an increase under both heads over 1919.

The *Nory Put*, referring to the Russian electrical services, says that the leading combination, called the "Elektrosila" (electric power) section, includes 10 factories, of which the most successful are the Siemens-Schuckert, the Dynamo, and V.E.K. The reports on the others are not particularly satisfactory.

The same journal refers to a direct electric train service on the "Machovin" system, to be started soon between Petrograd and Moscow.

Germany.—An amalgamation of the electricity supply works owned by the State, and carried on under joint stock auspices, either in continuation of former company proprietorship, or as special companies created by the Government, has now been decided upon, the absorbing concern being the Electro-Works Co., of Berlin, which was formerly the Golpa-Jessnitz Lignite Co., of Bitterfeld, and which supplies power to, among others, local ammonia nitrate works, based upon the fixation of atmospheric nitrogen. The Electro-Works Co., for instance, is taking over the assets of the central German concerns known as the Power Transmission Co., the Central German Power Works Co., the Micderlausitz Power Works Co., the Brigitta-Sachsenburg Corporation, and the Lignite Co., and thus secures possession of the power works at Zsehornewitz, Trattendorf, near Sprenburg, and Lauta, the lignite mines of Golpa and Brigitta, and the high-pressure transmission lines from the power stations situated in the lignite districts of Bitterfeld and Lausitz to Berlin and to Saxony. These cases, however, are not the only instances of companies whose shares are entirely held by the State, as most of the former State armament works are now vested in a Government company, under the title of the German Works Co., and are apparently engaged on peace-time manufacturing work.

Finland.—The Finnish Government has just asked the Chamber of Representatives for a loan of 22,500,000 fr. for the first portion of the work of developing the State waterfalls. Finland possesses very considerable water-power resources, only a small fraction of which is at present utilised. It is reckoned that the falls on the river Ulea, and on the watercourses more towards the south, are equal to 1,600,000 h.p. at the turbines. A large part of these belong to the State, which owns the most important, or, at least, is interested in their utilisation. On the upper Vuoksen it has the disposition of 380,000 h.p. as possessor of the Imatra Falls, and is the principal shareholder in the undertaking concerned with the development of the Tornator Falls (211,000 h.p.), the Kymmenae River (18,500 h.p.), the river Ulea (542,000 h.p.), and the Pyakos Falls (99,800 h.p.). Although the outlay on the utilisation of these several falls will amount to many hundred millions (it is reckoned that the falls of Imatra alone will call for 320,000,000 fr.), it is, nevertheless, held that the Government should not hold its hand, for the high price of both coal and wood has forced a large number of industrial undertakings to utilise the falls belonging to them, which are, however, not being worked under the most favourable conditions.—*L'Industrie Electrique.*

Derby.—Fire at Power Station.—An outbreak of fire occurred at the Derby electricity works on June 11th, causing a dislocation of the tramway services. As the fire happened somewhere about the factories' closing time, they were not affected to a great extent. This is the second recent fire; the first occurred on May 13th.

Douglas (I. of M.).—Electricity Committee.—At the June meeting of the Town Council a resolution was moved : "That as the purposes for which the Electric Lighting Committee was established have now been accomplished, it is necessary that a standing Electric Lighting and Power Committee be appointed from the Council to deal with the electrical undertaking, and to carry out the terms and conditions of the Bill which has now passed both branches of the Legislature, and under which certain work must be commenced within six months of the date of its promulgation." After a lengthy discussion the motion was defeated, the town clerk explaining that it was for the Council to give the existing Committee a fresh appointment, or else appoint a Standing Committee.

Hamilton.—Proposed Water-Power Scheme.—It was reported to the Town Council that a company is considering utilising certain water power in Lanarkshire for the generating of electricity. The matter has been remitted to Messrs. Edmundsons for their consideration. The Council is applying for power to borrow £12,000 for extensions.

Inverness.—Proposed Water-power Scheme.—At a meeting of the Town Council on June 13th, the Council's consulting engineers presented a report on a scheme for providing electricity to the town by means of water power. It is proposed to utilise Loch Luichart for this purpose, and the districts included in the scheme are Strathpeffer, Dingwall and Inverness. The estimated capital expenditure will be £230,000, and an output of 8,800,000 kWh is expected to be obtained. Later the supply may be extended to Invergordon, Tain, Elgin and Lossiemouth. It was stated that the price per kWh could be fixed at 3d. for Inverness and 1d. for Strathpeffer and Dingwall.

Leeds.—Year's Working.—The report upon the electricity works for the year ended March 31st, 1921, records a total income from all sources of £519,021, as compared with £468,718 during 1919-20. Working expenses amounted to £313,055, as against £237,823, leaving a gross surplus of £205,966 (£230,895). Income-tax and loan charges absorbed £152,105, leaving a net profit of £53,861, little more than half that of the previous year (£100,418). Of this profit, £23,592 was contributed to capital expenditure, leaving an actual surplus of £30,269. The total number of units sold rose from 63,023,502 to 63,921,813, and the generating costs per unit sold from 1·41d. to 1·71d. The average price obtained per unit increased to 1·95d. from 1·79d. The electrical engineer reports a relatively large increase in the amount of energy used for heating purposes, but the demand for power for traction purposes fell off. The generating capacity remains at 51,000 kW.

London.—Woolwich.—The Borough Council has decided to apply for permission to raise its statutory maximum charge for electricity for lighting from 6d. to 10d. per unit.

St. Pancras.—The Council has received the permission of the Electricity Commissioners to borrow £26,450 for the provision of generating plant, and £12,700 for the purchase of converting plant.

Long Eaton.—Year's Working.—It is reported that the working of the Council's electricity supply undertaking, for the year ended March 31st last, resulted in a deficit of £3,200.

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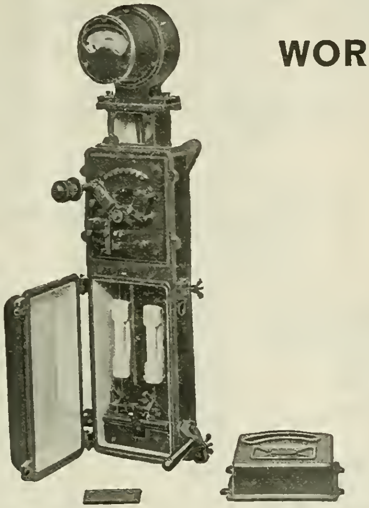

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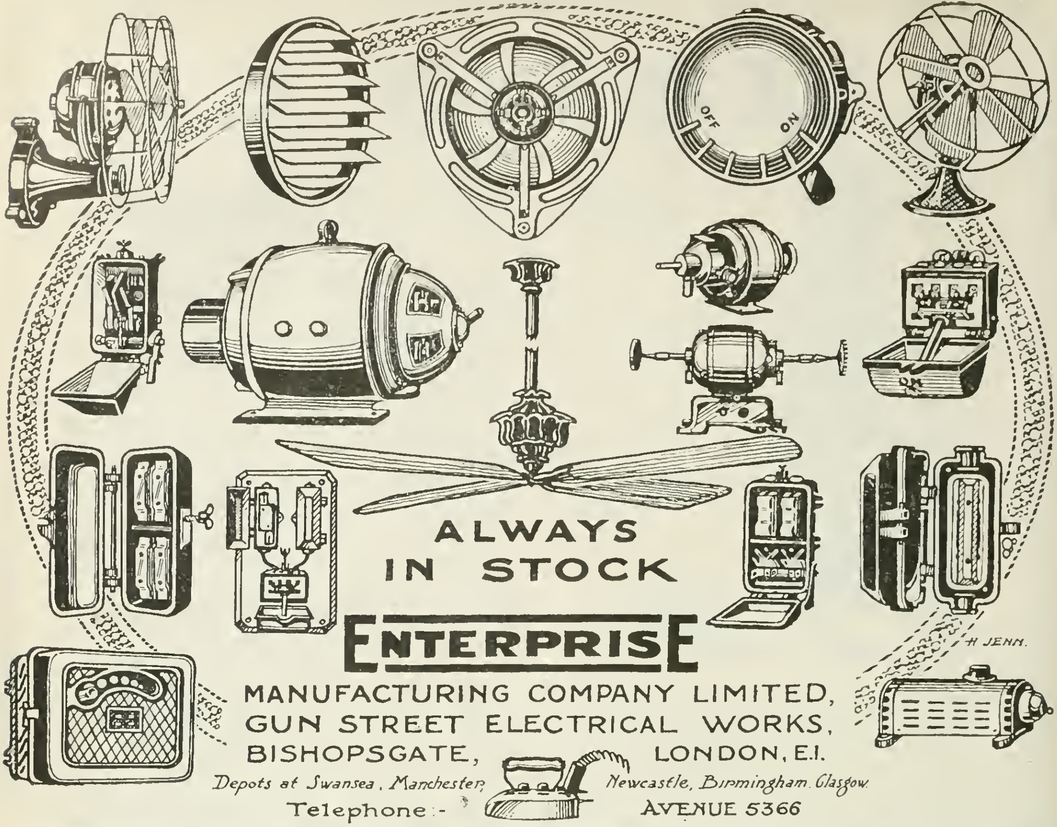

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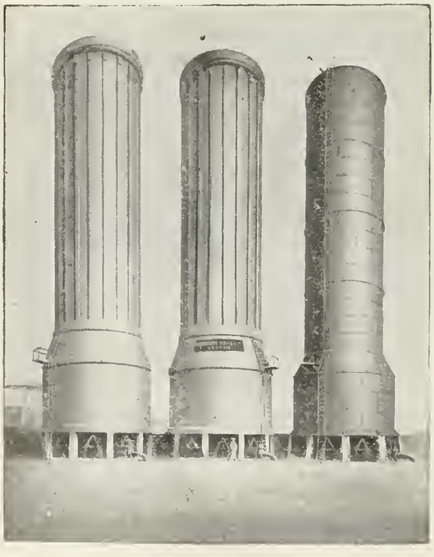

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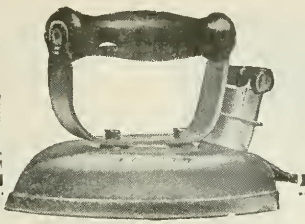

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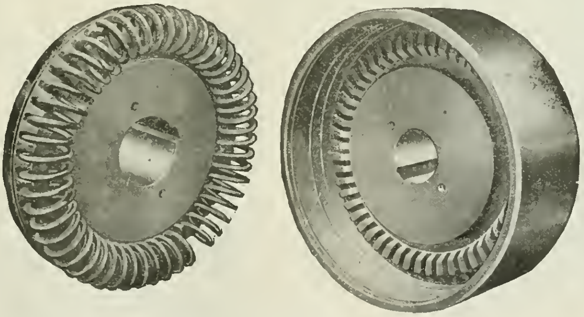

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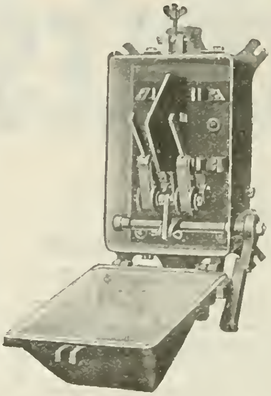

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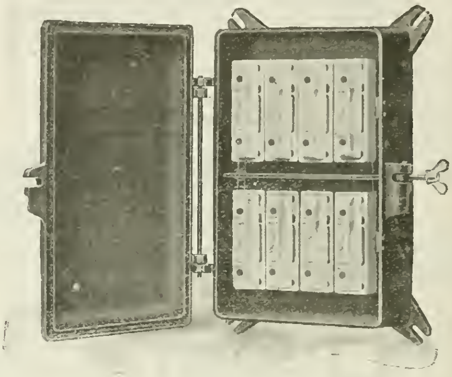

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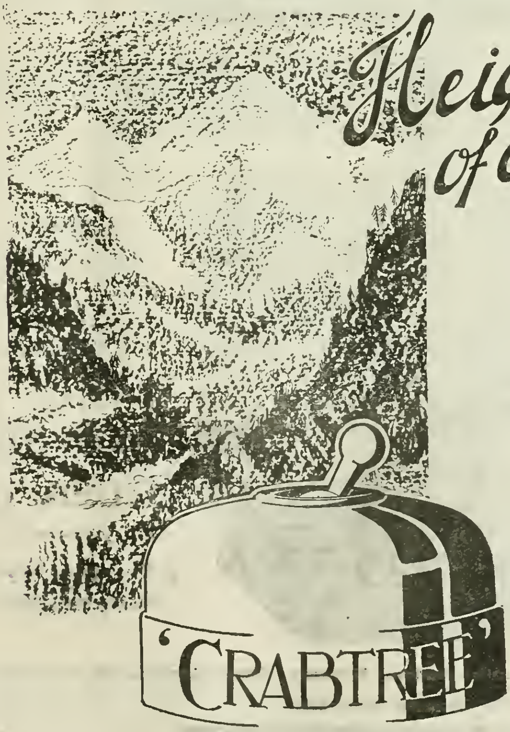

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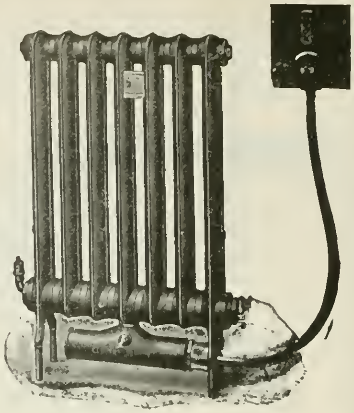

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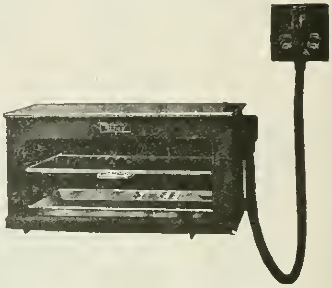
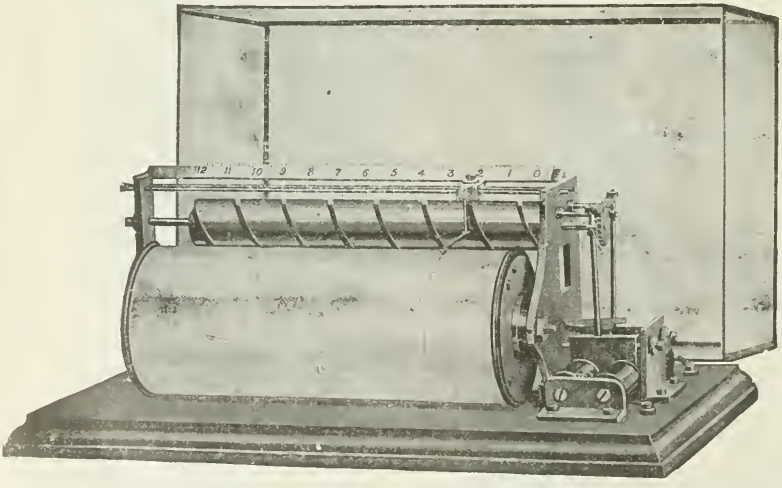


Also

All Descriptions of
ELECTRIC COOKING APPARATUS.

COX-WALKERS, LTD.,

USE A **"GRAYCLIFFE" RECORDER** and keep a check on :—



OUTPUT
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TOLLS,
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TIDES, &c.

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A Recorder is your best employee.

Agents in: Scotland, India, Australia, South Africa, Norway, New Zealand & elsewhere.

Write for E.R. Recorder Pamphlet.

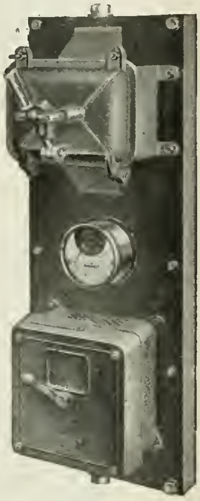
DARLINGTON, ENG.

Compact Control Units A.C & D.C

For Slip Ring Motors.

The A.C. Lever Switch Type Motor Control Panel is a very neat and compact self-contained unit. It consists of a sheet steel base arranged suitable for wall fixing, on which is mounted a Triple Pole Ironclad Combined Type Lever Switch and Cartridge Fuses and a type "V" Enclosed Ventilated Three-phase Rotor Starter with or without no-voltage release as desired. A Moving Iron (E.G.S. Grade 1) Ammeter of suitable capacity can be fixed to the panel if required.

The illustration shown here depicts a panel so equipped. Each unit is complete with all necessary interconnections at back of panel so that in fixing up the minimum of work is involved.



Typical A.C. Panel.

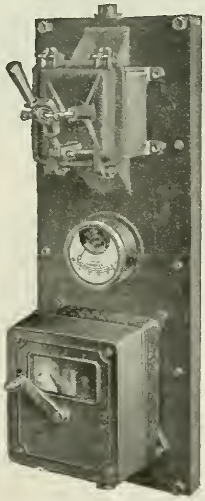
CONFORMS TO HOME OFFICE REQUIREMENTS.

For Direct Current Motors.

The D.C. Lever Switch Type Motor Control Panel is similar in general appearance to the A.C. Panel. The sheet steel base, however, is mounted with a Double Pole Ironclad Combined Type Lever Switch and Cartridge Fuses and a Type "S D" Enclosed Ventilated Motor Starter with no volt and overload releases.

The illustration shown, depicts a D C. Panel equipped with a Moving Iron Ammeter of suitable range.

Each unit is complete with all necessary interconnections at back of panel. When fitting up, the only connections to be made are the mains and the motor leads.



Typical D.C. Panel.

CONFORMS TO HOME OFFICE REQUIREMENTS.

Write for Leaflets :—
A.C.—V82b/2-3.
D.C.—V82a/2-3.
Or let us Quote to your Requirements.

THE Mark of Efficiency.

METROPOLITAN-VICKERS

ELECTRICAL COMPANY LIMITED. TRAFFORD PARK MANCHESTER.

HITHERTO the buildings we have illustrated as wired on the J. & P. System have possessed some distinctive feature, even if only that of newness. The one we show above, however, is deliberately selected as being neither new nor uncommon.

It is a house of a type which our English towns contain in scores of thousands. We reproduce the view to remind you that the J. & P. Wiring System is the best and cheapest for the every-day job as well as the special one—the system which can be installed in houses already built, with the minimum of expense and disturbance to decorations.

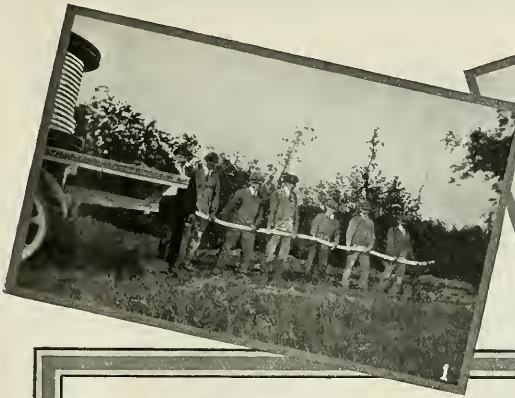
Mr. Harry Moss, A.M.I.E.E., 82, Leeds Road, BRADFORD, kindly supplied this photograph in response to our request for something "all in the day's work."

Johnson & Phillips, Ltd.,

Electrical Engineers and Cable Makers since '75,

Charlton, LONDON. S.E. 7.

City Office—12, Union Court, Old Broad Street, E.C. 2.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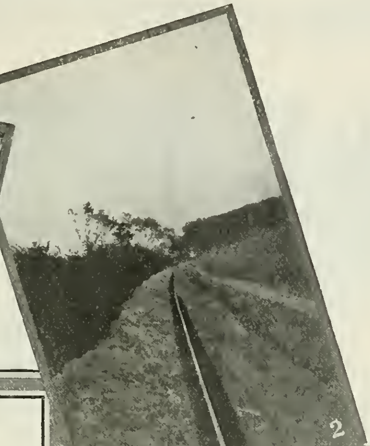

2

Power for a Lincolnshire Ironworks.

Here we illustrate a contract which we have recently completed, and by which power is supplied to a well-known Lincolnshire Ironworks by means of Electricity conveyed to a distributing centre by underground cable, and distributed from thence by overhead lines.

Our illustrations show:—

(1)—*Cable being unreeled from one of the many drums conveyed to the scene of action by Motor Lorry.*

(2)—*Stretch of trench with cable laid therein.*

(4)—*Three E.H.T. Cables, paper insulated and lead covered suspended from steel catenary wires, supported on, steel structures, leaving the Power House and crossing over the sidings and beds where pig-iron is run out from melting furnaces.*

(6)—*The Three cables divided by steel structure seen in the picture, two continuing to the terminal pole of the overhead lines and the other leading off to the Pump House—*

(5)—*The Single Cable dipping down to and entering the Pump House, which lifts water from the reservoir.*

(3)—*The 6,000 volt line (with Earth wire and telephone lines below) which supplies power to the Pump House, the latter being built over the bore holes.*

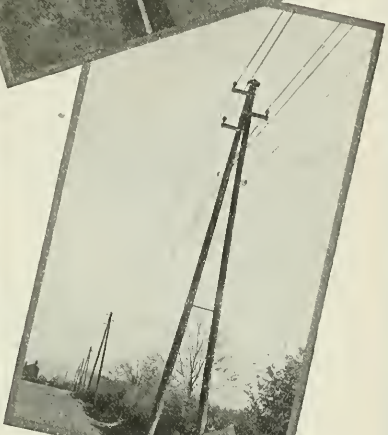
and the manufacture of the Cables, together with the laying and erection, were executed throughout by us.

For such work our organisation offers exceptional facilities, and possesses a vast experience, concerning which all interested in Electrical Installations should enquire.

We invite such enquiries :—

JOHNSON & PHILLIPS, LTD.,
CHARLTON, LONDON, S.E. 7.
City Office :—12, Union Court, Old Broad Street, E.C. 2.

Branches at—BIRMINGHAM, BRISTOL, CARDIFF, GLASGOW, MANCHESTER, NEWCASTLE-ON-TYNE, PORTSMOUTH, SYDNEY, N.S.W.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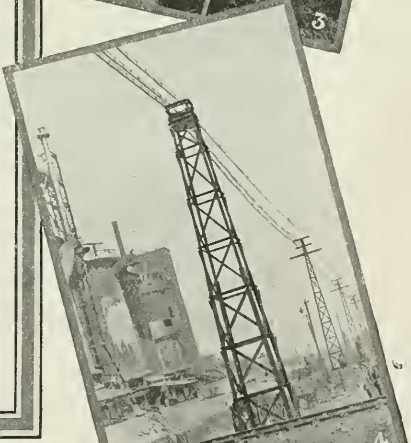
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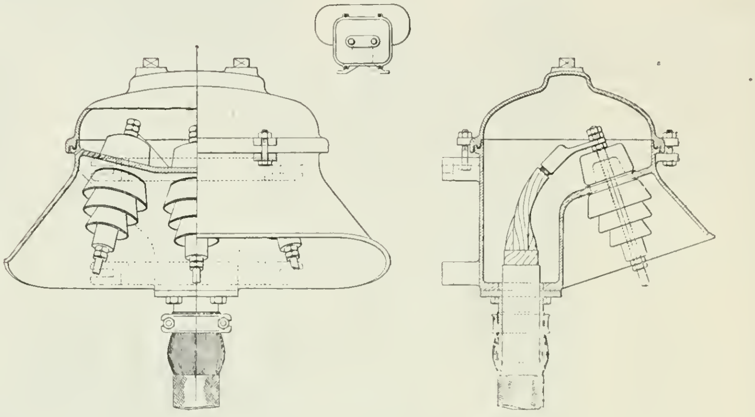
6

5

E.H.T. TRIFURCATING BOX

for

OUTSIDE USE.



THIS BOX HAS THE FOLLOWING FEATURES:—

Absolute watertightness.

Insulator in two pieces enables the outer portion to be renewed if broken without dismantling box.

Fixing lugs suitable for round poles or channel arms.

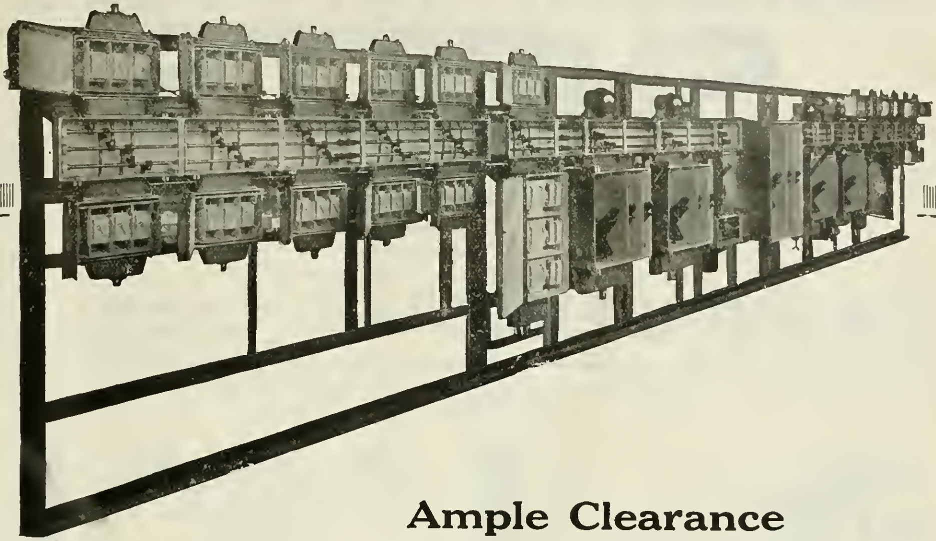
Armour clamp suitable for wire or tape armour.

Simplicity in erection.

The Macintosh Cable Co., LIMITED.

Electrical Engineers, Cable Makers and Contractors,

DERBY:	LONDON: CONTRACTING DEPARTMENT.	LIVERPOOL:
Ashbourne Road Mills,	22/3, Jewin Street.	Rice Lane, Walton.
Telegrams—"Macintosh, Derby." Telephones—1200 Derby.	"Lark Barb." 1603 City.	"Conductor Liverpool." 73 Walton.



Ample Clearance and Easy Accessibility.

The above illustration is a photographic reproduction of a

HOPE'S PATENT

Fluvent

(REGD. TRADE MARK)

Power Centre Distribution Board

recently made and erected by us. Note the ample clearance and easy accessibility to all parts throughout.

It should always be remembered that the "FLUVENT" Distribution Board is built upon the Unit Principle (British Patent) with the Standard "FLUVENT" Switch Fuse for outgoing circuits; the incoming circuits taken in either through links, a large "FLUVENT" Switch Fuse or Oil Switch as preferred.

All Joints between the Unit System bus-bar chambers and switches are WATERTIGHT, the connections passing through cast-iron joint pieces. EXTRA UNITS can easily be added from time to time merely by moving the end covers.

ALL "FLUVENT" Switches are mounted on mica-covered steel rods, have parallel break, are guaranteed to stand 3,000 volts to earth for five minutes, and give an insulation test of 50 megs. Strongly made of mica, steel and china only, with all moving parts fitted with lock-nuts and split pins.

Write NOW for detailed information of the "FLUVENT" system, we cordially invite application for same.

Early deliveries guaranteed for Urgent or Special Orders.

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FOR Generators, Motors & Transformers.

MINIMUM CORE LOSSES.

GRADES { MIDDLETOWN ELECTRIC | MIDDLETOWN TRANSFORMER | MIDDLETOWN TRANSFORMER (Special)

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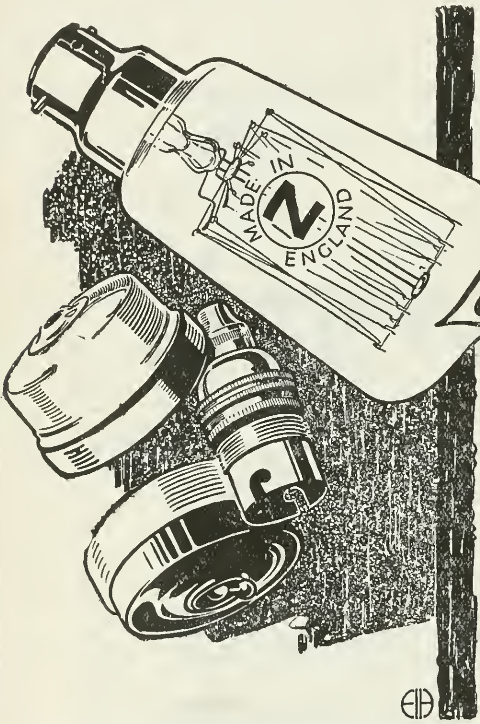

"Z"

Lamps & Accessories

We have comprehensive stocks of Lamps and Accessories, and can despatch immediately reasonable quantities of Vacuum and Gasfilled Lamps, together with standard lines of Wiring Accessories. It would pay you to get details of our Stocks and Prices. Also obtain particulars of our offer to send our "Electrolux" Portable Cleaning Apparatus on special terms. The "Electrolux" is more compact than other Cleaners. The dust bag is *inside* the body and there are no revolving brushes.

M2

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Telephone: Museum 4650 (4 lines).
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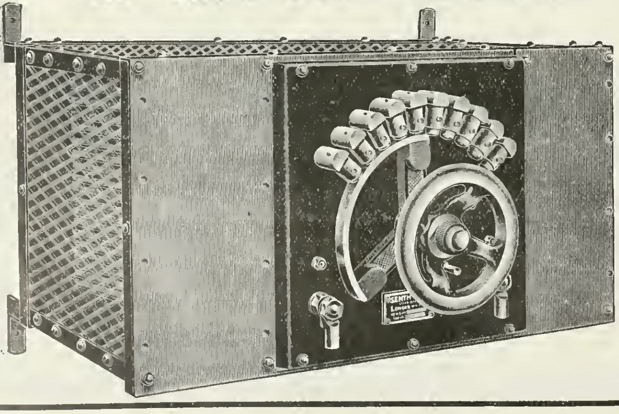

RHEOSTATS AND DIMMERS

for Incandescent or Arc Lamps of any capacity. Single or tandem types.

WE INVITE ENQUIRIES

ALSO FOR LOAD AND TESTING RESISTANCES.

Write (or 'phone Willesden 1488).

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Contractors to the Admiralty, War Office, India Office, Colonial Office, Postmaster-General, &c.

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LIGHT & POWER SET

DEFINITELY "IMPROVES WITH USE"—
HAS A HIGH POWER AND A LOW PRICE—
IT IS THE MOST COMPACT AND PERFECTLY EQUIPPED MODEL
ON THE MARKET — CONTRACTORS ! SHARE OUR PROFITS

The KNIGHT SLEEVE VALVE ENGINE

More than half the
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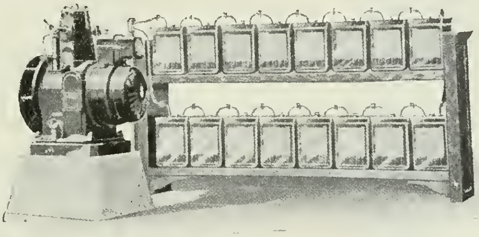

Advantages.

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- NO BELT.
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Brief Specification.

POWER	3 H.P.
WATTAGE	1¼ KW.
BATTERY CAPACITY	225 AMP. HOUR.
PRESSURE	30 VOLTS.
WEIGHT WITHOUT BATTERY	336 LB.
AVERAGE RUNNING COST PER WEEK ...	4/-
ENGINE SPEED	1350 R.P.M.
FLOOR AREA COVERED ENGINE ...	2 FT. SQ.
FLOOR AREA COVERED BATTERY	7.5 SQ. FT.

OIL AND FUEL SELF-CONTAINED.
AIR COOLED KEROSENE ENGINE.
DIRECT COUPLED SHUNT WOUND GENERATOR.
16 CELL BATTERY.

RETAIL PRICE COMPLETE £225.

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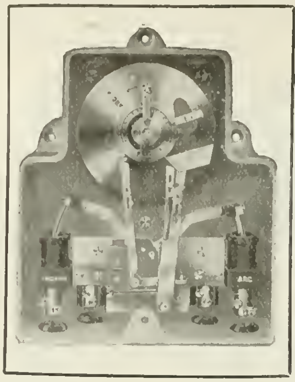
AGENTS - - - YOU WILL BE WHEN YOU READ OUR SALES PLAN.

WRITE TO-DAY FOR FULL PARTICULARS.

DON'T
BLAME
YOUR
LAMP-
LIGHTER
FOR LATE
RISING



—Use Venner Time Switches.

"The Switch that does everything—except fail."

The illustration is of a "DF" type, that switches on at dusk, changes over to half-night lamps when you will, and finally switches all off at dawn.

There is no programme too complicated for us to carry through.

Our catalogue is very detailed. Would you like a copy?

VENNER TIME SWITCHES LTD.
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TEL. VICTORIA 4550. GRAMS. CLOXWICHES PHONE LONDON.

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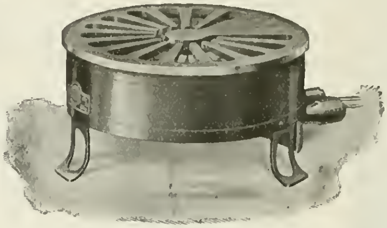
E F LTD
NORWICH

"Heatrae" ELECTRIC BOILING RING.



PATENT APPLIED FOR.

REAL PROGRESS
in Boiling Ring Construction.

CHEAP——SUPER-EFFICIENT.

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MANUFACTURERS,

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Telephone: 1800 WIMBLEDON (three lines). Telegrams: "FOSTERACO, WIMBLE, LONDON."

"APEX" IRONCLAD SWITCHGEAR,
Transformers,
SHOP LANTERNS and REFLECTORS,
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OUR

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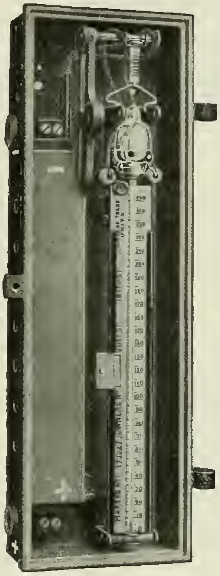

1-10 AMP. "STRAIGHT,"
250-500 or 1000 UNITS.

BECAUSE THEY ARE SUITABLE FOR

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BY CHOOSING THE RIGHT METER YOU

MINIMISE YOUR OUTLAY

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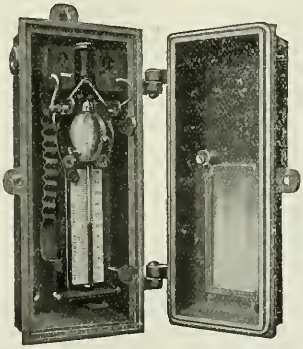

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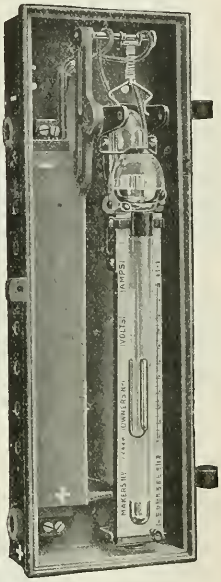

1-10 AMP. "SYPHON."
2000 UNITS.

Reason Manufacturing Co.,
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Telegrams : "Reason, Brighton."
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ALSO MADE IN SIZES UP TO 1,000 AMPERES.

SPRING SUSPENSION—MAINTENANCE NIL—NO MOVING PARTS, WEAR, OR FRICTION—NO NON-STARTING LOSSES—VOLTAGE DROP LOW.

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Showroom Service.

Realising the value of display and demonstration the Company has arranged attractive and comprehensive exhibits at its Head Office, MAGNET HOUSE, Kingsway, London, W.C. 2, and at each of its numerous showrooms throughout the United Kingdom and abroad, where a magnificent variety of Electric light fittings and every other domestic electrical requisite may be inspected and explained to the greatest advantage.

The unique resources of these showrooms are placed entirely at the disposal of Contractors who may desire to send their clients for personal selection, whilst the policy of the Company provides efficient safeguards to the individual interests of the Trader.

Books of Showroom Introduction Cards are supplied to the Trade, post free on request.

(A1391)

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FOR SALE.

Advertisements are inserted under this heading at 14s. per inch.

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LARGE STOCKS ON HAND.

NEW Motors, Ironclad Switch and Fuse Gear, &c.

Hard Drawn Bare Copper Wires.

Cables and Wires.

Vacuum and Half-watt type and Automobile Lamps, Osram and Mazda makes. See below.

DELIVERY FROM STOCK.

New Hard Drawn H.C. Bare Copper Wires—

Nos. 8, 11, 4/0, 3/0, S.W.G., also ⅜ in. rod and 1 in. by 3/16 Copper Strip, at 9½d. per lb.

New Cables and Wires Insulated—

7/18, at £40 per mile.
7/16, at £69 per mile.
7/14, at £97 per mile.
19/20, at £57 10s. per mile.
19/17, at £120 per mile.
37/14, at £380 per mile.
37/12, at £550 per mile.
3/22, at £13 per mile.
3/20, at £16 per mile.

Note.—Out prices are per mile and not per 1,000 yards.

Also sizes up to 91/11, and also 53/34 and 53/24 Three Core Cab Tyre.

The above Wires and Cables are "Glovers," "Henleys," "Hackbridge," "Callender's," and "Helsbys British Insulated" makes. Suitable quantities supplied.

255 miles 3/22, doubly taped, 2,500 meg. grade "Connolly," "Henleys," and "Callender's" make V.I.R. Wire, ¼ mile drums, £5 10s. each, drums free.

880 yards Black, or 440 yards of each Red and Black, on drums.

3/22, double taped ditto Wire, 15s. per 110 yards coil.

Galvanised Stranded Wires, 7/14, 4/8, and 7/8 gauges, also 7 and 11 gauge single ditto, 27s. 6d. and 25s. per cwt.

New Motors.

6-h.p. G.E.C., 220/240 V, 1,090 revs., £55 each.

9-h.p. G.E.C., 220/240 V, 840 revs., £85 each

10-h.p. Siemens, 220/240 V, 890 revs., £92 10s. each.

10-h.p. E.C.C., 220/240 V, fitted with reducing gear, from 850 revs. to 250 revs., £110 each.

15-h.p. B.T.H., 220/240 V, 845 revs., £120 each.

All the above new Motors are shunt wound and are complete with slide rails and pulleys.

New Direct Coupled Sets, E.C.C. make, shunt Motor, 1.65 h.p., 7.1 amps., Dynamo, .8-kW, 6/10 volts, 1,200 revs., with large polished slate switchboards fitted with necessary fittings. Price £90 complete per set.

New Osram and Mazda Lamps.

We hold in stock approximately 200,000 Metal Filament and Half-watt type Gasfilled Lamps in their original wrappers as from the makers, in voltages from 25 volts, 230 volts.

Also 15,000 Automobile Lamps, 4 volt to 12 volt, all watts.

We allow special discounts of 45 per cent. off all Vacuum and 37½ per cent. off gasfilled new List Prices.

Also Ediswan Screwed Cap Osram Lamps, 220, 110, and 125 volt, 40 watts, ready for immediate delivery, 55 per cent. off new List Prices.

All lamps guaranteed.

A large stock of Ironclad Switch and Fuse Gear and Starters, also Ironclad Distribution Boards at greatly reduced prices.

Two-groove Porcelain Cleats, ⅛, 3/16, and ¼, at 6s. per gross pairs. Also large stock of other sizes, including Bobbin Cleats.

Quantity of Assorted Porcelain Leading-in Tubes.

Post Office pattern and h.t. Insulators at low prices.

Insulator Spindles, Wall Arms, and Corner Brackets.

We also hold a large stock of general Accessories by the best manufacturers, comprising D.P. and S.P. Switches, Distribution Boards, Volt and Amp. Meters, Conduit and Conduit Fittings, screwed and slip, Chatterton's Compound, Mica, Sheet Ebonite, and Fuses, all sizes.

Copper tubing, ⅜ in. up to 1 in. assorted gauges.

25,000 gross of Nettlefold's Screws, various sizes. All at clearance prices.

G.E.C. English Porcelain 5 amp. Wall Plugs, 18s. per doz.

5 amp. Cream Cut-outs, 6s. 6d. per doz.

Distribution Boards, in nicely polished hardwood cases, 3 and 4-way, at 3s. 3d. per way; 5-way, 3s. per way.

3½ in. Polished and White Enamel Blocks, 2s. 6d. per doz.

B.T.H. Quicklok Cleat Ceiling Roses, 9s. per doz.

Good quality imported Ceiling Roses, 5s. per doz.

Key Switch Holders, best quality, 19s. per doz.

20 amp. up to 100 amp. pure tin Fuse Wire, 2s. per lb.

Good quality ⅝ in. screwed conduit, 20s. per 100 ft., ¾ in. ditto, 27s. 6d. per 100 ft.

New "Bellings," 3-heat, 2-pint Gluepots, 110-120 volts, 200 to 220 volts, with connections, 50s. each.

Desk Fans, 25 volt, d.c., slightly stock soiled only, guaranteed in good order, 40s. each.

New Combined Toasters with Cooking Utensils, 220 volt, 80s. per set.

All communications to Head Office.

EDWARDES BROS.,
20, Blackfriars Road, London, S.E. 1.
Established 1890. 'Phone: Hop. 2115. 6225

FOR SALE.—*Continued.*

ELECTRICAL PLANT FOR SALE.

New and Second-Hand, in Good Condition.

Dynamos.

Ref. No.	Make.	KW.	Volts.	Revs.	Winding.
121	E.C.C.	50	110	720	S.
818	Westinghouse	135	220	300	C.
226	Peebles	495	220	300	S.
823	Phœnix	170	400	750	C.
315	Holmes	150	450/550	425	S.
441	Elec. Co.	200	480	350	C.
34	J. & P.	150	500	380	S.
860	Scott-Mountain	150	500	350	C.

Alternators.

Ref. No.	Make.	KW.	Phases.	Volts.	Revs.	Cycles
845	Westinghouse	80 (2 of)	3	200	250	50
414	G.E.C.	70	3	570	500	25
414	Do.	135	3	570	500	25
414	Do.	150	3	570	500	25
115	Do.	750	1	2000	277	60
423	Westinghouse	200	3	2400	300	50
840	A.E.G.	300	3	2500	350	50
805	Parsons	300	3	3000	3000	50
814	Westinghouse	300	3	3000	3000	50
830	Dick, Kerr	625	3	3000	1500	50
830	Westinghouse	300	3	3300	375	50

D.C. Steam Sets.

Ref. No.	Make.	KW.	Volts.	Winding.	Steam Pres. lbs.
494	Browett-Jackson	15	100	S.	80
412	Belliss-B.T.H.	50	100/125	S.	150/160
847	Browett-Royce	30	105/110	C.	150/160
202	Willans-Siemens	15·9	110	S.	100
248	Sentinel-Verity	12	200/250	S.	60
830	Browett-Royce	250	210	C.	125
831	Browett-Royce	250	210	C.	125
301	Willans-Siemens	250	220	S.	120
843	Marshall-Cro'pton	350	220	S.	100
912	Ruston-Siemens	250	230	S. & C.	160
912	Ruston	310	230	S. & C.	160
912	Ruston-Crompton	550	230	S. & C.	160
504	Willans-Mather	50 (2 of)	250	S.	175
74	Belliss-W'house	140	250	S.	130
822	Barker-Mather	100	440	C.	200
830	Mather & Platt	132	440	S.	—
501	Belliss-Parker	150 (3 of)	440/525	S.	160
925	Belliss-Dick-Kerr	260	440/550	C.	130/160
926	Belliss-Crompton	450	440	S.	190
463	Belliss-Siemens	500	445/480	S.	150
665	Willans-Mather	324	450/550	S.	200
504	Do.	50	450/550	S.	175
504	Do.	150 (2 of)	460/500	S.	175
847	Belliss-Crompton	240/250	460/520	S.	150/160
870	Do.	100/120	500	C.	120
309	Belliss-Holmes	180	500	S.	150
236	Willans-E.C.C.	375	500	S.	180

Plant List (comprising Steam Sets and Turbines, Motors, Diesel Sets, Gas Sets, Engines, &c.), sent upon request.

BRITISH CENTRAL ELECTRICAL CO., LTD.,
6 and 8, Rosebery Avenue, London, E.C. 1. 6229

'Phone No.: Hol. 5848.
Telegraphic Address: "Briticent, Holborn, London."

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All Oil Immersed, Self-cooled for 50 periods supply.

No. Available.	KW. Capacity.	Phase.	Primary Volts.	Sec. Volts.	Make.
4	0.25	Single.	440	125	Morris Lister.
2	0.50	,,	440	,,	,,
2	0.75	,,	300/440	,,	Burnand.
10	1.00	,,	,,	,,	,,
1	2.00	,,	440	,,	,,
1	2.50	,,	400/440	,,	,,
5	2.50	Three	440	216.5	Brush.
2	2.50	,,	,,	220	,,
7	5.00	,,	,,	216.5	,,
9	6.25	,,	,,	217	,,
6	31.25	,,	,,	216.5	,,

All new and available for immediate delivery, with or without oil.

Apply "Transformer," c/o A. A. Black, Ltd., Bank Street Sheffield. 6168

HIRE OR SALE.

ELECTRIC Motors and Dynamos.—Machines always available.

ARMATURES and FIELD COILS
rewound or repaired without delay.

'Phone: Museum 8080.
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FOR SALE.—*Continued.*

MYLAN & SMITH (Engineers), Ltd.,
SHEFFIELD.

ELECTRIC MOTORS. Best makes only. Many of them new, and all thoroughly overhauled and tested prior to despatch.

Two Phase, 50 Periods, 200 Volts (4-wire).

One 5-h.p., 1,450 r.p.m., squirrel cage.
One 10-h.p., 1,440 r.p.m., squirrel cage.
One 15-h.p., 710 r.p.m., squirrel cage.
One 16-h.p., 715 r.p.m., slip ring.
One 20-h.p., 720 r.p.m., slip ring
Two 30-h.p., 940 r.p.m., slip ring.
One 30-h.p., 580 r.p.m., slip ring.
One 40-h.p., 720 r.p.m., slip ring.

Three-phase, 25 Periods, 400/440 Volts.

Eight 7½-h.p., 1,440 r.p.m., squirrel cage.

Three-phase, 40 Periods, 400/440 Volts.

Two 7-h.p., 2,300 r.p.m., squirrel cage.
Three 7½-h.p., 760 r.p.m., squirrel cage.
Three 12½-h.p., 575 r.p.m., slip ring.
One 18-h.p., 760 r.p.m., squirrel cage.
One 20-h.p., 2,300 r.p.m., squirrel cage.
One 36-h.p., 580 r.p.m., slip ring.
Two 44-h.p., 760 r.p.m., slip ring.
One 48-h.p., 575 r.p.m., slip ring.
One 64-h.p., 580 r.p.m., slip ring.
Two 72-h.p., 760 r.p.m., slip ring.
Two 88-h.p., 580 r.p.m., slip ring.

Three-phase, 50 Periods, 400/440 Volts.

Twenty-four 4-h.p., 1,400 r.p.m., squirrel cage.
Twenty 6-h.p., 1,460 r.p.m., squirrel cage.
One 10-h.p., 385 r.p.m., squirrel cage.
One 12½-h.p., 715 r.p.m., slip ring.
One 36-h.p., 725 r.p.m., slip ring.
Two 44-h.p., 950 r.p.m., slip ring.
One 48-h.p., 725 r.p.m., slip ring.
One 64-h.p., 720 r.p.m., slip ring.
Two 72-h.p., 950 r.p.m., slip ring.
Two 88-h.p., 715 r.p.m., slip ring.
One 100-h.p., 480 r.p.m., slip ring.
One 250-h.p., 365 r.p.m., slip ring.

Three-phase, 50 Periods, 500/550 Volts.

Three 16-h.p., 720 r.p.m., slip ring.
One 45-h.p., 720 r.p.m., slip ring.
Two 55-h.p., 950 r.p.m., slip ring.
One 60-h.p., 720 r.p.m., slip ring.
One 80-h.p., 720 r.p.m., slip ring.
Two 90-h.p., 950 r.p.m., slip ring.
Two 110-h.p., 715 r.p.m., slip ring.

Direct Current, 220/240 Volts.

One 3-h.p., 740 r.p.m., compound wound enclosed ventilated.
One 5-h.p., 500 r.p.m., shunt wound, enclosed ventilated.
One 5-h.p., 700 r.p.m., compound wound, totally enclosed.
Forty-five 4-h.p. to 50 h.p., various speeds and types.

Direct Current, 440/500 Volts.

One 5-h.p., 1,000 r.p.m., shunt wound, protected.
One 6-h.p., 800 r.p.m., shunt wound, protected.
One 10-h.p., 880 r.p.m., shunt wound, enclosed ventilated.
One 10-h.p., 1,200 r.p.m., shunt wound, protected.
One 15-h.p., 1,100 r.p.m., shunt wound, protected.
One 30-h.p., 750 r.p.m., shunt wound, enclosed ventilated.
One 36-h.p., 480 r.p.m., compound wound, semi-enclosed.
One 50-h.p., 630 r.p.m., compound wound, protected.
One 250 h.p., 485 r.p.m., compound wound, open.
One 450-h.p., 300 r.p.m., compound wound, open.

Crane Rated Motors.

Thirteen 220 and 440 volt, series wound, totally enclosed crane rated Motors, 13 to 50 h.p.

Suitable control gear, slide rails, and pulleys are always available for the above machines.

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Electrical Stores:
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'Grams: "Topical," Sheffield 6561

FOR SALE.—*Continued.*

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Wholesale Electrical Suppliers,

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Telephone Nos.:—
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Telegrams:—
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STOCK OF NEW D.C. MOTORS.

No. in Stock.	Type.	Maker.	B.H.P.	Volts.	R.P.M.	Pulley.	Rails.
2	Encl. vent.	E.C.C.	50	400/480	600	16 × 10	Yes
1	Encl. vent.	E.C.C.	40	400/480	600	15 × 9	Yes
1	Protected.	Siemens.	80	400/480	750	14 × 8	Yes
4	Encl. vent.	E.C.C.	30	400/480	750	14 × 7	Yes
1	Protected.	Siemens.	25	400/480	810	12 × 7	Yes
1	Protected.	Siemens.	25	500/550	810	12 × 7	Yes
3	Encl. vent.	E.C.C.	25	400/480	785	12 × 7	Yes
4	Tot. encl.	E.C.C.	20	400/480	850	14 × 7	Yes
2	Encl. vent.	E.C.C.	20	400/480	850	12 × 6	Yes
1	Encl. vent.	E.C.C.	15	400/480	1000	8 × 6	Yes
5	Encl. vent.	E.C.C.	10	400/480	900	8 × 6	Yes
6	Tot. encl.	E.C.C.	9	400/480	1000	8 × 6	Yes
5	Encl. vent.	E.C.C.	8	400/480	1000	6 × 4	Yes
8	Encl. vent.	E.C.C.	5	400/480	1000	6 × 4	Yes
1	Protected.	Siemens.	3	200/240	1450	5 × 4	Yes
7	Encl. vent.	E.C.C.	3	200/240	900	5 × 4	Yes
23	Encl. vent.	G.E.C.	2	200/240	1050	5 × 4	Yes
49	Encl. vent.	E.C.C.	2	200/240	1250	5 × 4	Yes
1	Encl. vent.	E.C.C.	1½	200/240	1000	5 × 4	Yes
18	Protected.	B.K.B.	1¼	200/240	1500	4 × 3	No
19	Tot. encl.	Verity	1	200/240	1600	Yes	Yes
29	Protected.	Crompton.	1	200/240	1500	3 × 3	Yes
1	Protected.	B.K.B.	½	200/240	1350	4 × 3	No
1	Protected.	L.	¼	200/240	1500	Yes	No
111	Protected.	B.K.B.	¼	200/240	1500	Yes	No
2	Protected.	U.	⅛	200/240	2000	Yes	No

1, new, E.C.C., compound-wound, open protected type, interpole Generator, 30 kW, 220 volts, 950 r.p.m., with regulator, pulley and rails.

16 E.C.C. Cinema Reducer Sets, consisting of 2-protected type machines, motor, 340/380 volts, suitable for 400/480 volts, d.c. supply, 1200 r.p.m.; generator to give an output of 60 volts, 100 amps., complete with shunt regulator and double automatic starter.

6 ditto, 60 volts, 80 amps.

Stock of Second-Hand D.C. Motors.

1 Tot. encl. Verity 3 200/240 1200 6 × 3½ Yes

1 Encl. vent., type E.C.C., compound-wound Motor, 150 b.h.p., 440 volts, 500 r.p.m., with pulley, rails and bedplate, two end shield type and two pedestal type bearings. Complete with starting panel.

1 Encl. vent., compound wound, interpole, L.D.M. Motor, 115 b.h.p., 460 volts, 600 r.p.m., with pulley and rails.

1 Protected type, B.T.H., compound wound, 6-pole interpole Generator, 52 kW, 220 volts, 650 r.p.m., with 14″ pulley and rails.

Stock of New A.C. Motors.

Protected type, squirrel-cage, Star Delta wound Motors, 400/440 volts, 50 cycles, 3-phase, complete with rails.

Maker.						Pulley.
Verity	Two	20-h.p.,	at	950	r.p.m.	11 × 6
Verity	Two	13½-h.p.	„	710	„	11 × 6
E.C.C.	Two	15-h.p.	„	1000/955	„	8 × 6
E.C.C.	One	14-h.p.	„	750/715	„	10 × 6
E.C.C.	Two	20-h.p.	„	1000/955	„	10 × 6
E.C.C.	One	18-h.p.	„	750/715	„	12 × 6
E.C.C.	One	24-h.p.	„	1000/960	„	12 × 6
E.C.C.	One	24-h.p.	„	750/720	„	12 × 7

E.C.C., 3-phase, protected type, 400 volt, 50 cycles, Slip Ring Motors, each complete with brush-lifting and short-circuiting device, slip-ring cover, two oil ring lubricated end shield bearings, standard shaft and pulley as specified below, complete with slide rails, standard terminal box with bushed cable holes, the slipping cover also having bushed cable holes.

No.	H.P.	R.P.M.	Pulley.
1	14	750/715	10 × 6
1	20	1000/960	10 × 6
1	18	750/715	12 × 6
2	24	1000/960	12 × 6
1	37	750/725	16 × 8
2	45	750/725	16 × 9
1	55	750/730	18 × 10

Terms: Offered subject to being unsold. Cash with order. 777

NEW MOTORS. DELIVERY FROM STOCK AT LESS THAN MAKERS' PRICES.

SINGLE-PHASE, 50 periods, 100/200 V, twenty (½ to 10-h.p.), Brook and Century.

THREE-PHASE, 50 periods, 400/440 V, thirty Parkinson, 1 to 20 h.p.

DIRECT CURRENT, 500 V, sixteen, by E.C.C., Scott, Siemens, and Bull.

Second-hand Motors, 3-phase, 440 V.

Direct current, 100 and 500 V, and single-phase, 100/200 V.

Midland Dynamo Co., Ltd., 64, Belgrave Gate, Leicester.

5487

FOR SALE.—*Continued.*

FOR SALE.

THE Guardians of the Ormskirk Union invite Tenders for the purchase of one 50-b.h.p. National Gas Engine, coupled to "Witton" Multipolar Dynamo, 220 V, 140 A, d.c., 230 r.p.m., which were installed at their Institution in 1914.

The above may be inspected, by appointment with the Master, Poor Law Institution, Ormskirk.

Tenders to be in my hands not later than 9 a.m. on TUESDAY, JULY 5th, 1921.

ALFRED DICKINSON,
Clerk to the Guardians.

Ormskirk.
June 15*th*, 1921. 6159

D.C. MOTORS.

FOR SALE, the following d.c. Motors, complete with Starters, excepting the 2-b.h.p. All in good running condition. Can be inspected by appointment.

No.	Volts.	B.h.p.	R.p.m.	Size of Pulley.	Make.
1	220	2	1150	Back-geared 6½" to 1½". Countershaft pulley. 3½" × 5" face.	Peerless Elec. Co., U.S.A.
1	220	¾	1250	2¼" × 4" face.	Crocker Wheeler.
2	220	1	1675	Back-geared 4¾" to ¾". Countershaft pulley. 5½" × 4" face.	" "
1	230	7½	1150	5⅞" × 6½" face.	Westinghouse.
2	220	½	350 1000	2½" × 4½".	Peerless Elec.

6,163, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4

GREEN SILK-COVERED WIRE.

TENDERS are invited for approximately 3,800 lb. of Green Silk-covered Wire. To be cleared without reserve.

FERRANTI, LTD., Hollinwood, Lancs. 6184

ELECTRIC MOTOR REPAIRS.

ARMATURES and Field Coils rewound, new commutators supplied, temporary Motors loaned if required.

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'Phone: Museum 6274. 6171

NEW TURBO GENERATOR & SURFACE CONDENSING PLANT.

ONE 5,000-kW = 6,250 k.v.a. Turbo Generator, 6,600 volts, 50 cycles, steam pressure 200 lb., superheat 250 deg. Fahr. Surface Condenser designed for Cooling Water inlet temperature of 80 deg. Fahr.

This Plant is practically completed in Maker's Works in England.

For particulars and price, apply to—
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FOR SALE.

500 volt, constant pressure Megger for sale, as new. Offers.

Twelve 96 amp.-hour Chloride Accumulators, as new, teak lead-lined cases, £2 each, or best offer for lot.

Two 10-way Desk intercommunication 'Phones, and one wall type, at 25s.

One 6-valve French Amplifier, £8 10s.

One Ericsson common Battery Table 'Phone, with 1,000 ohm ringer, practically new, £4 10s. Extending Wall Bracket for above, 20s.

Sixty Cheque Protectors, 25s.

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DIRECT-COUPLED FOR PARAFFIN OR GAS.

50 kW Aster-Siemens, 110/220-220/550 volts d.c.

50 kW Aster-Siemens, 110/220-220/540 volts a.c., 3-phase, 50 cycle.

1 kW Petters-Boothroyd, 220 volts, 750 r.p.m.

All the above sets are brand new and complete with all spares, fuel and water tanks, switchboards, &c.

Also number of Searchlight Projectors with switchboards.

Full particulars, photos, and lowest prices from—

E. W. FARROW & SONS, Spalding, Lincs. Tel. 101. 5968

FOR SALE.

1,000 kW, comprising two Compound Engines, direct coupled English Manufacturing Co.'s compound wound, direct current Dynamos, 500 volts, 500 kW each.

Allen's surface condenser, 30,000 lb., with motor-driven air and circulating pumps. Excellent condition. May be seen running. Cheap.

JENNINGS, West Walls, Newcastle-on-Tyne. 6199

FOR SALE.—*Continued.*

FOR SALE.

DIESEL ENGINES, six cylinder, two and four stroke, 350, 1,000, 1,200 H.P., excellent condition Dynamos for above 250 or 500 volts D.C. Immediate delivery and low price.

Also two 500-KW. Parsons Turbine Sets, 250 or 500 volts, D.C., with Condenser and spare armature.

Electrically-driven Air Compressors, 250 volts, D.C., pressures, 1,500 to 3,000 lb. per sq. in.

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GREAT REDUCTION IN PRICES
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Alternating and Direct Current Motors, manufactured by the following:—

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which are in stock at our Showrooms in Birmingham.

Write for new stock list and state your requirements to—

CHARLES PURDEN, LTD.,
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New Telephone Numbers (5 lines): C 7228-7232.
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NEW MOTORS FOR SALE OR HIRE.

D.C., ¼-H.P., ⅓-H.P., ½-H.P., 1-H.P., 2½-H.P., 3-H.P., 5-H.P., 7½-H.P., 10-H.P., 200/240 volts; 3-H.P., 5-H.P., 7½-H.P., 10-H.P., 25-H.P., 400/460 volts; 1-H.P., 2½-H.P., 530 volts.

A.C., 10-H.P., 15-H.P., 25-H.P., 3-phase, slip ring, 415 volts, 950 R.P.M., 50 cycles, with starters, pulleys, rails.

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GAS ENGINE SETS WITH DYNAMOS.

ONE 3-line Vertical Tandem National Engine, coupled to G.E.C., 440 volt, 500 kW Generator.

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Two 2-cylinder Horizontal Scavanging Premier Engines, coupled to 440 volt, 220 kW Bruce Peebles Generator.

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One 850-kW to 1,000-kW Gas Engine, direct coupled to Siemens Dynamo, 500 volts, together with complete producer Plant (full specification with drawings on application).

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BRAND NEW ELECTRIC TANGYE PUMPS.

THREE Sets immediately available. Capacity each 20,000 gallons per hour, against total "head" of 120 ft., complete with 25-h.p., 500 volt, d.c. Motors, and starting gear. Location London. Sold singly if required.

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75-h.p., 3-phase, 415 volts, 50 cycles, 575 r.p.m., slip-ring.

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40-h.p., d.c., 440 volts, 850 r.p.m.

15-h.p., d.c., 440 volts, 930 r.p.m.

12-h.p., d.c., 440 volts, 300/900 r.p.m., with Brookhirst panel.

5-h.p., d.c., 220 volts, 600 r.p.m., with Brookhirst panel.

7½-h.p., d.c., 220 volts, 750 r.p.m.

Many smaller sizes.

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FOR SALE by Private Treaty, the whole of the Machinery, Plant, Stock in Trade, and Letters Patent No. 140,903, and other effects of the Perna Engineering Works (Blackpool), Ltd.

The "Perna" Lighting Set (patented April 1st, 1919), suitable for Light Cars and Motor Bicycles, has already been placed on the market with satisfactory results.

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FOR SALE.—*Continued.*

FOR SALE.

FOR SALE, 50-H.P., 440 volt, 3-phase, 40 cycle Bruce Peebles Motors, 760 revs., with Ellison Starters.

Plating Dynamo, 6 volts, 340 amps., by Scott & Mountain.

48-KW., 220 volt, compound Generator.

15 and 22-H.P., 220 volt, D.C. Motors, with Brook Hirst Starting Panels.

100/120 volt, 110 amps., shunt wound bi-polar Dynamo, with ring oiled bearings.

DRUMMOND & Co., Middlesbrough. 321

FOR SALE.

MODERN ELECTRIC GENERATING PLANT.

75-kW, 500 volt, d.c., compound Set.
140-kW, 500 volt, d.c., triple expansion Set.
130-kW, 230 volt, d.c., compound Set.
225-kW, 220 volt, d.c., compound Set.
200-kW, 460/500 volt, d.c., compound Set.
420-kW, 460/500 volt, d.c., compound Set.
700-kW, 500/550 volt, d.c., triple expansion Set.
850-kW, 460/500 volt, d.c., turbo Set.
1,000-kW, 220 volt, d.c., geared turbo Set.

Also a number of 3-phase, 25 and 50 cycle Turbo Alternators up to 1,500 kW, and several Vertical Gas Engine Sets from 100 to 500 kW, 440 and 500 volts d.c.

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MOTORS.—IMMEDIATE DELIVERY.

FULL range of d.c. Motors from ½-h.p. to 30-h.p. All standard voltages in stock. For immediate delivery.

Full guarantees Attractive prices.

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½, 1, 3, 5, 7½, 10, 15, 20, 25, 30, 40, and 50-H.P., 400/440 volt, 3-phase, 50 cycle.

3, 5, 7½, 10, 15, 20, 25, and 40-H.P., 480/530 volt, D.C.

We are able to offer special terms for these Motors ex stock.

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NEW MOTORS. SPECIAL PRICES.

MAKER'S Guarantee—stock replaced as sold.

SQUIRREL CAGE.		SLIP RING.
1, 2, 3 and 4 H.P. 950 and 1440 R.P.M.	SINGLE PHASE.	5, 6, 7½, 10 and 15 H.P. 950 and 1440 R.P.M.
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Several good S.H. Motors at attractive prices. 6126

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CABLES.

PAPER-INSULATED, Lead-covered, and Armoured.
.1 to .6, 3-cored, Low Tension.
.0125 to .4, 4-cored, Low Tension.
.1 to .6, Single Low Tension.
.025 to .075, Single e.h.t.
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All guaranteed new by leading maker.

Write in first instance to 6214, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

VARIOUS ELECTRICAL PLANT FOR SALE.

Special Opportunity.

MOTOR GENERATORS.

Ref. 912—500 kW Crompton Set, on combined bedplate, 230/240 volts, 460/470 volts, complete with starters for starting either side.

Ref. 937—100 kW Phœnix Set, motor 480/530 volts. Generator 510/540 volts, specially suitable for traction purposes.

D.C. MOTORS.

Ref. No.	Make.	H P.	Volts.	Revs.	Winding.
705	Laurence Scott	75 (3 of)	220	420	S.
705	Do.	75 (3 of)	220	420	C.
215	Lancs. Dynamo	150	220	450	S.
910	Westinghouse	50 (2 of)	400	600	C.
914	Lancs. Dynamo	110	460	650	C.
910	Mather & Platt	50	500	275	S.
910	Westinghouse	60 (2 of)	500	600	S.
910	B.T.H.	80	500	600	S.

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'Phone Holborn 5848. 'Grams. "Briticent, Holborn, London."

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TRANSFORMERS AND MOTORS FOR SALE.

THREE 500-kW, oil cooled Transformers, 10,750/425 volts, 3-phase, 50 periods, by British Electric Transformer Co.

Two 100-kW, oil cooled Transformers, 6,600/220 volts, 3-phase, 25 periods, by Brush Electrical Engineering Co.

One 50-kW, oil cooled Transformer, 440/110 volts, 3-phase, 25 periods, by Johnson & Phillips.

One Motor Converter, 110 volts, 25 periods, to 12 volts, 20 amps., by Crypto.

MOTORS, 3-PHASE, 440 VOLT, 25 PERIODS.

Five 40-h.p., slip-ring, Westinghouse, 720 r.p.m. Motors.
Two 35-h.p., squirrel cage, 725 r.p.m. Motors, by G.E.C.
One 30-h.p., slip-ring, 725 r.p.m. Motor, by G.E.C.
One 5-h.p., slip-ring, 500/477 r.p.m. Motor, by Siemens.
One Motor Generator, 3-phase, 440 volts, 25 cycles to 8 volts, 40 amps., mounted on bedplate, by Rhodes, Ltd.
One 200-h.p., slip-ring, Westinghouse Motor, 485 r.p.m.
One 160-h.p., slip-ring, B.T.H. Motor, 480 r.p.m.
Twelve 60-h.p., slip-ring Motors, by Westinghouse, 485 r.p.m.
Thirty 25-h.p., slip-ring, Westinghouse Motors, 720 r.p.m.
Three 20-h.p., slip-ring, Westinghouse Motors, 720 r.p.m.
Ten 10-h.p., squirrel cage, Westinghouse Motors, 710 r.p.m.
Nine 5-h.p., squirrel cage, Westinghouse Motors, 480 r.p.m.

MOTORS, 3-PHASE, 440 VOLTS, 50 PERIODS.

One 100-h.p., slip-ring, 720 r.p.m. Motor, by Fuller.
One 50-h.p., slip-ring, 950 r.p.m. Motor, by G.E.C.
One 7½-h.p., squirrel cage, 950 r.p.m. Motor, by Harding Churton.

MOTORS, 3-PHASE, 220 VOLTS, 50 PERIODS.

Four 5-h.p., squirrel cage, 975 r.p.m. Motors, by Brook, with starter (new).

MOTORS, 500 VOLT, D.C.

One 100-h.p., compound interpole Motor, 585 r.p.m., by Westinghouse.

MOTORS, 480/440 VOLT, D.C.

One 3½-h.p., shunt interpole, 950 r.p.m., by Newton, Ltd.
One 5-h.p., shunt interpole, 1,075 r.p.m., by Bruce Peebles.
One 10-h.p., shunt interpole, 1,075 r.p.m., by The G.E.C.
One 15-h.p., shunt interpole, 840 r.p.m., by Newton, Ltd.
One 20-h.p., shunt wound, 1,150 r.p.m., by G.E.C.
One 40-h.p., shunt interpole, 550 r.p.m., by J. P. Hall, with Brookhirst starter.

MOTORS, 220/250 VOLT, D.C.

One 60-h.p. Motor, by Rees Roturbo, Ltd., Wolverhampton (Thomas Parker), protected type, compound interpole, 210 volts, 640 r.p.m., new 1916.

One 30-h.p. Motor, by British Westinghouse Co., protected type, compound interpole, 220 volts, 600 r.p.m., new 1917.

One 24-h.p. Motor, by Royce, Manchester, protected type, shunt, speed 1,000 r.p.m.

One 20-h.p. Motor, by Morris Hawkins, 750 r.p.m.

One 12-h.p. Motor, by B.T.H. Co., totally enclosed, pipe ventilated, compound interpole, speed 800 r.p.m., new 1918.

One 9-h.p. Motor, by G.E.C., protected type, shunt interpole, 840 r.p.m., as new.

One 7½-h.p. Motor, by B.T.H., shunt interpole, 1,100 r.p.m.

One 4½-h.p. Motor, by B.T.H., protected type, shunt, 1,700 r.p.m.

Two 3-h.p. Motors, by Verity, shunt interpole, totally enclosed, 1,200 r.p.m., as new.

MOTORS, 100/110 VOLTS, D.C.

One 12-h.p., series wound, 850 r.p.m. Motor, by L. D. & M. Co.

One 5.75 shunt interpole, Westinghouse, 1,000 r.p.m., coupled to 3-in. Rotary Pump on C.I. bedplate.

One ½-h.p. shunt wound, 1,000 r.p.m., by Verity.

Two 1-kW, shunt wound Generators, direct coupled to 700 r.p.m., high-speed Steam Engine, by Robey.

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Two 10-kW, compound interpole, by the E.C. Co., 1,000 r.p.m.

One 20-kW, compound interpole, by Westinghouse Co., 450/500 r.p.m.

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385 yds. 7/14 Twin Concentric L.T. Paper L.C. & A., new on drum, by Western Electric Co.

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Watt-hour Meter, 230 volts and 2 S.P. 3,000 amp. Knife Switches.

THE MIDLAND COUNTIES ELECTRICAL ENGINEERING CO., LTD.,
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Telegraphic Address: "Rheostat, Birmingham." 6143

FOR SALE.— *Continued.*

FOR SALE.

PETROL-ELECTRIC Generating Sets. Ex-Government stock. Coventry-Simplex, Keighley-Kelvin, and Gardner direct coupled sets, output 100 amp, 80 volts, complete with Switchboard equipment. Practically new. Ideal for kinemas, or any power or lighting. Will run full load on about ½ gal. of petrol per hour. All 10 kW. Cost about £800 to build. Only 20 sets left. £185 cash at Liverpool.
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BATTERY Charging Dynamo, 50/70 V, 14·2 A, 1000 r.p.m. £22.—Giffen, St. Albans. 2366

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CROSSLEY Town Gas Engine, 8½ cylinder, with Fielding gas plant for same; also 14-kW, 140 V dynamo for sale. Best offer accepted.—Seen Electricity Works, Wadebridge, Cornwall. 2483

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DYNAMOS, 55 V, 12 A, 1000 r.p.m., shunt, by City Elec. Co., £11 10s.; G.E.C. £12 10s.—White, 140, Southwark St., S.E. 2442

DYNAMOS, 110 V, 32 A, 1430 r.p.m., by G.E.C., £27 10s.—White, 140, Southwark Street, S.E. 2443

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ELECTRIC Motors and Dynamos for sale or hire, d.c. and a.c. Machines always ready, guaranteed.—'Phone: 488 H'smith. The Electro-Generator Co., 1A, Shepherd's Bush Road, W. 6. 2464

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FOR Sale, one Crypto Dynamo, 100 volts, 10 amperes, 1400 revs., 12-in. pulley, in good condition. Makers No. 28,210, Type 210. Offers invited.—Secretary, Swindon Victoria Hospital, Swindon. 2465

FOR Sale, one 10 h.p. second-hand Motor, 715 r.p.m. 3-phase, 50 cycle 400/440 volt, complete with pulley, slide rails, and starter; one 5 h.p. ditto, 700 r.p.m.; one 7½ h.p. ditto, 955 r.p.m.; one 5 h.p. ditto, 1400 r.p.m. All in absolutely first-class condition at bargain prices.—W. P. Young & Co., 40, Sanvey Gate, Leicester. 5003

FOR Sale or Hire, Motors and Dynamos, 440, 220, 110 volts.—Martin, 320, Witton Road, Birmingham. Phone: East 883. 1470

FOR SALE.—*Continued.*

FOR Sale, owing to alterations to purchaser's scheme, one new 5-tons 3-motor electrically-driven overhead travelling crane, 220 volts, d.c. Motors can be changed to suit other supply if required. Immediate delivery. Also, for delivery in three weeks, 3 2-tons Electric Pulley Blocks with 400 volts a.c. motors.—Full particulars and prices from makers, S. H. Heywood & Co., Ltd., Reddish, near Stockport. 6204

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Call or write, Inspector of Recruiting, 4, Henrietta Street, Covent Garden, W.C. 2, or R.A.F. Recruiting Depot, 298, Bath Street, Glasgow. 5970

SHIFT ENGINEER.

SHIFT ENGINEER required at the Eccles Corporation Electricity Works. Must have good electrical and mechanical experience. Salary in accordance with National Joint Board Schedule (present rate being £314 1s. 11d. per annum).

Applications, stating age, experience, when at liberty, &c., with copies of recent testimonials, to be forwarded forthwith to the Borough Electrical Engineer, Electricity Works, Cawdor Street, Patricroft, Lancs. 6176

ARMATURE WINDERS.

GOOD a.c. and d.c. Winders required immediately for repair work. None but first-class men need apply to—

W.M. Engineering Co., 6, Fleet Street, Dublin. 2455

SITUATIONS VACANT.—*Continued.*

IPSWICH CORPORATION ELECTRIC SUPPLY AND TRAMWAYS.

Appointment of Chief Engineer and Manager.

THE CORPORATION invite applications from fully-qualified Electrical Engineers for the above position. The gentleman appointed will be responsible for the control of the following Undertakings and Branches:—

The Electric Supply Undertaking.—D.c., d.c. Traction, and 3-phase a.c. (h.t. and l.t.) supplies. Present capacity of Power Station 6,000 kW. A second 3,000 kW Ljungstrom Set is now in course of erection. Total sales for year ending March 31st last 5,464,955 units.

The Installation Department. (Providing installations for lighting, power, &c.)

The Electric Vehicle Garage Department. (Garage for 35-40 vehicles.)

A Separate Refuse Destructor Works.

The Electric Tramways Undertaking, including the upkeep of the permanent way. There are 10.8 miles of route and thirty-six cars.

The total number of employés was 400 on March 31st.

The salary will commence at £900, rising to £1,200 by annual increments of £50. The gentleman appointed will be required to devote the whole of his time to the duties appertaining to the position. He will be required to plan and carry out extensions in connection with either Undertaking as they become necessary, and he must possess a wide experience in such work. He must be a Corporate Member of the Institution of Electrical Engineers, and have already held a responsible position in connection with an up-to-date Electric Supply Undertaking.

Applicants should state age, details of experience, how soon they could take up appointment (the date should be September 1st, if possible), and should submit copies of not more than three recent testimonials.

Applications must reach the undersigned not later than July 18th, 1921.

Canvassing in any form will disqualify.

WILL. BANTOFT,
Town Clerk.

Town Hall,
Ipswich. 6213

EAST INDIAN RAILWAY.

Electric Power Station Superintendent (Grade 2).

THE DIRECTORS are prepared to receive applications (by letter only) from duly qualified candidates for appointment to the above post in India.

Candidates should be about 30 years of age, and must have served a trade apprenticeship with an electrical firm of good repute, and have subsequently gained good experience in the erection and running of electric power stations generating and distributing electrical power in the direct current and alternating current form. Good experience on the steam side is essential. Candidates must furnish full particulars of their training and experience.

Salary, Rs. 525 per calendar month, rising by annual increments of Rs. 25 per month to Rs. 600, and subsequently to Rs. 650 per month.

Terms: A four years' agreement, with free passage out and home on satisfactory termination of engagement.

Candidates must state their age, and if married, the number of persons in their family for whom living accommodation is necessary.

The selected candidate will have to pass a strict medical examination by the Company's Consulting Physician before appointment.

Letters of application, which should be accompanied by copies only of testimonials, Army discharges, &c., must be addressed to the undersigned not later than July 6th, 1921.

By order,
G. E. LILLIE,
Secretary.

East Indian Railway Company,
28-30, Nicholas Lane, London, E.C. 4.
June 20th, 1921. 6203

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.

Box Number and Electrical Review address count as seven words.

ASSISTANT Engineer to works engineer wanted at large engineering works. Must be capable organiser and able to undertake control of small drawing office, and preparation of all details in connection with works extensions and layouts.—State age, experience (fully), previous positions held, and salary required, to 6181, Electrical Review, 4, Ludgate Hill, London.

A VACANCY occurs in a large provisional supply undertaking for a Constructional Electrical Engineer. Good knowledge of electrical detail and modern e.h.t. switchgear. Salary £500 per annum.—Apply, stating references, to 6192, Electrical Review, 4, Ludgate Hill, London.

A YOUNG Armature Winder required; must be able to wind car-lighting dynamo armatures, fields and cut-outs and other small armatures. Smart improver considered.—State all particulars, if Union, and wages required, to 2456, Electrical Review, 4, Ludgate Hill, London.

SITUATIONS VACANT.—*Continued.*

DESIGNER.—Vacancy occurs with firm North of England, for designer a.c. and d.c. plant, up to 150 h.p. Must have had previous experience.—Apply, stating salary and full qualifications, 6142, Electrical Review, 4, Ludgate Hill, London.

DRAUGHTSMAN (temporarily for 6 months or longer) required with mechanical and electrical experience. One with knowledge of power station lay out essential.—Reply, stating age, married or single, full particulars of education and experience and salary required, to General Manager, Northampton Electric Light and Power Co., Ltd., 25, Bridge Street, Northampton. 2335

DRAUGHTSMAN, with shop experience and accustomed to instrument and switchgear work, wanted in neighbourhood of London. Give fullest particulars of experience, also state age and salary required.—2461, Electrical Review, 4, Ludgate Hill, London.

ELECTRICAL Engineer required who can work out and develop the windings and manufacture of small electric motors, transformers, and instruments. Good opening for smart young man.—2459, Electrical Review, 4, Ludgate Hill, London.

ENGINEER.—Power Plant Engineer wanted for large engineering works in the North. Applicants must have had sole charge of a municipal or industrial power station. Only men who can prove their ability to reduce operating costs, and maintain same at a minimum, will be considered.—Applications should state age, full particulars of experience, and salary required, to 6182, Electrical Review, 4, Ludgate Hill, London.

ENGINEER.—Wanted by firm of switchgear manufacturers in Manchester district a first-class Engineer, fully experienced in design of all classes of switchgear apparatus, lay-out systems and modern protective gear. Must also be able to prepare estimates for large installations. Only really capable men who have held responsible positions in similar capacity considered.—State age, experience, training, and salary required, to 6146, Electrical Review, 4, Ludgate Hill, London.

FOREMAN for tramway and generating station workshop. Permanent position to suitable man. Wages, subject to revision with engineering trade, £6 per week.—Apply, with copies of references, to Rhondda Tramways Co., Ltd., Rheola Road, Porth, Glam. 2462

FOREMAN required to take charge of department in large telephone works. Complete knowledge of manufacture of all types of G.P.O. cords essential. One with experience of tinsel manufacture preferred.—Reply, stating age experience, and salary desired, to 6049, Electrical Review, 4, Ludgate Hill, London.

FOREMAN required to take charge of department in large Telephone Works. Complete knowledge of manufacture of all types of G.P.O. Cords essential. One with experience of tinsel manufacture preferred. Reply, stating age, experience, and salary desired, to 6207, Electrical Review, 4, Ludgate Hill, London.

INDIA.—A firm of Electrical Engineers and Contractors in Calcutta require the services of a competent engineer, age not over 32, single, with thorough knowledge of d.c. and a.c. work, conversant with steam and oil engines; good prospects to right man. Rs. 600 per month to commence, five years' agreement.—Write, giving details of experience, age, and send copies of testimonials to Z. X., 731, c/o Deacons, Leadenhall Street, E.C. 3. 2428

INSTRUMENT Inspector, also fully qualified tester, wanted.—State fully technical knowledge and experience, type of instruments examined, age and salary required, to 2453, Electrical Review, 4, Ludgate Hill, London.

JOINTERS required with experience of e.h.t. cable jointing. Only first-class men need apply, giving full particulars of experience and wages required, to 6057, Electrical Review, 4, Ludgate Hill, London.

MANAGERS Wanted, for Electrical Contracting Department.—Mann, Egerton & Co. have vacancies in London and the provinces. Sound commercial and technical training and experience essential, particularly as regards country house installations and factory equipment. Duties comprise general control estimating, inside and outside organisation and supervision, initiation of new business, and the attainment of prompt and efficient service.—Applications (in confidence) with scheduled particulars of previous experience, copies of two recent references, and photograph (if possible) to "R.," Mann, Egerton & Co, Ltd., 21, King Street, Norwich. 6211

POWER Station, Tramcar and Omnibus Rolling Stock Superintendent required for an extensive company system in the Midlands.—Apply, giving full particulars of experience, to 6167, Electrical Review, 4, Ludgate Hill, London.

REQUIRED, by well-known manufacturers of ironclad switchgear, Representative, commission only, already having connection south and south-east coasts.—2467, Electrical Review, 4, Ludgate Hill, London.

SALESMAN.—Representative wanted for the Midlands with good electrical engineering knowledge, capable of advising buyers and securing business. Preference will be given to man with sound connection. Applicants must state age, experience, and qualifications. If testimonials are enclosed, only copies should be sent.—6180, Electrical Review, 4, Ludgate Hill, London.

SITUATIONS VACANT.—*Continued.*

SECRETARY required for small Electric Lighting Company in West of England. Will be required to undertake general clerical work. Write, stating salary, 2481, Electrical Review, 4, Ludgate Hill, London.

SWITCHBOARD Attendant required, with experience of d.c. three-wire system. Experience with accumulators an advantage. 48 hour week. State wages required, and when disengaged.—6218, Electrical Review, 4, Ludgate Hill, London.

TRAVELLER for London and suburbs required by Wholesale Electrical firm Small salary and good commission. State experience and terms.—6232, Electrical Review, 4, Ludgate Hill, London.

TRAVELLER to handle side line; good commission. Samples weigh few ounces. State ground covered.—Box C. S. 3152, c/o Haddon's Advertising Offices, Salisbury Square, E.C.4. 6160

TRAVELLERS required to sell, upon commission only, very high-class enamelled and other insulated magnet wire, also all classes of special electrical conductors and moulded ebonite. Must have connection with large users and factors. Respective districts to be covered: Lancashire and Yorkshire, Newcastle and district, Glasgow and district, Birmingham and district, Bristol and South Wales. State fully experience and lines at present handling.—6221, Electrical Review, 4, Ludgate Hill, London.

WANTED, Commutator Builder, used to railway traction armatures (London district).—6051, Electrical Review, 4, Ludgate Hill, London.

WANTED, Driver with experience of Diesel and gas engines, able to undertake running repairs. 48 hour week. State wages required, and when disengaged.—6217, Electrical Review, 4, Ludgate Hill, London.

WANTED, energetic Commercial Engineer as Sales Manager, by London manufacturers of electrical instruments and heating appliances. Must be technically and commercially qualified.—Apply, stating age, experience, training, and remuneration required.—6187, Electrical Review, 4, Ludgate Hill, London.

APPOINTMENTS FILLED.

Dissatisfaction having been so often expressed that unsuccessful applicants are left in ignorance of the fact that the position applied for has been filled, may we suggest that advertisers notify us to that effect when they have arrived at a decision. We will then insert a notice free of charge under this heading.

COUNTY Borough of Croydon (Shift Charge Engineer).

SITUATIONS WANTED.

MINISTRY OF LABOUR.

The Proprietors of the Electrical Review have placed this space at the disposal of the District Director, Ministry of Labour, 3 and 4, Clement's Inn, Strand, W.C. 1, to whom all replies should be addressed, quoting number of advertisement, the date on which it appeared, and the name of this paper.

ELECTRICAL Engineer.—Age 23, single. Magneto expert and general electrical engineering. Tracing and correction of faults in car electrical equipment. General workshop practice. (52,964).

TRAINING Vacancy required in Mechanical Engineering. Age 25, Lieut., had two years' technical training Engineering Institute. Desires to complete. (52,767).

TRAINING Vacancy required in Electrical Engineering. Age 25, C.S.M., had 12 months training Sterling Telephone and Elec. Co., and 4 months theoretical training Science School, Dublin. Desires to complete. (70,503).

ELECTRICAL Engineer.—Age 24, single. Assistant Electrical Engineer. Mains department. Sub-station. Experience in 1100-V, 3-phase transforming down to 200-V for general supply. Laying of mains, and supplying light and power to consumers. Testing installations. (3538/21)

ELECTRICIAN or Motor Car Electrical Improver.—Age 21, single. City and Guilds Certificate. First-class magnetism and electricity, first-class telegraphy, and second-class telephony. Three years' experience in G.P.O. engineering department. Seven months as inspector in loading coil department of electrical company. (99,679.)

MANAGER Electrical firm.—Age 58, married. Naval Officer. 23 years' experience as assistant and general manager of electrical supply company. (356,914.)

ELECTRICAL Instrument Fitter and Wirer.—Age 22, single, Experience of Wireless Telegraphy with Mercantile Marine (54,328.)

WIRELESS Telegraphist.—Age 28, married. Two years' experience as above. Good knowledge of I.C. Engines, (53,745.)

SITUATIONS WANTED.—*Continued.*

MECHANICAL and Electrical Engineer.—Age 35, married. Motor Engineer, R.N. Served 2 years' apprenticeship to tramway company. Seven years' experience as Charge Engineer tramway company; six years as Chief Superintendent municipal tramways in South Africa. Thorough knowledge construction and maintenance of I.C. Engines, steam engines, turbines, &c. Willing to go abroad. (1451/21.)

ELECTRICAL Engineer.—Age 33, married, 2nd. Lieut. A.M.I.C.E. A.I.E.E., fluent French, Portuguese and Danish; three years' as pupil to cable company, going through all shops, five years' experience as outside superintendent, cables and overhead work. Ten months' experience erection of machinery and construction of works and starting production of light railway tracks, &c. (97,016.)

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

A CAPABLE Electrician, Foreman or otherwise. Out of London preferred. Good testimonials. 22 years' experience with plants, power, motors, telephones, house and factory wiring, estimating.—6, Bickerton Road, London N. 19. 2458

ACTIVE Electrician (Mechanical), generating plant, motors, wiring (all systems), complete installations, overhead, mains, country house, factory, institutions, seeks situation anywhere.—Morris, Lynchmead, Winscombe, Somerset. 2354

A DISABLED ex-Soldier (24), seeks situation, Storekeeper, &c., or would learn a trade, something in the electrical line. Good references, willing worker. Pre-war over two years' electric lighting and fitting. — 2324, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER (25), ex-service, seeks situation as electrician-improver or mate, used to lighting and bells. Good references.—2486, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER, seeks situation as chief draughtsman, 20 years' experience, mechanical and electrical with leading firms. Reasonable salary.—2327, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER, disengaged, 20 years' practical electrical experience, seeks progressive position, assistant manager, superintendent, progress, supervising, commercial, general, extensive experience in buying for large combine. — 2311, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER (19), practical and technical, City and Guilds exams., use to manufacture of switchboards, X-ray coils and apparatus, rectifiers, electric clocks, &c.—H., 202, Totterdown Street, Tooting. 2337

A FIRST-Class Electrician, charge or otherwise; references.—4, Squires Lane, Finchley. 2338

ALL-round Wireman, 20 years' experience, wants job, new installations or maintenance, charge or otherwise; nine years with suburban supply company.—"Electrician," 256, High Road, Willesden Green. 2494

AN Electrical Engineer ("Batti Wallah"), age 32, wants situation with prospects; all-round experience; initiative, organising ability, not afraid of work; non-Union; excellent references.—2370, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AN Electrician, plant, wiring, engines; any job; anywhere.—71, Kenthouse Road, S.E. 26. 2406

AN Improver seeks situation anywhere; age 18; three years' experience.—C. Averham, Gerrards Cross. 2297

A PRACTICAL Engineer and Electrician, 20 years' experience with d.c. dynamos, motors, 2 or 3 wire system, Lancashire and Babcock boilers, high speed engines, pumps, and auxiliary plant, gas and paraffin engines. Three years as charge engineer in municipal undertaking; can do all mechanical and electrical repairs, not afraid of work, will accept any position; age 39.—2253, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARMATURE Winder (Improver), 4 years' experience, seeks engagement.—2449, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARMATURE Winder, all types, repairs, maintenance, breakdowns.—J. E. K., 20, Kempshead Road, Camberwell. 2413

ARMATURE Winder; good experience, good references. Distance no object. Eight years' all round armature experience, a.c., d.c.; rewinds, repairs. Age 22. Would consider offer abroad. —A. Playbe, Myrtle Villa, Heybridge, Essex. 2484

ASSISTANT Electrician, wants work, power, lighting and 'phones, five years in the trade.—2493, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

BUYER or Manager, first-class commercial experience, shop and drawing office training, wide knowledge, used to detailed work, &c., desires change; age 40.—2372, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

COMPETENT Electrician-Mechanic seeks situation, wiring, all systems, repairs, power and private plants, charge or supervise, machine repairs, good references. — 2332, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS WANTED.—*Continued.*

ELECTRICAL and Mechanical Engineer employed with large contracting firm, requires spare time employment in a consulting or other capacity where his experience would prove useful. —2476, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL and telephone Engineer, with 30 years' experience seeks position in an installation contractors as manager or supervisor, used to all wiring systems and country house work.—2402, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (experienced), maintenance, power, lighting, installation, lifts.—"Electrician," 61, Grand Parade, Harringay, N.4. 2342

ELECTRICAL Engineer, now unemployed, is willing to prepare drawings and drafts for patents. Ordinary drawings and tracings; or to carry out any engineering work. Reasonable terms asked —2415, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, age 27, disengaged, experienced in switchgear, motors and power installations, has thorough technical and practical knowledge and speaks Portuguese and Spanish.—2393, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (G.I.E.E.), thoroughly trained (technically and commercially), many years' city experience, desires important and trustworthy position; fully conversant with motors a.c., d.c., &c., home and foreign buying and selling markets well known, possessing initiative, tact, exceptional administrative qualifications, and a gentleman of good address.—2423, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Fitter, Winder and Electrician, also lifts; 20 years' experience; references.—E. S., 34, Furnan Avenue, Walthamstow. 2403

ELECTRICIAN, all-round wireman, power and plant work, years experienced.—"Electrician," 31, Mason Street, Reading. 2404

ELECTRICIAN disengaged. All branches, charge or otherwise.—Martin, 69, Vant Road, Tooting, S.W. 2440

ELECTRICIAN, energetic, h.t., a.c., and d.c. power plant running and erection, switchboards, lighting, bells, &c. Age 22. Accept £5 per week wages.—2487, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN, competent and reliable mechanic seeks maintenance or other job.—"Electrician," 1, Crossley Terrace, N. 7. 2489

ELECTRICIAN, good reference, power, lighting, and 'phones, new installation or jobbing.—2492, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN, lighting, power, alarms, signs; any distance.—Robertson, 26, Rosebank Grove, Walthamstow. 2419

ELECTRICIAN seeks employment, maintenance or installation work. Any distance. — Salmon, 22, Stepney Green Dwellings, E. 2421

ELECTRICIAN, wiring all systems, motors, testing. Charge if required.—T. R., 6, Listria Park, N.16. 2429

ELECTRICIAN, thorough knowledge and experience, all descriptions erection, maintenance work. Good references —6, Tachbrook Road, Southall, Middlesex. 2400

ELECTRICIAN, practical and technical, seeks engagement. experienced in a.c. and d.c. work, country house plant, 'phones, &c.; 12 months motor test bed. Ex-corp. R.E., pre-war experience, aged 28; good references.—Burden, 14, Rosenthal Road, Catford. 2320

ELECTRICIAN, country house plant work, lighting or power; highest references.—"W," 81, Seventh Avenue, Manor Park, E.12. 2239

ELECTRICIAN, experienced; first-class references; any where —146, Westmoreland Road, Walworth. 2319

ELECTRICIAN, 12 years' experience (age 29), used to general contracting work, screwed tubing, plant work, &c.—E. C., 13, Moselle Avenue, Wood Green, N. 22. 2303

ELECTRICIAN wants job. Power and lighting, a.c. and d.c. Good all round. 14 years' experience. Go anywhere.—2457, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN, wireman, wants work. Lighting, power, maintenance, &c.—G. S., 46, Mayton Street, N.7. 2469

ELECTRICIAN-Wireman, competent all branches, country house work, plant and repairs.—J., 44, Chichester Road, Tonbridge. 2373

ELECTRICIAN-Wireman, good all-round hand, 20 years' experience, good refs.—D., 4, Rossetti Gardens, Chelsea. 2339

ELECTRICIAN-Wireman, plant and installation work, anywhere. —B. J. S., 20, Clarence Road, Tottenham, N. 15. 2352

ELECTRICIAN, 21 years' experience, power, A.C. and D.C., lighting and telephones. References.—2346, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN, thoroughly competent power, 'phones, lighting, overhead line construction; experienced with gas and oil engines: age 26; seeks responsible situation, home or abroad.—44, Belgrade Road, Stoke Newington. 2343

SITUATIONS WANTED.—*Continued.*

ENGINEERING Publicity.—Fully trained electrical engineer (32), versed in theory and practice, journalism, and all details of engineering publicity, is open to receive offer for services.—2127, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENGINEER and Works Manager, A.M.I.E.E., 1st class B. of T certificates, 18 years' experience h.t. modern London power station (five years as station superintendent), at present works manager of large expanded metal works in Western area, is desirous, for personal reasons, of returning to London district. Open to accept responsible position in either power station or manufacturing branch. Excellent testimonials from well-known power-station engineers. Exceptional experience in organising work, costs and handling men.—2381, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENGINEER-Draughtsman, young ex-Service, used to design of rheostats, general electrical apparatus ; workshop experience ; references —Odom, 8, Manor Gardens, Richmond. 2474

ENGINEER. Remarkable contracting and commercial experience, seeks responsible post, preferably commercial. London or abroad.—2360, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENGINEER, Electrical, Mechanical and Sales, 12 years' experience. Five years Royal Engineers. Thorough knowledge Rectifiers. Requires responsible position where hard worker with initiative is essential. First-class references.—2325, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FIRST-Class Engineer-Electrician, maintenance and erection, motors, lifts, &c., a.c. and d.c., seeks permanency. Charge of installation preferred.—2163, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

HAVING had the experience of Oil firing in U.S.A. would be willing to fill situation.—Percy Gilbert, Treeve, Hayle. 2418

IMPROVER, electrical experience in all branches, age 27, disengaged.—E. Pratt, 65, Holly Park Road, New Southgate, N. 11. 2500

IMPROVER, used to all class of conduit tubing, wiring, four years' experience.—2497, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

IMPROVER (20), just completed apprenticeship with dynamo and motor manufacturers, excellent reference, small repair shop preferred.—2308, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MAINTENANCE Electrician, thorough experience, seeks re-engagement.—Beveridge, 15, Delamere Terrace, W.2. 2416

MAINTENANCE or any other capacity. Who requires energetic man, 24 years. Late telephone factory and maintenance inspector. General electrical knowledge.—2501, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MILLWRIGHT Electrician, 16 years' experience, wants work ; large experience of power and factory maintenance, machinery repairs, &c. Top hole references. Low rate.—170, Standen Road, Wandsworth, S.W. 18. 2191

METER Repairer, 16 years' practical experience, with C.C., A.C. phase, and slot meters. Good electrical knowledge. excellent references. Age 38.—F. M., 12, Pentney Road, Balham, S.W. 12. 2350

ORGANISATION, Secretarial, &c. Young man (33) desires change. (A.C.I.S.). Book-keeping and accountancy, commercial and company law, shorthand, &c. Expert organiser. 13 years' first-class experience with leading electrical engineers.—2488, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PLUMBER-Jointer, experienced, disengaged, seeks progressive employment.—2316, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SALES Manager (or assistant). Good organiser ; up-to-date commercial and technical experience. Reasonable salary. Would go New Zealand or Canada—2470, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SMALL Premium to apprentice youth (17), 18 months' experience with electrical engineering firm.—M., 47, Glebe Road, Hornsey, N.8. 2450

TRAMWAY Smith, Fitter, used truck work bearings, shoeing.—Howard Groves, Staple, Canterbury. 2480

WIREMAN wants job. Any system.—Robinson, 5, Agincourt Road, Hampstead, N.W. 2351

WIREMAN, all branches, wants work.—4, Seaton Street, N.W.1. 2420

WIREMAN'S Assistant (20), four years' experience, requires situation. Disengaged.—Brooks, 16, Thornhill Road, N.1. 2436

WIREMAN disengaged. Experienced all branches—lighting, power, telephony, erection and maintenance. Go anywhere.—MacGregor, 63, Brewster Gardens, W. 10. 2482

WORKING Foreman (age 39), control extensive high-class contracts and maintenance, lighting, power, heating, telephones, fire alarms, bells, cranes, hoists, electric vehicles, complete country plants testing, fault finding, rectifying, estimate labour and materials, and prepare entire schemes, mansions, hospitals, cinemas, factories, paper mills, &c. London, country or abroad.—2353, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS WANTED.—*Continued.*

YOUNG Engineer, age 22, with 5½ years' practical, mechanical and electrical workshop experience, and with solid technical training, desires Junior Position with electrical engineer. Low salary until ability proven. Ripe for specialisation. London preferred, though not essential.—For particulars, write 2392, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

YOUTH (18½) requires sit ; 4 years' mechanical and electrical experience. Willing.—R., 17, Linden Avenue, N.W. 2411

AGENCIES.

Advertisements are inserted under this heading at 1s. 9d. per line.

LAMP AGENCY.

ONE of the oldest British Electric Lamp Companies, manufacturing both Carbon and Metal Filament Lamps, has vacant the district comprising the Counties of Norfolk, Suffolk, Cambridge, and part of Essex. Applications (which will be treated confidentially) from representatives having good trade connections, should be forwarded to—
6042, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

AUSTRALIA.

MANUFACTURERS desiring Connections and Trade are invited to communicate with W. G. WATSON & Co., LTD., Electrical Engineers and Merchants, 279, Clarence Street, Sydney, N.S.W. Cable Address : "Switchon, Sydney." London Representatives : MURRAY-COOMBES & RICHARDS, 150, Southampton Row, W.C. 1.

Manufacturers desiring

REPRESENTATIVES IN AUSTRALIA

are invited to communicate with :—

H. ROWE & Co., Electrical Engineers and Importers,
Head Office : 507, Flinders Street, Melbourne,
Australia. 6230

A FIRM of Electrical and Mechanical Engineers, recently reorganised, established for over 16 years, having extensive connection in Scotland, with offices and warehouses in Glasgow, desire additional agencies preferably cable, motors, conduit, switchgear and heating appliances—2472, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCY.—The Victoria Electrical Co., of 27, Berry Street, Manchester, sole agents for the British Empire of V.E.C. Dutch made half Watt type and drawn wire lamps, are prepared to appoint agents in all principal towns of the United Kingdom. Exceptional terms. Corporations, large consumers, and factors supplied from stock. Write for particulars. 2250

AGENCY Required for South Wales to represent well-known manufactures of Ironclad Switchgear. Only applicants who have already established connection can be considered.—2468, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENT wanted in Lancashire for moulded insulators, must be first-class man with good connection in electrical trade.—6186, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENTS wanted to represent an old-established Firm manufacturing Overhead Electric Travelling Cranes, Electric Telphers, Monorail Hoists, Pulley Blocks, Winches, &c. Countries available for allotment to representatives of good connection : Norway, Sweden, Russia.—Full particulars to 6210, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOREIGN Agencies or Agents quickly obtained by advertising in foreign papers.—Rates, &c., from Deacon's British and Foreign Advertising Agency, 7, Leadenhall Street, London, E.C. 3. 5846

METALLIC Filament Lamps.—Established firms wanted to act as distributing agents in every county in Great Britain. Firms appointed will be granted sole agency in their respective counties.—Write Z. Y. 751, care Deacons, 7, Leadenhall Street, E.C. 2471

SOLE London Agencies for electrical goods, required by experienced representative.—Howard, 42 Braxter Park, Streatham, S.W. 2499

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Advertisements are inserted under this heading at 1s. 9d. per line.

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A. LEAROYD & SON, Bridge Works, Clapton, N.E.—Telephone : Dalston 2278 ; Telegrams : "Frangible, Lowclap, London," buys for prompt cash every description of second-hand Generating Sets, Accumulators, Motors, Transformers, old Arc Lamps, Meters, Cable Scrap Metals, Metallic Drosses, &c., &c. Inquiries solicited. Established over 50 years. 1776

ARTICLES WANTED.—*Continued.*

D.C. Generator wanted, 350 kW, 440 volts, 340 r.p.m., 3-phase, 50 cycles. State type, condition and price.—6046, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PLATINUM Scrap wanted for cash; the highest market price given. Call, or parcel by post, prompt cash by return.—L. Stern, Rotunda Buildings, 5, Bold Street, Liverpool. 2241

REQUIRED, bridge-megger, post office pattern, complete with resistances.—6128, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, two sets each 250 to 300-kW, 220 volts, d.c., with Belliss or Browett engines. — Particulars and price to Walker, 2, Oswald Street, Glasgow. 6099

WANTED, Electrical Sets, all sizes, boilers, accumulators dynamos, motors, &c.; also scrap cable and metals. Complete plants purchased.—Williams & Sons, 37, Queen Victoria Street, London, E.C. 4. Telephones: 3938 City and 834 Hop. 8574

WANTED, good second-hand Alternator, 400 V, 2-phase, 50 periods, about 40 to 60 kW; either belt-driven or direct-coupled to steam or oil engine.—All particulars, stating lowest price and where can be seen, to 2466, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Semi-Diesel Oil Engine, 150 to 200 b.h.p., direct-coupled to 100-kW (approx.) generator, voltage 220/250.—Full particlulars to 6183, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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WANTED 0·5 and 0·6 in., 1 in. V.I.R., or paper, cable.—Milne and Phillips, 78, High Street, Birmingham. 2479

WANTED, 2 or 3 Alternators for direct-coupling 400/600 kVA; 3-phase, 50 periods, 333 or 375 r.p.m.; voltage immaterial. Full particulars and price.—6198, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

25 TO 50 h.p. Semi-Diesel Vertical Engine, direct coupled to 200 volt, 50 cycle, single phase generator, or would consider separately.—Morse & Taylor, 124, Victoria Street, London, S.W.1. 6208

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ELECTRIC Light for country houses. Manufacturers of dynamo switch boxes and batteries. Please communicate with selling agents of 5 h.p. engine for farm work, &c.—Address "Electric," Wm. Porteous & Co., Advertising Agents, Glasgow. 2496

ELECTRICAL Washing Machine wanted. State make, price and particulars.—6162, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

LIBERAL commission paid by established London Electrical Engineering Co., for introduction of business (installation work), town or country.—Write in confidence, 2490, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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WANTED, Generator, compd., 200 volt approx., 12-kW, moderate speed, with slides and shunt regulator.—Full particulars and price to T. H. Wathes & Co., Ltd., High Street, Leicester. 2452

WANTED, one Single-phase Motor, 100 volts, 83 cycles, 10 or 12-h.p., with starter. — 6173, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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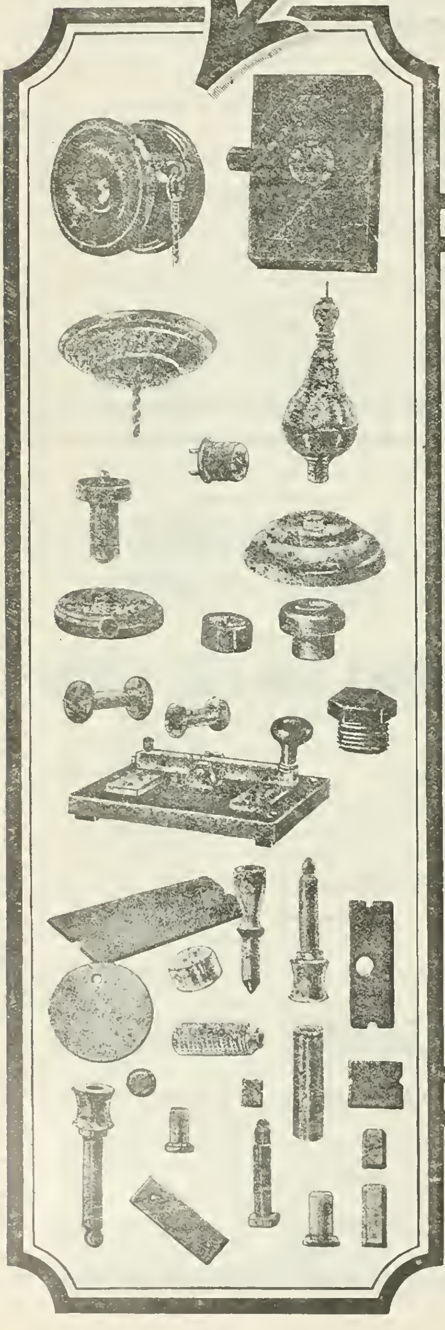

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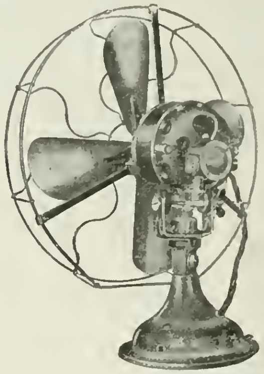

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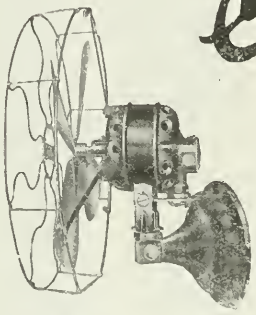

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Telephone: City 4358 Telegrams: "Autosyncro, Manchester."
Birmingham Branch: Daimler House, Paradise Street.
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Scottish Agent: J. Hally Craig, 45, Hope St., Glasgow.
Telephone: Central 793. Telegrams: "Halcra, Glasgow."
Wales: Witty & Wyatt, 5, Burt St., Clarence Rd., Cardiff.
Telephone: Cardiff 232. Telegrams: "Whitwy, Cardiff."

Newcastle-on-Tyne: E. Angus Leybourne, Cathedral Buildings.
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Nottingham: The Electrical Stores (Nottingham) Ltd.
35, 37, 39, South Sherwood Street, Nottingham.
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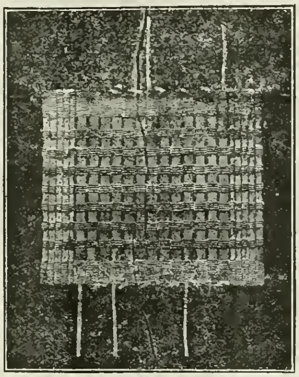

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PORTABLE ELECTRIC BLOWER.

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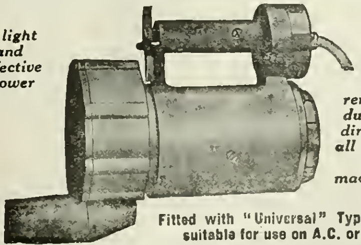

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have acquired the whole of the surplus X-Ray and Electro-Medical Stores of the

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They are therefore able to offer apparatus by the best makers at a fraction of current prices. The apparatus has been re-conditioned, and is therefore guaranteed to be in

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The Stocks comprise:

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Complete X-Ray Installations, with Accessories ... ... from	115	0	0
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OFFICIAL NOTICES.

Latest Time for receiving, 5 p.m. Wednesday.

Advertisements are inserted under this heading at 10s. per inch.

COMMONWEALTH OF AUSTRALIA.

Postmaster-General's Department.

TENDERS are invited up to July 11th, 1921, for the supply and delivery to the Postmaster-General's Department, State of Tasmania, of Switchboard Material generally, as per Schedule T 317.

Specifications, tender forms, &c., can be obtained at the Office of the High Commissioner for Australia, Room E 5, Australia House, Strand, W.C. 2. 5976

GEORGE H. WISE,
Postmaster-General.

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Reply to 6172, Electrical Review, 4, Ludgate Hill, London, E.C. 4.

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Electricity Department.

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Section "B."—Low Tension d.c. Board.

Section "C."—Rotary Converters and Starting Gear.

Full particulars and specification may be obtained on application to Mr. F. Garside, Electricity Works, Laburnam Road, Aldershot.

Tenders, sealed and suitably endorsed, are to be sent to the Clerk to the Council, D. Llewellyn Griffiths, Esq., Municipal Buildings, Grosvenor Road, Aldershot, not later than Tuesday, June 5th, next. 6165

RHYL URBAN DISTRICT COUNCIL.

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1,000 yards or thereabouts of .3 by .3 by .15 Low Tension Cable.

One 5-way Feeder Pillar for above.

Switchboard Panel and Gear for above.

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The Council do not bind themselves to accept the lowest or any Tender.

T. AMOS JONES,
Clerk to the Council.

Council Offices,
Clwyd Street, Rhyl. 6209

LONDON COUNTY COUNCIL.

TENDERS are invited for the supply and laying of h.t. Electric Cables, &c.

The Specification, form of tender, and general conditions may be obtained from the Clerk of the Council, County Hall, Spring Gardens, S.W. 1, on payment of a deposit of £2 to the Cashier of the Council, which amount will be refunded on receipt of a *bona-fide* tender.

Tenders should be addressed to the Clerk of the Council, and delivered to the County Hall, Spring Gardens, S.W. 1, not later than four p.m. on Monday, July 11th, 1921. Any tender received after that time will not be considered.

The Council does not bind itself to accept the lowest or any tender.

JAMES BIRD,
Clerk of the London County Council.
6216

NOTICES RELATING TO PATENTS.

Latest Time for receiving, 5 p.m. Wednesday.

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Associate of the Institution of Automobile Engineers, Associate Inst. [illegible] E., C.P.A., F.C.S.
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5, CORPORATION STREET, BIRMINGHAM.

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Watsham's

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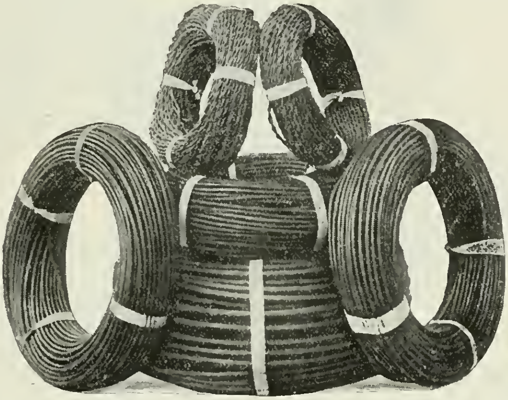

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1/·036	4	17	6	8	11	7
1/·044	5	13	1	9	19	1
3/·029	7	2	9	12	11	4
3/·036	9	3	8	16	3	3
7/·029	11	13	4	20	10	8
7/·036	16	8	8	28	18	7
7/·044	21	18	1	38	11	2
7/·052	29	3	2	51	6	5
7/·064	40	14	10	71	14	1
19/·052	64	6	7	113	4	4
19/·064	92	15	10	163	6	2
19/·072	109	16	10	193	6	6
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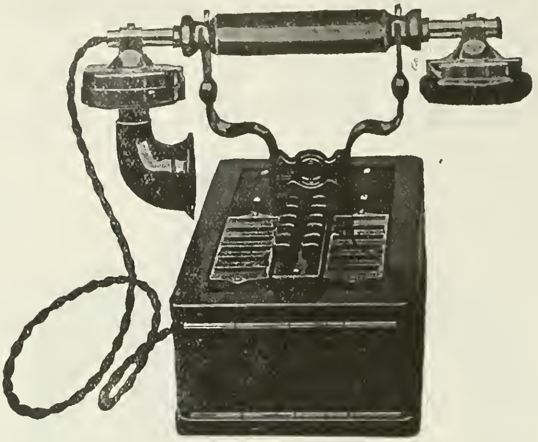

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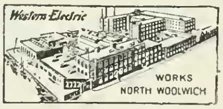

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All Sizes up to 300 H.P.
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Manchester: 54, Corporation Street.
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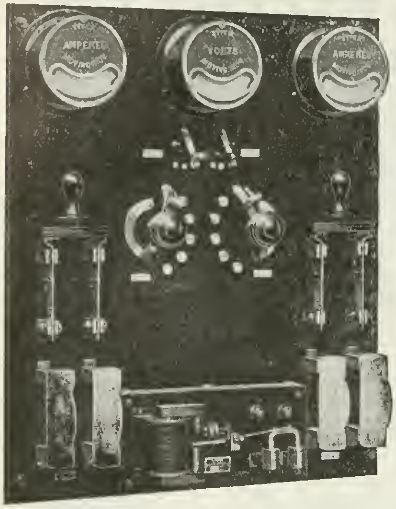

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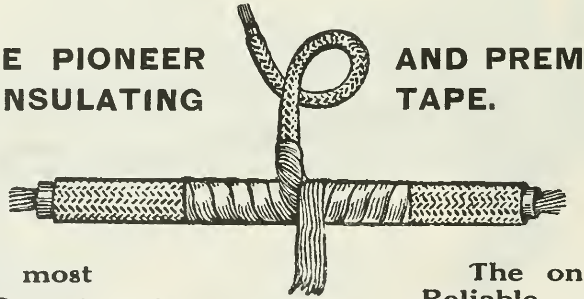

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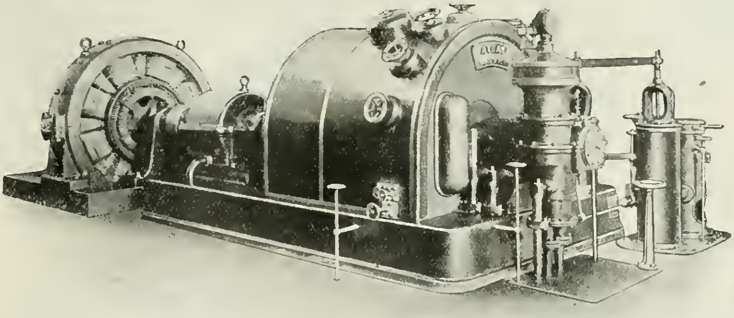
Sizes up to 10,000 KW.



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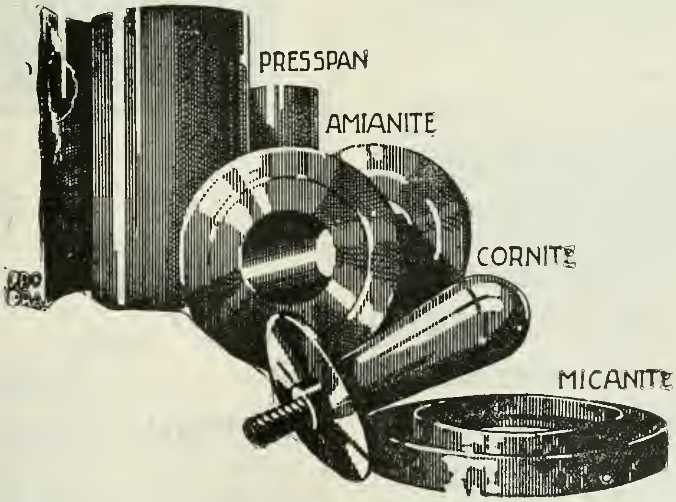

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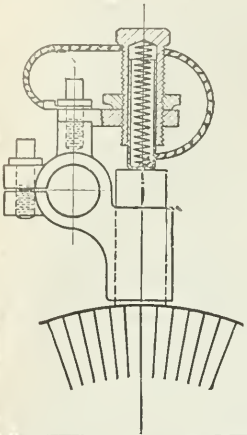

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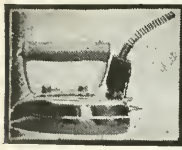

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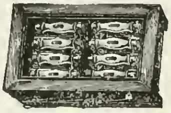

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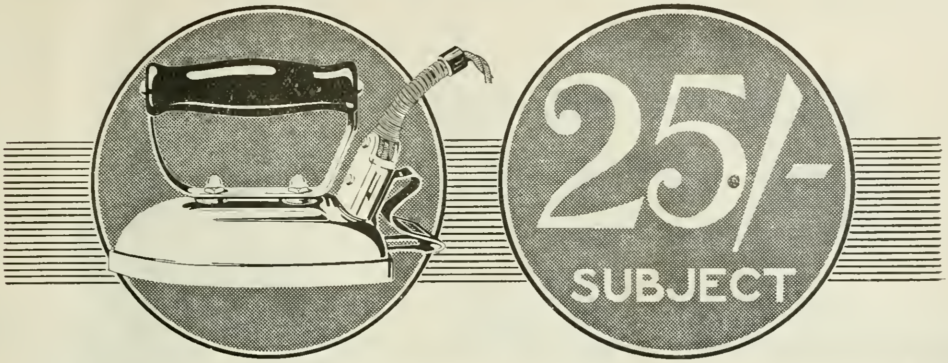

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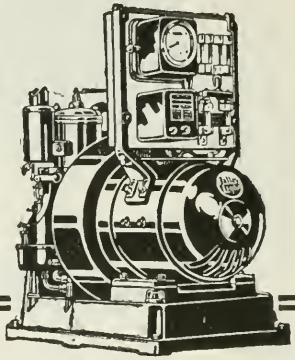

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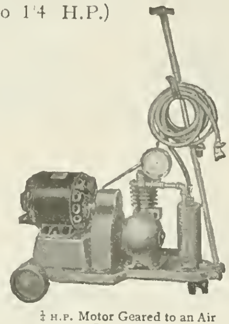

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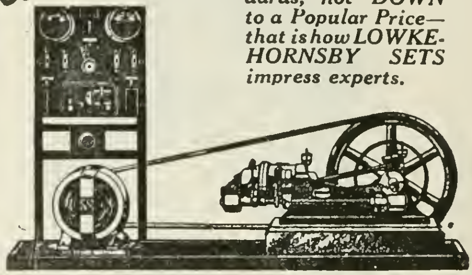

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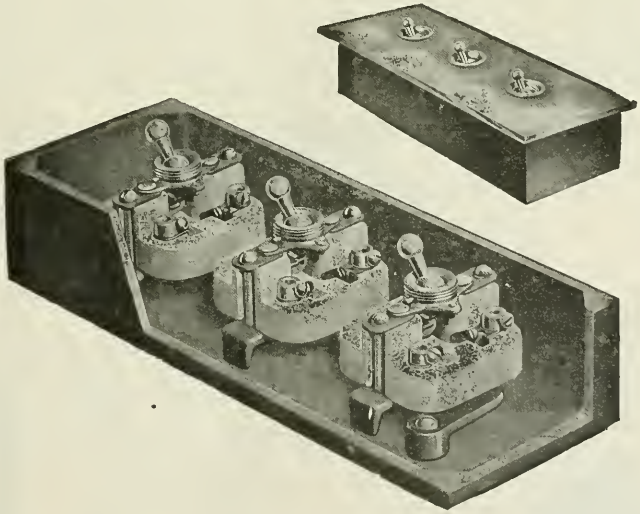

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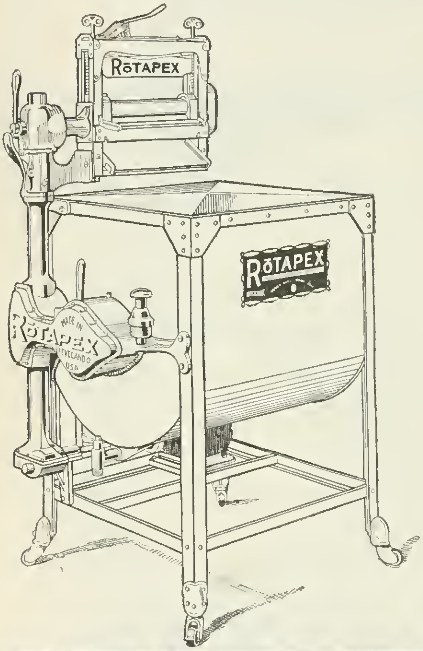

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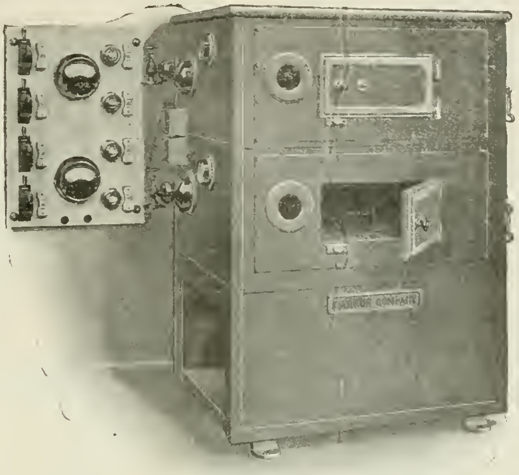

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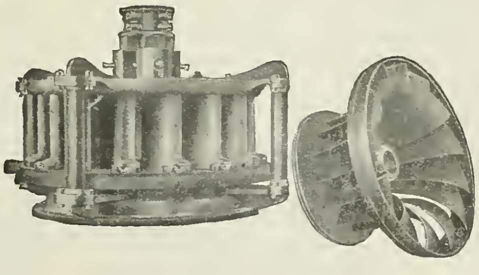

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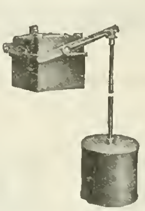

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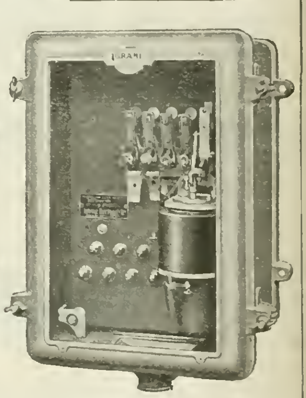

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Middlesbrough.—Temporary Price Increase.—The Cleveland and Durham County Electric Power Co. has asked the Middlesbrough Corporation to agree to an additional charge of ½d. per unit on a proportion of the units supplied, to cover the cost of oil firing during the present coal shortage. This has been agreed to, and the charge will be increased to consumers by a corresponding amount on the expiration of the present quarter.

New Zealand.—Thames Valley.—Paeroa is the first town in New Zealand to obtain electric light through the operation of the Electric Power Boards Act of 1918. The power is derived from Horahora, the controlling body being the Thames Valley Electric Power Board. This Board was gazetted in February, 1920, and, as a preliminary, it was decided to obtain power to borrow £200,000 for reticulating the district. The consulting engineers to the Board realised that the cost of reticulation would greatly exceed this sum. They considered it might be in the neighbourhood of £500,000, but they were not prepared to give definite figures until a thorough investigation of the district had been carried out. This investigation has now been made, and the engineers estimate the total cost of the scheme at £514,000, exclusive of interest during construction. They consider the work can be completed in from five to six years. The annual revenue is estimated at £93,000, and total annual expenditure at £88,000. These figures are based on a canvass of the district carried out in April and May, 1920. The maximum demand will be in the neighbourhood of 3,000 kW.—*Auckland Weekly News.*

Progress of Works.—The *Auckland Weekly News* says that the Lake Coleridge station, which supplies Christchurch and Canterbury, is being extended as rapidly as possible by the diversion of additional water and an increase of plant. It is hoped shortly to be able to meet the demand, and also to supply the power demanded by South Canterbury. To supply Dunedin 8,000 h.p. is being developed at Waipori, and arrangements have been made to double this output. It has been considered inadvisable to proceed with works on Lake Hawea and Wanaka for the present. Another Southland project is the development of power at Monowai; owing to financial stringency the Government has had to assist this scheme with a guarantee.

Oldham.—Inferior Coal.—For the past fortnight the cost of coal per unit sold by the Corporation electricity works has been 1·77d., as compared with 0·70d. for the corresponding period of last year, the difference being largely due to the very poor quality of coal now being supplied.

Preston.—Purchase of Undertaking.—During the hearing, in London, of an application by the National Electric Supply Co., Ltd., for sanction to a scheme of distributing profits and assets between the various classes of shareholders, in consequence of the sale of the Preston undertaking to the Corporation, it was stated that the price of purchase was £266,000, £61,000 of which would be paid in cash and £205,000 in mortgage bonds secured on the rates.

Rathmines (Dublin).—Strike Ended.—The electricity supply service has been resumed, on the settlement of the municipal employés' five weeks' strike on a wage issue.

Shanghai.—Year's Working.—The annual report of the engineer-in-chief and manager of the municipal electricity department for the year ended December 31st, 1920, has just come to hand. It is interesting to recall the fact that the lay-out and design of the power and sub-stations, distribution system, and in fact everything connected with the undertaking, is planned in the department's offices at Shanghai, and that the selection of tenders by the Electricity Committee is made solely upon the recommendation of Mr. T. H. U. Aldridge, M.I.E.E., &c.; the European staff numbers 105, and the Chinese 2,207. Financially, the year's business has resulted, after providing for interest (Tls. 464 306), and depreciation (Tls. 575,816), in a net profit of Tls. 781,916, which will be appropriated as follows:—Contribution to the municipal general funds, Tls. 630,000; transfer to general reserve, Tls. 72,800; transfer to contribution to general funds (equalisation account), Tls. 78,200, the balance (Tls. 916) being carried forward. The gross profit on the revenue account is Tls. 1,290,121, which represents 10·34 per cent. on the undertaking's capital outlay, and the estimated net profit for 1921 is Tls. 1,029,816. It is regrettable that after having taken steps to procure additional generating plant to meet the increasing demand, the delayed delivery by many months of the 42-in. circulating water-pipes should have prevented the use of the first of the two new 18,000-kW turbines. The operative plant capacity of the generating stations on December 31st, 1920, was the same as at the end of 1919, viz., Riverside station, 33,000 kW, and Fearon Road station 5,600 kW. A 10,000-kW turbo-generator, built by Messrs. C. A. Parsons & Co., was put into service in April in the Riverside station, and would normally have increased the plant capacity, but in March the No. 3 5,000-kW A.E.G. machine broke down, and the other machine (No. 4) of the same make and size failed in April. The first was repaired and in service again in July, but broke down a second time in September; both sets being then unfit for further service were scrapped. The loss of these two machines prevented the long-overdue overhaul of the G.E. Co. 10,000-kW set (No. 5), which during 1920 ran practically continuously every day throughout the year. First put into commission in September, 1917, it was out of service for only 34 days up to the end of October, 1919. Adverse conditions frustrated the hopes of materially reducing the cost of production during the year, and made it necessary to restrict the output to new consumers by some 4,000 kW. A testing department has been started at the power station under the direction of a fully qualified analytical chemist, and the plant additions, which will be available for use in 1921, consist of two 18,000-kW turbo-generators, with condensers already installed, and one 10,000-kW machine, all built by the G.E. Co. Two Babcock & Wilcox, and two Stirling 80,000-lb. boilers, with mechanical stokers, were ordered in 1919, but the delivery promises were not fulfilled. The maximum load was 36,712 kW, and the load factor improved to 46·7 per cent. The total kWh generated amounted to 179,619,458, and those sold to 144,539,632, an increase of 41·2 per cent., made up as follows:—Private lighting, 20,298,672, an increase of 23·93 per cent.; public lighting, 1,454,812, an increase of 21·9 per cent.; heating and cooking, 1,240,136, an increase of 30 per cent.; power, 116,839,147, an increase of 46·71 per cent.; and traction, 4,706,865, an increase of 12·3 per cent. The ability of the department to meet unprecedented demands for power has been seriously in question upon several occasions during the year, owing to non-delivery of plant long overdue Recent contracts placed in Great Britain amount to £504,026, and in the U.S.A. to 676,792 gold dollars.

Southampton.—Supply to Itchen.—In a report to the Town Council upon the question of supplying electricity to Itchen, the electrical engineer states that it will be necessary to dredge a trench across the river in which the cables will be laid, the trench afterwards being filled in naturally by the silt. The estimated cost of the supply is £25,000, and it is recommended that the scheme be proceeded with as soon as a sufficient number of residents in Itchen signify their desire to take a supply.

Swansea.—Closing of Dock.—The Swansea Harbour Trustees have written to the Corporation intimating that unless the Corporation contributes to the establishment and other charges incurred by the North Dock, this dock will be closed, as the reduced state of the traffic dealt with does not justify its being kept open. The Corporation derives its water for condensing purposes from this dock, but the Electricity Committee points out that as much water is returned as is taken out, and it costs the Trustees nothing. The Trustees' request is therefore considered preposterous.

Wallasey.—Breakdowns.—Last week there were three more electricity failures at Wallasey, resulting in the stoppage of the electric tramway service, once on Wednesday and twice on Thursday. The explanations given for the stoppages are—a faulty boiler tube, shortage of oil, and the poor quality of the fuel.

Wolverhampton.—Alterations, &c.—The Electricity Committee has authorised the electrical engineer to carry out by direct labour certain alterations to the building in Commercial Road, previously used as a store, in order to convert it into a substation to contain the seven large transformer units required to give a bulk supply to the Midland Electric Corporation, Ltd., and the Cannock Urban District Council, at an estimated cost of £487. In order to give a supply of electricity to the 225 houses to be erected at Parkfield Road, under the Housing Scheme for the Borough, and also to provide for the lighting of the streets in this district, authority was given for the laying of the necessary mains, &c., at an estimated cost of £3,203.

Worksop.—Electricity for Waterworks.—It has been decided to install electric motors in the place of the existing steam engines to drive the pumps at the waterworks.

TRAMWAY AND RAILWAY NOTES.

Barrow.—Loan.—Application is being made by the Town Council for sanction to borrow £16,000 for additional car accommodation, including the purchase of land, &c. New points and crossings are being purchased at a cost of £2,800.

Cardiff.—Proposed Fare Revision.—Owing to the losses incurred by the tramway undertaking, the City Council is considering the revision of fares at a special meeting.

Chadderton.—Application for Time Extension.—The Urban District Council has agreed to join in a memorial to the Ministry of Transport, asking for an extension of two years in the time for the proposed extension of the tramways to the Butler Green district.

Continental.—Belgium.—The Société Bruxelloise d'Electricité is in negotiation with the Belgian State Railway authorities with reference to the supply of the necessary power for the part of the Brussels-Antwerp Railway which is being electrified.

Spain.—A concession has been granted to the Sociedad-Anonima Tranvia Central de Asturias for an electric line from Oviedo to Posada de Llanesa, and an electric tramway system at Oviedo.—*Reuter's Trade Service* (Madrid).

Halifax.—Track Renewals Approved.—At the Town Council meeting, last week, it was reported that the Ministry of Transport had sanctioned the doubling of the tramway track between Holly Bank Road and Thornhill Road, and the meeting approved the action of the chairman and deputy chairman of the Committee in authorising the work to proceed day and night in order to provide work for the unemployed.

Hull.—Oil Fuel.—The general manager and engineer of the Corporation tramways gives some interesting information regarding the use of oil fuel in an article contributed to the

Tramway and Railway World. A sufficient number of boilers to take the whole of the tramway load was equipped with gravity-fed burners with oil jets, arranged in the centre of steam jets. The oil used is Mexican residual with a specific gravity of ·987, and a calorific value of 18.750 B.th.u. per ton—the cost is £5 5s. per ton. A fortnight's working gave the following results, which are compared with the results from the use of coal. Oil fuel :—232 tons ; units generated, 238,865 ; lb. of fuel per unit generated, 2·17 ; cost of fuel per unit generated, 1·223d. For coal :—384 tons ; units generated, 238,865 ; lb. of fuel per unit generated, 3·6 ; total cost per unit generated (coal only), ·860d. The cost of converting four boilers was £300.

Jamaica.—RAILWAY ELECTRIFICATION DEFERRED.—The Kingston correspondent of *The Times Trade Supplement* states that the scheme for the electrification of the Jamaica Railway has been shelved owing to the question of cost. It would involve an expenditure of £2,000,000, and this, the Governor has informed the Legislature, is beyond the resources of the colony. The Council has sanctioned the further relaying of the Jamaica Railway, to enable surveys to be carried out in areas where the inhabitants are pressing for railway extension and bridge construction. The surveys will embrace at least four sections of the island.

Leeds.—YEAR'S WORKING.—The accounts of the Corporation tramway department for the year ended March 31st last show a total revenue from all sources of £995,636, as compared with £876,526 for 1919-20. Working expenses totalled £729,385, as against £606,347, leaving a gross profit of £266,251, a slight decrease on the previous year's figure—£270,179. After crediting bank interest, &c., and deducting loan interest and other capital charges, the result was a net profit of £5,580, a considerable fall from the profit of £83 757 realised in the previous year. This was occasioned chiefly by the heavy expenditure upon track renewals, which amounted to over £100,000. The number of car-miles run showed an increase of 2·98 per cent., being 10,176,874.

London. — AN UNDERGROUND STOPPAGE.—With the exception of the Central London Railway, the whole of London's underground railway services were held up on the evening of June 18th for half-an-hour. A shortage of steam occurred at 6.25 p.m. at the Lots Road power station, Chelsea, and this caused the power to fail. Many trains were stranded in the tunnels. By 6.55 p.m. the pressure was restored. The loss of pressure was understood to be due to the indifferent quality of the coal in use at the generating station. Ten of the 50 boilers generally working at Lots Road have been adapted to burn oil fuel, but these, it was reported, were not responsible for the delay.—*The Times.*

OIL FUEL AT GREENWICH.—It is stated that two boilers have been equipped for burning oil fuel, and that two others are in process of conversion at the L.C.C.'s Greenwich power station. The total estimated cost, including pipe-lines, is £4,200.

Sunderland.—NEW CARS.—The Corporation has purchased 12 saloon-deck and vestibule tramcars from the English Electric Co., Ltd., Preston. It is 14 years since the Tramways Committee bought any cars, so that these cars represent a considerable advance on anything that the town possesses. Two of the vehicles were put into service last week, and the remaining 10 will appear in a short time. These cars are fitted up with front exits, and a number of other cars are being arranged similarly, the authorities considering this a distinct advantage over the old types.

Westmorland.—PROPOSED MOUNTAIN RAILWAY.—The County Councils of Westmorland and Cumberland have received from Mountain Railways, Ltd., proposals for the construction of an electric railway from Ambleside to Keswick—a distance of 16½ miles. The estimated cost of the scheme is £150,000, and it is proposed to make the line of standard gauge, to enable the trains to run in conjunction with the London and North-Western system. A great deal of opposition has been incurred by the proposals.

Wolverhampton.—FARE REVISION.—On March 14th the Town Council decided to apply to the Minister of Transport for an order modifying the statutory provision regulating the charges to be made for passengers on the Corporation tramways. An interim order has been issued enabling the Corporation to charge—for the conveyance of passengers other than artisans, merchants, and daily labourers—fares not exceeding 1½d. per mile, or portion thereof, and for the conveyance of artisans, mechanics, and daily labourers' fares not exceeding 1d. per mile, or portion thereof.

TELEGRAPH AND TELEPHONE NOTES.

Cable Interruptions.—The earth tremors which were recently experienced in the Sydney, N.S.W., suburbs, occurred again on June 17th. By a singular coincidence, and the second time within the past few days, the Eastern Extension Telegraph Co.'s cable service has been seriously interrupted. In response to inquiries on the subject, one of the company's officials said that the seriousness of the breakdown seemed almost to suggest the occurrence of a "submarine earthquake," all the company's Red Sea lines having suffered.—*Reuter's Trade Service* (Sydney, N.S.W.).

Russia.—TELEGRAPH SERVICE TO BE REOPENED.—The Copenhagen correspondent of the *Morning Post* states that at the Great Northern Telegraph Co.'s general meeting it was stated that negotiations concerning the reopening of the Russian cable service will soon be completed. The Petrograd station, of which all the instruments are intact, will then be reopened, and the stations served by the Russian land lines *via* Irkutsk and Vladivostock will be able to communicate with Europe and Eastern Asia.

The Post Office.—ADVISORY COMMITTEE.—The Post Office Business Advisory Committee met on June 15th, for the first time, when the Postmaster-General (Mr. Kellaway) took the chair, and 17 out of 19 members were present. Members of the Committee were told a good deal about the administration of the Post Office, and there was an informal discussion on general matters, especially telephones and telegraphs. The Committee, which will meet again shortly to plan its scheme of work, has been instituted to advise the Postmaster-General on the steps to be taken to give an efficient service at less than the present rates.

U.S.A.—TELEGRAPHIC ERRORS.—The contentions of the Western Union Telegraph Co., that it cannot be held liable for damages caused through errors in transmitting messages while its lines were under Government control, have been upheld by the Supreme Court, and a decision of the South Carolina Courts awarding damages to Mr. S. B. Poston, a cotton dealer, on this ground was reversed.—*Manchester Guardian.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aldershot.—July 2nd. Urban District Council. Electric light wiring, Park housing scheme. F. Garside, electrical engineer.

July 5th. Urban District Council. Electricity Department. E.h.p. switchgear ; l.p., d.c. switchboard, rotary converters and starting gear. (See this issue.)

Australia. — MELBOURNE. — August 10th. Victorian Railways. 250 core-type impedance bonds for power signalling, with a capacity of 1,000 amperes per rail ; also 50 miles of solid insulated copper wire, No. 14 Brown & Sharpe gauge, and 50 miles of solid insulated copper wire, 16 standard gauge.

July 27th. Victorian Railways. Incandescent lamps for electric car lighting : 24,000 metal filament, 46 W, 116 V ; 4,000 carbon filament, 32 W, 140 V. 5-h.p. electric motor, controller and resistances, or, alternatively, 5-h.p. electric motor and equipment.*

August 17th. 3,000 sets of renewals for caustic soda primary cells.

August 30th. Board of Works. Four electrical centrifugal pumps, each with a capacity of twelve million gallons daily.

September 7th. Victorian Railways. Sixteen sets of air-brake equipment, 450 to 600 V, d.c., for single-deck tramcars.—*Reuter's Trade Service* (Melbourne).

SHIRE OF HAMPDEN (VICTORIA).—August 17th. Boiler-house plant, steam-driven electricity generators, transformers, meters, switchgear, cables, poles. Specifications from Mr. H. C. Ingleton, Shire Hall, Camperdown, Victoria.—*Tenders.*

Edinburgh.—July 11th. Electricity Supply Department. H.p. steam pipes and valves. Specification 33. (June 17th.)

Glasgow.—June 27th. Electric lighting work at the extension to the administrative building at Lightburn Hospital, near Shettleston. Mr. Jas. A. McCallum, Clerk to the Committee, 15, West George Street, Glasgow.

Liverpool.—June 25th. Electric supplies for the West Derby Board of Guardians. H. P. Cleaver, Clerk, Brougham Terrace.

London.—L.C.C. July 11th. Supply and laying h.p. electric cables, &c. (See this issue.)

L.C.C.—July 11th. One 8,000-kW steam turbo-alternator and exciter, condensing plant, &c. ; seven 1,000-kW rotary converters, static transformers and accessories. (June 10th.)

Manchester.—June 28th. Electricity Committee. Supply of cable requirements during six months ending December 31st, 1921. Mr. F. E Hughes, Secretary, Electricity Department, Town Hall, Manchester.

June 28th. Electricity Department. 27,000 yards weldless-steel spigot and socket tubes. (June 17th.)

New Zealand. — WELLINGTON. — August 9th. Public Works Department. Suspension-type porcelain insulators for the Waikato power scheme.*

Rhyl.—July 9th. Urban District Council. Electricity Department. 1,000 yd. ·3 × ·3 × ·15 l.p. cable, 1-5-way feeder pillar switchboard panel and gear. (See this issue.)

South Africa.—July 5th. Electrification of Capetown-Simonstown and Durban-Maritzburg railway lines.

Transvaal.—Rand Water Board. September 9th. Erection of a complete installation of mechanical or other filters capable of filtering 5½ million gallons of water per 24 hours at the Vereeniging main pumping Station (Contract No. 232). Copies of the contract documents may be obtained from the Chief Engineer, Rand Water Board, Johannesburg, upon a deposit of three guineas.*

Barberton.—July 29th. Municipal Council. Plant in connection with the proposed scheme for the supply of electricity :—Two steam boilers, two 75-kW steam-driven alternators, switchboard, and instruments, steel chimney piping, feed pumps, cables, &c., steel poles, conductors, &c., transformers, house service meters, &c. Specifications, £2 2s., from Prof. W. Buchanan, 75, Louis Botha Avenue, Johannesburg.

Uruguay.—Monte Video.—August 18th. State Electricity Works. Steel petroleum tank, Worthington duplex steam pump for oil, 250 metres steel tubing.*

September 3rd. The Commercial Secretary to His Majesty's Legation at Monte Video reports by cable to the Department of Overseas Trade, that the local authorities are advertising for tenders for the supply of 59.250 metallic-filament lamps of assorted sizes, from 10 to 300 c.p., 225 volts, which are required by the State Power House.

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Aldershot.—Urban District Council :—

Single-wire armoured cable, for bulk supply of electricity, £5,476.—Callender's Cable and Construction Co., Ltd.

Australia.—The Victorian Electricity Commission has accepted Messrs. Babcock & Wilcox's tender of £178,000 for the complete installation of boiler plant at the Newport power house. It is expected that a substantial portion of the tender money will be expended locally.—*Reuter's Trade Service* (Melbourne).

Ayr.—Town Council. Electric light installation, 40 houses, G. Gillanders, Glasgow.

Barnes.—Fire Brigade and Lighting Committee. Recommended :—

Twelve months' supply current limiters.—Electric Utilities, Ltd.

Birmingham.—Messrs. F. Hogg & Co., of Smethwick, have received the contracts for electrical installations for the Park Road Congregational Church and Schools at Aston, and the Wesleyan Methodist Church and Schools, at Smethwick.

Glasgow.—Electricity Committee :—

Cables for 12 months.—Callender's Cable & Construction Co., Ltd.; Enfield Ediswan Cable Works, Ltd.; W. T. Glover & Co., Ltd.; General Electric Co., Ltd.
Meters for 12 months.—Edison Swan Electric Co., Ltd.; Ferranti, Ltd.; Chamberlain & Hookham; Metropolitan-Vickers Electrical Co., Ltd.
Crane and grab for the Dalmarnock power station, £1,064.—W. Morgan and Co., Ltd.
Two overhead travelling cranes. £3,540.—Sir W. Arrol & Co., Ltd.
Rotary converters.—British Thomson-Houston Co. (£9,300) and General Electric Co., Ltd. (£9,074), each for one set.
Transformers, £1,556.—Metropolitan-Vickers Electrical Co., Ltd.

Town Council. Accepted :—

Electrical work in connection with the Municipal Buildings, £6,911.—Johnston, Park & Co.
Electric lighting at Knightswood Hospital.—W. C. Martin & Co., Ltd.

Gravesend.—A contract for the electrical work in connection with the Gravesend Borough Council housing scheme (King's Farm Estate) has been received by the Sturdy Electrical Co.

London. — Hammersmith. — Electricity Committee. Recommended :—

Relining overhead coal bunkers with reinforced concrete, £1,150.—Griggs and Son.
Exciter switchboard, £135.—Park Royal Engineering Works, Ltd.
Steel framework for the foundations for the first 10,000-kW generating set, £475.—Sanders & Foster, Ltd.
Concrete foundations for the 10,000-kW set, £1,150.—J. Dorey & Co., Ltd.
Circulating water pipes and supports in connection with the condensing apparatus, £4,506.—Mechans, Ltd.

Stoke Newington.—Electric Lighting Committee. Recommended :—

H.p. and l.p. switchboards, £4,976.—General Electric Co., Ltd.
Extra cubicle accommodation, £115.—General Electric Co., Ltd.
Cables (various sizes).—W. T. Henley's Telegraph Works Co., Ltd.

Kilmarnock.—Town Council :—

Steelwork for extensions to tramcar sheds, £549.—Redpath, Brown and Co., Ltd.

St. Boswells.—The contract for installing electric light and power at Eildon Hall, St. Boswells, for the Duke of Buccleuch, has been secured by Messrs. Lowdon, Bros. & Co. The power is to be developed by a water turbine.

Taunton.—Town Council.

Anglo-American Oil Co., Ltd.—600 tons of standard fuel oil, for the electricity works, £5 5s. per ton.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, June 24th. At the Imperial College of Science, South Kensington. At 5 p.m. Ordinary meeting.

Electrical Trades' Benevolent Institution.—Monday, June 27th; at 2.30 p.m. At the Cable Makers' Association Offices, Sardinia House, Sardinia Street, W.C. Confirmatory meeting of alteration to rules, giving additional power to local advisory committees.

Institution of Civil Engineers.—June 28th, 29th, 30th, and July 1st. At the Institution of Civil Engineers, Great George Street, Westminster. Engineering Conference.

Institution of Electrical Engineers.—Thursday, June 30th. At the Natural History Museum, Cromwell Road, S.W. From 8.30 p.m. to 11 p.m. Conversazione.

Institution of Mechanical Engineers.—Thursday, June 30th; at 10.15 a.m. Friday, July 1st; at 10.30 a.m. At the Institution, Storey's Gate, S.W. London Summer Meeting. Conference on "The Means of Increasing the Thermal Efficiency of Heat Power Plants."

NOTES.

Summer Time.—A Bill to make permanent the yearly introduction of "Summer Time," which at present is legalised under regulations which were introduced during the war period, has been introduced in Parliament by Sir John Baird, the Under Secretary of the Home Office.

Fatality.—An inquest was held at Dewsbury, last week, on the body of Ernest Holroyd Priestley (24), foreman station electrician at the Thornhill power station of the Yorkshire Electric Power Co., Ltd. While examining the rear of the operating mechanism on the top of some h.p. switchgear he received a shock at 10,000 volts. Mr. Benjamin Benyon, charge engineer, said deceased had been instructed that only one section of the switchboard was "dead," and he should not have entered the cubicle where he received the shock.

The Electrical Trades Benevolent Institution.—The general meeting to confirm the alterations of the rules which were passed at the annual general meeting, will be held at the Cable Makers' Association's Offices, Sardinia House, Sardinia Street, W.C. 2, on Monday, 27th inst., at 2.30 p.m.

A Municipal Vehicle Demonstration.—The annual conference of the Institution of Municipal and County Engineers, of which Mr. Norman Scorgie, M.Inst.C.E., borough engineer and surveyor, Hackney, is president-elect, was held in London from June 15th to 18th inclusive, and in conjunction therewith a demonstration of mechanically-propelled vehicles, &c., used in municipal work was arranged by Mr. E. F. Spurrell, borough engineer, Holborn, and hon. sec. of the Institution for the Metropolitan district, took place in Lincoln's Inn Fields, W.C., on the afternoon of June 16th.

The vehicles on view were operated to facilitate inspection by the visitors, and although the major portion of the exhibits was of a non-electrical nature, the exhibition was nevertheless of value, not only to municipal men, but to the general public. Members and visitors were invited to inspect two improved electric lamps which are located on the north side of High Holborn, east of Kingsway and opposite the Holborn tube station. The lamps, which are manufactured by the General Electric Co., Ltd., for street lighting purposes, give a very even distribution of light, and embody Mr. H. T. Harrison's patent which has been described in our pages.

The electric vehicles exhibited numbered five, including one of Messrs. Tilling-Stevens's well-known petrol-electric type. This was fitted with an end-tipping body operated by the electric motor which normally drives the vehicle, and the tipping gear is automatically controlled.

The General Vehicle Co., Ltd., had on view a 2-ton vehicle fitted with a side-tipping body, as used by the Bath Corporation, and Agricultural and General Engineers, Ltd., showed a Garrett 2½-ton vehicle with an electrically-operated end-tipping body, as used in the borough of Hampstead. The tipping is done by means of a separate motor placed under the driver's seat, and is automatically controlled. The vehicle will travel a distance of approximately 35 miles on a good level road on one charge of the battery, and the main controller is interlocked with the brake levers.

The Orwell electric dust van exhibited by the Hackney Borough Council was one of the four vehicles fitted with side-tipping gear supplied by Messrs. Ransomes, Sims & Jefferies, Ltd., two of 3½ and two of 2 tons capacity, which are engaged in house refuse collection in connection with an experiment which is being made of a daily collection from certain areas in the borough.

Finally, Messrs. Electricars, Ltd., had on view a 15-cwt. vehicle, the propelling energy for which is derived from a 300-Ah Edison battery. The body is end tipped electrically, and an outrigged motor drives each of the rear wheels through a shaft. The main controller is fitted with a spring so that the make-and-break action is speeded up, thus doing away with the burning which usually occurs on the first and second notches.

All the electric vehicles shown were more or less of standard types, and the newest thing noticed was the Tilling-Stevens body-tipping gear.

Appointments Vacant.—Electrical power station superintendent (Rs. 525 per calendar month), for the East Indian Railway Co.; chief engineer and manager for the Ipswich Corporation Electric Supply and Tramways (£900, rising to £1,200 by annual increments of £50). See our advertisement pages to-day.

The Radiation Resistance of Antennæ.—In a communication to the *Journal* of the Institution of Electrical Engineers, by A. Press, M.I.E.E., the loss of energy by electromagnetic radiation, quite apart from absorption effects, is likened to a compound hysteresis loss. This is because both the electric field and the magnetic field absorb energy from the system, but the quantum of energy returned is rather less than that taken up to charge the respective fields. After developing the mathematics for elliptical hysteresis, the antenna is treated as a transmission line loaded hysteretically because of radiation effects. The true voltage and current distribution values as a function of the antenna length then follow. As a result of this analysis the trough in the antenna resistance characteristic as a function of the impressed frequency is explained. The rising branch is to be ascribed to the capacitative radiation, quite apart from pure absorption effects. The falling branch is then seen to be due to the magnetic component of radiation. The minimum in the characteristic curve corresponds to the radiation condition in which the capacitative equal the magnetic hysteresis effects. The hysteresis constants per unit of length as obtained from the graphs are then to be made the means of comparing different antenna systems.

Telephones in Western Canada.—The telephone is considered an essential utility of Western Canadian life to such an extent that one telephone to every nine persons is found west of the Great Lakes, and telephone construction, both line and exchange, planned for the immediate future, is as large as, if not larger than, for any previous period. The business of telephony in this area is permanent and expanding, and offers a profitable field to manufacturers of instruments, exchange equipment, and line supplies. To a considerable extent the rapid progress of Western Canada has been aided by remarkably efficient telephone services. Western Canada is a country of long distances and relatively sparse settlement, and the telephone enables the farmer, many miles from town, to transact business with the facility of the city broker. Thus the rural telephone is installed in many far-away homes; of the total of 272,495 telephones in Western Canada, approximately 90,000 are rural.

The principal American and Canadian manufacturing companies are closely associated with the telephone operating services in Eastern Canada and British Columbia, and naturally supply the material used in those services, but the construction, ownership, and operation of the service in the three prairie provinces (Manitoba, Saskatchewan, and Alberta) are almost entirely Governmental. These three Government telephone departments are the principal free purchasing agents in Canada, and although they have had, in the past, of necessity to obtain much of their equipment from manufacturing companies connected with the privately-owned services, they have expressed, in no uncertain terms, their desire for new sources of supply and, in particular, look to the United Kingdom. H.M. Trade Commissioner at Winnipeg (Mr. L. B. Beale) has prepared a detailed report on the telephone services of Western Canada, from which the above has been extracted. The report, which shows the annual amount of business in telephone material available, and the chances of United Kingdom manufacturers and merchants of securing this business, should be applied for at the Department of Overseas Trade, 35, Old Queen Street, London, S.W. 1, quoting 4504 ED/PN.—*Board of Trade Journal.*

INSTITUTION NOTES.

Institution of Electrical Engineers.—Visit of American Engineers.—In connection with the Engineering Conference convened by the Institution of Civil Engineers for next week, a deputation of distinguished engineers from the United States is visiting this country.

The opportunity will be taken to present the John Fritz gold medal to Sir Robert Hadfield, to whom it was awarded for his invention of manganese steel; the ceremony will take place on Wednesday morning at 10 a.m.

The deputation will be present at the Institution conversazione, to be held on June 30th. It consists of:—Mr. Ambrose Swasey (chairman), Messrs. Charles T. Main, Robert A. Cummings, John R. Freeman, and D. C. Henny (American Society of Civil Engineers), Messrs. Ira N. Hollis and Jesse M. Smith (American Society of Mechanical Engineers), Colonel Arthur S. Dwight, Mr. C. F. Rand, Dr. George Otis Smith, and Mr. W. Kelly (American Institute of Mining and Metallurgical Engineers), Dr. F. B. Jewett, Dr. A. E. Kennelly, and Major-General G. O. Squier (American Institute of Electrical Engineers), and six ladies.

About 10 p.m. Mr. Ambrose Swasey will speak in the Central Hall of the Museum, and he will be followed by Dr. F. B. Jewett, who will convey a message from the American Institute of Electrical Engineers to the Institution of Electrical Engineers.

Institution of Production Engineers.—A general meeting of the Institution will be held at the Institution of Mechanical Engineers, Storey's Gate, S.W. 1, on Friday, July 15th, at 7.30 p.m., when all who are interested in matters appertaining to production are invited to attend.

At this meeting, Mr. Max R. Lawrence, M.I.M.E., M.I.A.E., will deliver a paper on "Production and the Engineer."

The proposed activities of the Institution during the coming winter session will be outlined, and announcements will be made with regard to the election of various grades of members.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Mr L. W. Wild, M.I.E.E., physicist to Automatic and Electric Furnaces, Ltd., sailed on the *Olympic* on 15th inst., for New York, where, by arrangement with leading manufacturers, he will give practical demonstrations of Wild-Barfield automatic steel hardening furnaces.

Mr. G. H. Purkiss, assistant superintendent of the traffic department of the Southend-on-Sea Corporation Tramways, who has resigned, after being for 16 years on the staff, has been presented by his colleagues with a canteen of cutlery and silver.

A bonus of £100 per year is to be granted to Fleetwood's electrical engineer in respect of the period, January, 1921, to March, 1922.

Dover Town Council has decided to offer the following reduced salaries to members of the electricity works staff:—Chief assistant (1914 salary, £200; 1920 salary, £538 and cost-of-living award), £400; mains engineer (£200 and £427), £300; senior shift engineer (£100 and £293), £236; second and third shift engineers (£94 and £287 and £78 and £287 respectively), £231; with the cost-of-living award. These officials are to be given notice to terminate their engagements, with the option of reappointment at the reduced salaries.

Hammersmith Borough Council Electricity Committee has appointed Mr. J. A. West to the position of engineer-in-charge, at £412 + cost-of-living bonus, at present £25; there were 90 applicants.

Mr. Herbert Tetlow, manager of the electricity department of the Bacup Corporation, was married last week to Miss Edith Holland, of Heywood.

A Press report states that Mr. Victor Bone, who has been joint managing director to Messrs. Ransomes, Sims & Jefferies during the last four years, will, in the course of a few months, be leaving Ipswich for Lincoln, taking up the position of works director on the board of the associated firms of Ruston & Hornsby, Ltd. The vacancy has arisen through the retirement of Mr. Alexander Ramsay, on his appointment to the post of permanent chairman of the Birmingham and District Engineering Employers' Federation. Mr. Bone's successor at the Orwell Works will be Mr. Frank Ayton, chief engineer and manager of the Ipswich Corporation Electric Supply and Tramways Departments.

Prof. T. Mather, Professor of Electrical Engineering at the City and Guilds (Engineering) College, Imperial College of Science and Technology, has been appointed for this session as external examiner in Electrical Engineering for the diploma examinations of the Bradford Technical College.

Mr. G. H. Rowbottom has been appointed sales manager to the Clyde Valley Electrical Power Co. in succession to the late Mr. R. Robertson, and he will take up his duties on July 1st. Mr. Rowbottom completed his studies at St. Andrew's University, where he obtained his B.Sc. Degree, and was Medallist in Electrical Engineering. He served his apprenticeship with Messrs. Alley & McLellan, Polmadie, and for many years has been associated with Messrs. Crompton & Co., Ltd., Chelmsford, on both their engineering and commercial staffs, latterly being assistant branch manager in their Glasgow Office.

At the conclusion of the last "discourse" of the session at the Royal Institution, says *The Times*, the Duke of Northumberland presented a gold loving cup to Sir James and Lady Dewar, a gift from the members on the occasion of their golden wedding.

Mr. C. N. Williamson is on a visit to this country in connection with the interests of his firm (C. N. Williamson & Co., electrical merchants, Auckland, New Zealand), for whom he is arranging agencies for British manufacturers. His address is 53, Beech Road, Stockport.

Obituary.—Mr. R. G. Knight.—The death took place, on June 12th, of Mr. Richard George Knight, who was in business as an electrical engineer at 11, Sundridge Parade, Bromley (Kent). He was 51 years of age.

Sir T. Wrightson.—We regret to announce that Sir Thomas Wrightson, of Head, Wrightson & Co., Ltd., passed away on Saturday last at the age of 82 years. He was a director of the North-Eastern Steel Co., Ltd., and chairman of a colliery company. He early served his articles as an engineer. In later life he devoted himself to public affairs and to political matters. His business activity, however, did not prevent him from devoting a great deal of time to the science of acoustics, in which he had the support of Lord Kelvin, and of which he made a lengthy investigation in association with Prof. Arthur Keith.

NEW COMPANIES REGISTERED.

Thermics, Ltd. (175,200).—Private company. Registered June 14th. Capital, £200 in £1 shares (100 "A" and 100 "B"). To carry on the business of electrical, mechanical, chemical, heating, ventilating, gas, hydraulic, water, and general engineers, chemists, steel converters, tin, copper and general smiths &c. The permanent directors are: W. W. Nobbs, 50, Fairhazel Gardens, West Hampstead, N.W.6; S. Evling, 29, Hartswood Road, Shepherd's Bush, W.; A. B. C. Licence, 56, Western Road, Romford, Essex; P. A. Lothbury (formerly P. A. Laubach), 3, Dennington Park Road, West Hampstead, N.W.6. Registered office: 2, Falcon Square, Aldersgate Street, E.C.

Anglo-Persian Development Syndicate, Ltd. (175,207).—Private company. Registered June 15th. Capital, £300 in £1 shares (100 founders). To acquire from the Government of Persia or other Governments concessions, grants, decrees, rights, powers and privileges; to carry on the business of a waterworks, electric light and gas works company in Persia, &c. The subscribers (each with one share) are: E. J. White, Lismore, Rockleigh Avenue, Westcliff-on-Sea, clerk; S. G. Parker, 52, Yerbury Road, Tufnell Park, N., clerk. The first directors are to be appointed by the subscribers. Solicitor: H. R. Turner, Kennan's House, Crown Court, Cheapside, E.C.

Alfred H. Hughes & Co., Ltd. (175,228).—Private company. Registered June 16th. Capital, £20,000 in £1 shares (6,000 10 per cent. cumulative preference). To take over the business carried on at 39, 39a and 41, International Exchange, Church Street, Birmingham, as "Alfred H. Hughes & Co.," and to carry on the business of manufacturers and repairers of and dealers in gas controllers and gas engines of all kinds, mechanical, electrical and general engineers, &c. The first directors are: A. H. Hughes, The Mount, Berkswell, Warwick; T. Wallis, One Ash, Kettering; R. A. Boucher-Giles, Rock Mount, Wolverley, Kidderminster; A. C. Brown, no address given; E. F. Wallis, no address given. Secretary: F. A. Hughes. Registered office: 39a, International Exchange, Church Street, Birmingham.

Heath & Serena, Ltd. (175,217).—Private company. Registered June 15th. Capital, £2,000 in £1 shares. To carry on the business of electrical and mechanical engineers, iron, steel and metal merchants, manufacturers of and dealers in motor and steam engines, motor cars, &c. The subscribers (each with one share) are: G. E. Heath, 8, Oakleigh Gardens, Whetstone, N.20, engineer; R. Serena, 29, St. James Street, S.W., director of limited company. The first directors are not named. Solicitor: L. Goldberg, 2-3, West Street, Finsbury Circus, E.C.

Price's Electrical Supplies, Ltd. (175,260).—Private company. Registered June 17th. Capital, £3,000 in £1 shares. To carry on the business of manufacturers of and dealers in goods, instruments, devices, appliances, apparatus, and fittings used in the manufacture, generation, distribution, accumulation, and employment of electricity or gas, water, heating, lighting, motor oil, mechanical, steam, and other power, &c. The first directors are: W. H. Price, Woodlands, Little Aston, Aldridge, Staffs; W. F. Cox, Heathcote, Court Lane, Erdington, Birmingham. Secretary: W. F. Cox. Registered office: Calton House, Great Charles Street, Birmingham.

Nazeing & District Electric Supply Co., Ltd. (175,258).—Private company. Registered June 17th. Capital, £7,000 in £1 shares. To carry on the business indicated by the title. The permanent directors are: E. Grace, 366, High Road, Tottenham, N.17, electrical engineer; H. Rose, 406, High Road, Tottenham, wine merchant; W. B. Tweddill, 109, Bruce Grove, Tottenham, N.17, electrical engineer; E. Silver, 446, High Road, Tottenham, N.17, haberdasher. Solicitor: J. Prag, Gray's Inn Chambers, 20, High Holburn, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Malaga Electricity Co., Ltd.—£10,000 debentures created in April, 1897, and £14,417 debentures issued in February, 1898, are now first registered, pursuant to Section 12 of the Act of 1907. At the same time, satisfaction of the whole £24,417 and also of £20,321, debentures issued from January, 1902, to February, 1905 (being all the debentures previously registered) is notified. The repayment was by instalments from July, 1912, to December, 1920.

C. F. Elwell, Ltd.—Mortgage debenture for £3,000, dated June 3rd, 1921, to secure £3,000, charged on freehold factory, &c., at Camberwell (subject to prior charge for £2,500) and the company's general assets, including uncalled capital. Holders: Radio-Communication Co., Ltd.

Balsera's Patents, Ltd.—Particulars of £3,000 debentures authorised January 31st and all issued June 1st, 1921, charged on the company's undertakings and property, present and future, including uncalled capital.

Barnsley and District Electric Traction Co., Ltd.—Particulars of £20,000 debentures authorised May 26th, 1921, whole amount issued, charged on the company's undertaking and property, present and future, including uncalled capital subject to trust deed dated April 8th, 1903, and acknowledgment of debt dated January 30th, 1908, securing £21,000 debenture stock.

Alderley & Wilmslow Electric Supply, Ltd. (47,663).—Return dated May 11th, 1921. Capital, £30,000 in £1 shares (10,000 preference). 15,009 ordinary shares taken up. £15,009 paid. Mortgages and charges, £15,000.

West London & Provincial Electric Supply Co., Ltd. (62,097).—Return dated June 1st, 1921. Capital, £150,000 in 70,000 ordinary and 80,000 preference shares of £1 each. 23,354 ordinary and 49,077 preference shares taken up. £1 per share called upon 15,854 ordinary and 41,577 preference shares. £57,431 paid. £15,000 considered as paid on 7,500 ordinary and 7,500 preference shares. Mortgages and charges, nil.

Aluminium Corporation, Ltd.—Particulars of £150,000 debentures, authorised January 19th, 1921; present issue £100,000, charged on the company's undertaking and property, present and future, including uncalled capital.

CITY NOTES.

Callender's Cable and Construction Co., Ltd. The annual meeting was held on June 16th, Sir J. Fortescue Flannery, Bt., M.P., in the chair. Proposing the adoption of the report, the chairman said that the past year had again been one of exceptional pressure and difficulty. The volume of business had been very large, and had taxed the resources of the company to the utmost. The new workshops for the manufacture of e.h.p. cables had been completed, and were already turning out that type of cable which would be very largely employed in future for electrical power distribution. Further, they had taken over the workshops which were erected on their land for the purpose of manufacturing war material. The Picardy works had now been completely converted for the purpose of manufacturing ordinary telephone cable, such as was used by the General Post Office, and had been actively employed all the year, and the other shops would be utilised for more peaceful operations. They would have been unable to cope with the orders placed in their hands, even with the extensions, had they not successfully installed the three-shift system, which enabled the company to increase the output of the factory very materially. At the last meeting he told them that the amount of work which was in front of them rendered it probable that they would have to appeal for further capital. That appeal was made shortly after the meeting, and further capital, amounting to £500,000, comprising 400,000 "B" preference shares of £1 each and 100,000 ordinary shares of £1 each, was raised. Of course, they could not expect to handle their increasing business without some increase in the cost of running, and that was seen in the item of £137,276 for general expenditure. Their ordinary expenditure had been largely increased owing to the heavier salaries and wages and war bonuses which had been paid, and to the higher cost of every item which went to form their general charges. They had also felt it necessary to increase their activities abroad, and the organisation of overseas trade was an operation which required much patience, time, and money. The consequence was that, whilst they had made a greater profit, not so much as they hoped was left to them. Nevertheless, the profit was sufficient to pay the same dividend as in the previous year, viz., 15 per cent., to deal effectively with the requirements as to depreciation, and to add the balance of several thousand pounds to the carry forward. They would not be surprised to learn that the period had been one of constant strain, and of extreme difficulty at home and abroad. Towards the end of the year they began to feel the competition of other nations, whose currency had become depreciated, and whose workpeople had recognised the necessity to work hard, so as to restore the commercial and industrial prosperity of their country. That competition still remained severe, but as the trade of those countries improved, and their exports increased, the advantage they at present enjoyed in a depreciated currency would tend to disappear. The relations between the company and its employés were excellent. That remark did not mean that there had been no labour troubles in the period, but rather that good sense on one side and fair treatment on the other, had led to the conclusion of a settlement, which they believed would have excellent results. The managing director, Sir Tom Callender, paid a visit to India in the earlier part of this year. His visit had materially strengthened their position in that country. Their agents in Australia and South Africa had sent them large orders during the period, and their recently-opened branch in South America had been eminently successful, and large contracts were in hand for that continent. Further developments were in progress. The business in the Near East was growing, but had been held up by the present unsettled condition and exchange disparities. The works profit for the year, after deducting all charges on manufacturing account and contracts, was, in round figures, £381,120, or about £90,000 more than for the year 1919. The re-establishment of their foreign trade, as well as the heavy advances in salaries and other expenses at home, had absorbed a good deal of that profit and left them with £182,919. From that the directors had written off £30,800 as depreciation on property and furniture, and after paying debenture interest and preference dividends, they had a balance of £97,919. Adding to that the balance from 1919, £105,803, gave a total of £203,723. They were carrying forward £108,000, which was about £2,300 more than was brought in from 1919. With regard to the future, the output of the factories during the earlier months of this year exceeded the output for the same period of last year, but there had been a very grave and serious dislocation within the last few weeks. As a result of the dispute in the coal industry, they found themselves at Erith faced with the alternative of exhausting their stocks of fuel without any possibility of replenishing them, or else closing the works. After giving the matter full consideration they decided that the better course was to close the factory. Therefore, about the beginning of May they paid off the workpeople at Erith, and had since been employing only a nucleus staff. The effect of that could not fail to make itself felt in the results of the present year, although they were hoping that the good trade in the earlier part of the year, and the business which was awaiting them when they again resumed operations, which they hoped to do immediately, would compensate for any loss that was incurred owing to that unfortunate stoppage. It was very evident, and it could not be repeated too often, that the prosperity of that company and of every other manufacturing company in this country, was vitally dependent upon the output and the reasonable certainty with which it could fulfil its obligations to its customers, and that the commercial prosperity of the nation must come to an end if they were liable to such stoppages, or had to consider them as a possible permanent feature in their business. Those frequent disputes with labour, even when they were not with their own people, but between employers and employed in other industries, had their ill-effect upon the general manufacturing industries of the country, and when it was remembered the large amount which they themselves annually paid in wages, which last year amounted to over £600,000, the workers must recognise that a dispute of two months which deprived them of a material part of that sum in wages, involved them in a personal loss which could hardly be recovered during the year. There was another burden which the companies of this country had to bear at the present time, and that was the pressure of taxation and the cost of local government. Limited companies, like themselves, who were large ratepayers, as such had no voice in the control of the area where works were situated, and yet contributed a very large sum to the cost of local government, a sum which was constantly increasing. In their case, they had paid in rates and taxes during the year 1920, a sum equivalent to a dividend of 15 per cent. on the ordinary share capital. That was a very heavy burden to bear, and one which handicapped them, especially in their foreign trade.

Sir T. O. Callender, in seconding the motion, said that, as the chairman had stated, the past year had been one of intense anxiety and great difficulty. They had had to face many electrical problems, including new types of cable work, and they had got through those difficulties successfully because they took in hand early in the day the construction of their e.h.p. cable works. That new branch of the factory had been of the greatest service to them. They were looking forward to a great increase of business in that type of cable. They had large orders in hand which would keep them busy for some time, and although the coal strike had make a big hole in their output, they were hoping to make good that deficiency during the months that were to come. When trade was reasonably good, and when commerce once more got back into its ordinary run, there was no question that very large electrical works would have to be overtaken, and the advent of the new period under the Electricity Commissioners would bring to them and other cable makers large contracts. With regard to their foreign work, for the present at least they had been compelled to close their books. That was a disappointment to them, because immediately after the war they had spent a good deal of money and time in securing a footing in various countries on the Continent. Up till quite recently what they had done in that direction had been very successful. Now, however, that Germany had entered the field in active competition, and owing largely to the fact that the German manufacturer was hardly taxed at all, coupled with the extraordinary condition of the exchange, and to the excellent way in which the Germans were working, they had found it impossible at the moment to compete with the Germans on the Continent. They believed, however, that some of those conditions would be altered before long, and they looked forward at no distant date to resuming their Continental business. In the meantime, it was a closed door to them. On the other hand, their business elsewhere was continuing to increase, and they approached the remainder of the year with great confidence. They believed that, subject to no other unfortunate disputes or stoppages occurring, they would have on the whole quite a good year. They were looking forward to a speedy termination of the coal strike, but in the meanwhile they had not been idle. They had converted several of their boilers for oil burning, and from their experience they thought it probable that the substitution of oil for coal might have a good effect in many directions, and they might have to extend it very widely in their factories.

The report was adopted.

United River Plate Telephone Co., Ltd.

The thirty-fifth annual ordinary general meeting was held on June 14th, Sir Frederick Green, K.B.E. (the chairman), presiding. The chairman pointed out that the earnings in Argentina and London, including profit on exchange, amounted during 1920 to £1,096,373, as against £976,168 in 1919, an increase of £120,205, and that the expenses, including maintenance, management in Argentina and London, and income and corporation tax, with the usual provision for the depreciation of plant, amounted to £855,606, as compared with £764,076 in the previous year, an increase of £91,529, resulting in a profit of £240,767, an increase of £28,675. Working expenses showed a considerable increase over those of the previous year. This was due partly to the growth of the business, but still more to higher wages and costs. The increased telephone earnings were something between £90,000 and £100,000. The total increase in earnings from all sources was over £120,000. The London expenditure, including £5,000 stamp duty on the increased capital, amounted to £19,684, and income tax and corporation tax to £93,912, together making a total of £113,597. The income tax debit was some £17,000 less than it would have been, in consequence of sundry successful claims against this tax in respect of previous years. The addition to the plant account was £374,587, and to real estate £55,315. The former amount was much greater than for 1919, and was, in fact, the largest addition to the plant account in the history of the company. Real estate (£55,315) was about the same as in the previous year, and consisted of new exchange sites, and some buildings which it had been found advantageous to purchase. Securities, consisting mostly of Government War Loans, amounted to £150,460, a sum considerably less than that shown in the previous balance sheets. Stocks of material stood at £264,278, a large sum, but the higher prices partly accounted for this. It was necessary, too, to hold large stocks as the work was carried on so far from sources of supply. Bills receivable and cash amounted to £45,956, a smaller amount than last year, but this was the natural consequence of increased activities in plant extensions. On the debit side of the balance sheet, the general reserve fund included the appropriation made at the last meeting, and amounted to £556,138, and the reserve for renewal of plant to £1,206,091. The latter figure included the provision made for 1920 at the usual rate, less the cost of the plant replaced. A very considerable amount of new plant had been shipped this year, and before long should be brought into service, and this would enable the company to reduce its list of waiting subscribers, which now amounted to more than 11,000 in the city of Buenos Aires alone. It would not be possible, however, to satisfy all until the new automatic exchanges were working, and this could not now take place until early next year. During the year under review 5,431 new subscribers had been added to the system, making the total number of stations 83,602, as against 78,171 at the end of 1919. These additions had been rendered possible by the opening of an entirely new exchange. The Argentina Government had issued permits for new lines for connecting several important towns to the national system and the construction of some hundreds of miles of new routes had been carried out. Several small independent enterprises on these routes had been absorbed, and arrangements had been made to take over the La Bahiense system, which was the second largest in the Republic. The present rates were far too low, and it was hoped that authority to increase them would soon be granted by the Government. The directors had decided to issue 108,000 new ordinary shares to meet prospective capital expenditure upon arrears of work. These shares would be of £5 each, and the ordinary shareholders would be entitled to take one new share for every three ordinary shares held. The report and accounts were adopted, and the retiring directors and auditors re-elected.

Madras Electric Supply Corporation, Ltd.

The annual meeting was held on June 15th, Mr. James Gray (chairman) presiding. The chairman said the accounts showed marked progress in every direction. The increases in the number of new consumers connected, the total connections in kilowatts, and the electricity sold had all been well maintained. It was estimated that the balance of revenue, apart from all questions of exchange, had increased by £20,000, but it should be remembered that the whole of 1920 had had the benefit of the increased tariff of 5 annas, whereas 1919 had had only five months. The balance of revenue account amounted to £81,446, to which had to be added £4,580, the dividend on shares in the tramway company, and £1,401 from interest on Treasury bills. These made a total of £87,427. On the debit side of the latter account there appeared the usual items for interest and redemption of debentures under the sinking fund. The sum of £20,000 had been debited for depreciation and renewals, which was £6,000 more than last year. Provision had been made for income tax paid and payable in India, amounting to £6,325, also £4,000 for corporation profits tax. The balance of net revenue for the year was £40,721. Adding £7,114 brought forward from last year, there was available for distribution £47,835. These results were obtained under somewhat adverse circumstances, as, in addition to the stoppage of the tramways between January 26th and February 4th, 1920, there was a strike of the company's employés, which began on May 25th and lasted until June 22nd. In the balance sheet the total of the capital account remained as before, but the number of ordinary shares showed an increase of 1,330, and the preference shares a corresponding reduction. The loan from bankers in Madras appeared as £22,187 10s., compared with £35,102 17s. 5d. at the end of 1919. At the last general meeting it was explained that the rupee floating liabilities and assets had been valued at 2s. at December 31st, 1919, with the exception of the loan from bankers, which it was considered prudent to convert at the actual rate of 2s. 4d. then ruling. At December 31st, 1920, exchange was 1s. 5¾d., at which rate the rupee liabilities and assets were converted, and this explained the reduction in the bank loan as it appeared in the balance sheet. Having regard, however, to a further reduction in exchange to about 1s. 3½d., the board considered it desirable to pay off this loan entirely, and this was done in March last. On the assets side of the balance sheet, the sum of £16,234 5s. 2d. was shown as expended on works representing chiefly the building of a new sub-station at Royapuram, the equipment of the new sub-station at Mount Road, and extensions of mains. Through a variety of causes, shipment of the four 250-kW rotary converters had been seriously delayed, but two of them were in transit and the other two were ready for shipment. The delay had caused great inconvenience and considerable loss of revenue, as there was a large amount of business waiting to be done. The increase of 1 anna for lighting and fans on a combined circuit was granted for a period of three years only from August 1st, 1919. The directors had applied to the Government, however, to withdraw the limitation as to period, and were very sanguine that their application would be favourably entertained.

The chairman, in reply to a complaint that the company's progress was behind that of other Indian concerns, pointed out that during the past six years the company's business had been developed entirely out of revenue, and if they had had command of new capital they would have made much greater progress. If it were possible to offer locally a portion of any new capital they might wish to raise, that would be done.

Edmundsons' Electricity Corporation, Ltd.

The accounts for the year ended March, 1921, show that after providing for income tax, mortgage and note interest, and debenture stock charges, the net profit is £16,053, as against £8,099 in the previous year. Including the balance brought forward (£10,090) the total available is £26,143, out of which it is proposed to pay a dividend for one year on the cumulative preference shares, requiring £12,000 and to carry forward £14,143. (Last year's report stated that owing to the necessity for conserving the company's financial resources, the directors were unable to recommend the payment of the cumulative preference dividend.)

CAPITAL EXPENDITURE AND GROSS PROFITS OF SUBSIDIARY AND OTHER COMPANIES.

Name.	Capital expended Dec. 31st, 1920.	Gross profit (before providing for capital charges and depreciation). 1920.	Load connected in kW. 1920.
Alderley	£56,076	£4,294	1,467 W.
Bromley	166,918	13,435	5,479
Folkestone	250,595	16,495	6,560
Guernsey	166,808	10,501	5,785
Isle of Wight	288,064	15,575	6,937
Ilfracombe	35,970	2,193	1,116
Lancashire Co. ..	1,243,915	47,377	32,804
Lymington	38,661	3,375	961
Melton Mowbray ..	48,098	5,092	1,288
Newmarket	45,579	2,953	1,284
North of Scotland ..	137,398	13,140	5,017
Ramsgate	54,346	5,356	1,951
Scarboro' Trams ..	99,430	*less* 835	—
Salisbury	74,051	7,531	2,162
Urban Co. Group ..	1,639,987	117,004	46,882
Whitchurch	6,422	81	128
Wycombe	126,208	16,993	3,519
Cromer	34,565	668	749
Dorking	46,623	1,371	1,519
Frome	68,104	4,176	2,438
Hamilton	90,091	6,012	3,475
Surbiton	74,807	6,797	2,735
Total 1920	£4,792,655	£299,774	134,259 kW.
,, 1919	£4,227,129	£208,622	122,233 kW

Annual meeting: June 30th.

Oriental Telephone and Electric Co., Ltd.

The annual general meeting was held in London on June 17th, the chairman, Sir H. Babington Smith, G.B.E., presiding. The greater part of the chairman's speech was a review of the directors' report, which was abstracted in our issue of June 10th (p. 759). Regarding the future of the Indian systems, he said that under the licences held by the Bombay and Bengal companies, and also by the Oriental Telephone Co. in respect of its Indian branches, the Government of India had the option of purchasing the telephone undertakings on defined terms on March 31st, 1923, provided notice was given not later than the end of March, 1922. If this power was not exercised by the Government in 1923, the licence gave a similar option in 1928, 1933, 1943, 1953, and the licence finally expired in 1963. The directors had represented to the Government that it was impossible to carry on a telephone system with efficiency if the remaining tenure was short, and uncertain. It was essential that plans for development should be laid well in advance of requirements, and that capital expenditure should be incurred which would not be immediately remunerative; but it was obvious that a company with an expiring tenure could not, without injustice to its shareholders, spend money on plant which would yield no return before the date of transfer, and would then be sold at a depreciated value. If the decision should be against purchase in 1923, they had asked that, in the general interest, the companies should be given a secure tenure for a considerable period, as well as authority to increase the rates to an extent necessary to enable them to cope with the high working costs now obtaining. Last year they had had reason to think that the Government was likely to exercise its option to purchase; at the present time there was reason to think to the contrary.

The chairman, in reply to questions, said that, as he mentioned last year, the liquidation of the Egyptian Co. was only held up because of an outstanding question with regard to income tax between the liquidator and the Inland Revenue authorities. He trusted that before they next met the liquidation would have been completed. With regard to the question as to whether it was necessary to place such large sums to reserve, his answer was that in a telephone business it was extremely prudent to strengthen the reserves with a liberal hand. Depreciation of plant was always large, but it might be larger than was anticipated owing to the progress of invention, while in the case of this company there were so many uncertainties as to the termination of licences, the outcome of purchase terms, &c. Respecting the capital reserve account and the depreciation and general reserve account, he said that these were in part represented by investments—namely, War Bonds—and in part by assets, shown on the other side of the balance sheet, consisting of plant, land and buildings, stores, and also holdings in subsidiary companies.

The resolution was unanimously carried.

British Electric Traction Co., Ltd.

The gross profit during the year ended March 31st, 1921, was £264,773, against £246,717 for the preceding year. The general expenses were £44,575, leaving a net profit of £220,197, plus £150,422 brought forward. After deducting debenture stock interest, £85,136, there is a balance of £285,483. There is to be placed to reserve £12,349; 6 per cent. is to be paid on the cumulative participating preference stock, and 4 per cent. for the year on the ordinary stock, leaving £177,319 to be carried forward. No provision has been made for corporation profits tax (if any), as it is proposed to deal with it in the year in which it is paid. The net profit of £220,197 for the year compares with £211,316 for the preceding year. The aggregate receipts of the associated companies for 1920 showed an increase, but the expenses increased in a greater ratio, due in a large measure to the fact that in the majority of cases the associated companies were not authorised to increase fares and charges until the latter part of the year, although advances in wages were granted earlier in the year. The amount standing to the credit of reserve account at March, 1920, was £500,000, from which has been deducted £19,954, mainly in respect of loss on realisation of war stock. There has been added £7,605 in respect of discount on £11,286 5 per cent. perpetual debenture stock, and £8,067 4½ per cent. second debenture stock purchased during the year, and it is proposed to transfer £12,349 from revenue to reserve. The reserve will then stand at £500,000. The investments, which now stand at £3,861,816, show a decrease, as the result of sales on balance, of £165,975 compared with the preceding year. The investments yielded a revenue of £208,386, representing an average of 5.39 per cent. for the past year on the amount at which they appeared in the balance sheet, as compared with 5.28 per cent. for the preceding year. Mr. J. S. Austen was appointed chairman of the company in July last when that position was vacated by Mr. E. Garcke. Mr. Garcke, who retained his seat on the board, has since been appointed deputy chairman of the company. Meeting: To-day, Friday, at the Holborn Restaurant.

Stock Exchange Notices.—The Committee has specially allowed dealings in the following, under Temporary Regulation 4 (3):—

Johnson & Phillips.—£350,000 8 per cent. first mortgage debenture stock.

The undermentioned have been ordered to be officially quoted:—

Newcastle-upon-Tyne Electric Supply Co.—£250,000 4½ per cent. consolidated first mortgage debenture stock.

Prospectus.—*Pernambuco Tramways & Power Co., Ltd.*—The list is announced to close to-day (or before) in an issue of £500,000 8 per cent. prior lien debentures to bearer, at 96 per cent. The funds are required for the construction and equipment of lines necessary to obtain increase of fares, for the lighting programme and provision of extra rolling stock, the repayment of temporary loans, and provision of working capital for stores, &c.

Ransomes, Sims & Jefferies, Ltd.—The report for the year ended March, 1921, shows that after paying debenture interest and preference dividend, it is not considered practicable to recommend a dividend on the ordinary shares, having regard to present adverse trade conditions, fall in selling values, and the necessity for conserving the resources.

Victoria Falls & Transvaal Power Co.—Final dividend of 4 per cent., less tax, on the preference shares in respect of 1920, making 10 per cent.; 3 per cent., less tax, on account of 1921; and a dividend of 5 per cent., less tax, in respect of 1920 on the ordinary shares.

Chloride Electrical Storage Co., Ltd.—Dividend of 5 per cent., free of tax, on the ordinary shares, making 10 per cent. for the year. £25,000 to reserve; £5,000 to employés' benefit fund; £23,340 carried forward.

Lancashire Power Construction Co., Ltd.—Dividend of 7 per cent. on the participating preference shares for the year; £4,192 carried forward. It is stated that there will shortly be a further issue of capital.

Yorkshire (West Riding) Electric Tramways, Ltd.—Interim dividend of 3 per cent., less tax, on 6 per cent. cumulative preference for the half-year ending June 30th.

Belgium.—The report of the Société d'Electricité du Nord de la Belgique for last year shows a profit of 650,177 fr., as contrasted with only 24,869 fr. in the preceding 12 months.

Arbroath Electric Light & Power Co.—The annual report shows a net profit balance of £5,712, after paying interest charges and 5 per cent. dividend on preference shares. At the meeting on Friday last, Mr. George Balfour, M.P., chairman, presiding, it was agreed to pay a dividend of 8 per cent. (less income tax) on the ordinary shares, and an additional 1 per cent. (less tax) on the preference for 1920; to place £3,000 to the reserves and renewals fund, making this fund £10,000, and to carry forward, subject to payment of directors' and auditors' fees, £1,367. The past year has been the most prosperous in the history of the company. The share capital has been increased to £100,000, and it is proposed to make an issue of new shares in the near future for the purpose of repaying loans and providing for extensions of plant and cables to cope with increasing demands.

Globe Telegraph & Trust, Ltd.—Net revenue for year ended May, 1921, after deduction of expenses £287,772, plus £1,379 brought forward, together with £10,000 transferred from reserve for contingencies account, total £299,181. Total distribution on the ordinary shares 10 per cent., free of tax. Balance carried forward £2,181.

Birmingham District Power & Traction Co.—To renewals £8,000, dividend of 6 per cent. on the ordinary shares; carried forward £4,508.

[Owing to pressure on our space, several "City" items are held over to next week.—Eds. Elec. Rev.]

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets make an indifferent showing in the matter of business. The miners' refusal to resume work came as a surprise of a distinctly unpleasant character. Moreover, it was expected that even if the ballot showed an adverse majority to peace, the men would go back to work in rapidly-increasing numbers, but they show no disposition to do so far. Consequently the markets are slow and dull. There is a little investment business going on, and men still talk hopefully of a Bank Rate reduction now that the Federal Bank of New York has lowered its minimum. But even this hope is tempered by considerations arising out of the strike.

The Home Railway market is one of the chief sufferers in the latest financial malaise. Coal is undoubtedly the main cause of the investor's positive refusal to look at the stocks in this department. Underground Electric Income Bonds managed to maintain a firm front at 80½, but the £10 shares have dropped to 2½ and the 1s. shares to 7s. Districts have lost 1½ at 18½. Metropolitans fell to 26, and the only stock in the market to show any firmness is Central London Ordinary Assented Guaranteed, which has risen 3 points to 48½. The company's non-assented ordinary stock stands at 31½, the deferred being 24½ and the preferred 34. But the guaranteed assented preferred ordinary has risen to 50 and the guaranteed deferred ordinary to 45½. London Electric £10 shares are better at £3. London and Suburban Traction preference eased off to 7s.; the ordinary are still half-a-crown.

Marconis have been as low as 43s. 3d., but a breath of buying restored the quotation to 2¼. Canadians remain at 8s., and Marines at 25s. Marconi 7 per cent. preference have gone back to 2 3/16. Cable stocks are steady as a whole. Western ordinary at 16⅝ are 5s. lower, otherwise there is no change in this particular group. The Anglo-American issues maintain their rise of last week.

United River Plate ordinary are quoted 5½, which is ex the right to the allotment of one new share at £5 for every three old shares previously held. The rights are valued at about 5s. premium, and the new shares are being dealt in on this basis. Siemens ordinary are also ex the right to the bonus, and the price was marked down to 20s. in consequence. The new 10 per cent. preference shares are now 21s. 3d., at which they look a good purchase. It is, indeed, only for this class of share that the investor is at present showing any partiality. Ordinary shares are out of favour, and, with the dividend outlook so much obscured by the labour troubles, it is not surprising that the buyer prefers to stick to fixed-interest securities, rather than to adventure into the more speculative ordinary.

Amongst manufacturing shares, British Aluminiums at 15s. 9d. and General Electric preference at 16s. 6d. are both 6d. down. The General Electric Company's 6½ per cent. "A" preference and 7½ per cent. "B" preference are now both quoted at the same figure. The new debenture is 89½ for the fully paid and 3¼ discount for the scrip. Electric Constructions at 16s. 3d. have lost 1/16. Telegraph Constructions remain at 20½. Engineering shares are steady, Babcock & Wilcox holding its rise at 2⅜. Iron, coal and steel shares are dull, rather than flat. Vickers have gone back to 12s. 9d. sellers, and the 5 per cent. tax-free preference to the same figure. Private advices from the provinces to London business houses hold out no particular hope of immediate settlement of the coal strike, but, in the City, the view is general that the present position leaves the Miners' Executive in a situation as difficult as it is delicate, and one which calls for extremely diplomatic handling if the trades union officials are to retain their power over the workers. Should they, the leaders, fail to do this, the theory is that it will be a good thing for stocks and shares in all industrial companies, as affording evidence that the tyranny of trade unionism may be weakened, and men left at liberty to work as they please.

The feature in the foreign list is a fall of 2½ points in Brazil Tractions, but Anglo-Argentine Tramways are dull also. The second preference at 2⅝ are ex the 5s. 6d. just paid on account of arrears. Mexican Light & Power first mortgage bonds have fallen 4 to 70½, owing to the disappointment felt at the lack of settlement news from Mexico. There is some grumbling on the part of holders of Mexican Utility bonds at the statement that Income Tax at the rate of 6s. in the £ is to be deducted from the payment of such arrears of interest as are to be distributed early next month.

There is no change at all in the list of home electricity shares. Occasionally a few come to market, but are readily taken. Gas stocks, however, are dull, in consequence of the coal strike, though this particular cause has not yet affected prices in the electricity market. A few Bournemouth & Poole second preference have been changing hands on the basis of 6 1/16. Metropolitan Electric new 7½ per cent. extension debenture stock, issued at 95, continue steady at 98, the partly-paid scrip being 3¼ premium. Victoria Falls preference are unchanged at 15s. 9d. and the ordinary at 7s. 6d., although the report is satisfactory, and the ordinary again receive 5 per cent. dividend. Rubber shares are flat upon undisguised fears that many companies must be running short of money; the weakness of the price of the raw material offers no encouragement to the usual supporters of the share market.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend		Price June 21,		Yield,
	1919.	1920.	1921.	Rise or fall.	p.c.
Brompton Ordinary..	12	12	8	—	£10 0 0
Charing Cross Ordinary ..	7	8	8⅞	—	10 8 8
do. do. do. 4½ Pref...	4½	4½	8	—	7 10 8
Chelsea..	4	8	8½	—	9 4 8
City of London	13	14	1 3/16	—	11 16 0
do. do. 6 per cent. Pref...	6	6	17/-	—	7 1 2
County of London	8	8	8⅛	—	9 17 0
do. do. 6 per cent. Pref...	6	6	6⅛	—	7 7 8
Kensington Ordinary	7	9	4⅛	—	10 18 2
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref. ..	6	6	2¾	—	10 18 2
Metropolitan	6	7	8½	—	10 0 0
do. 4½ per cent. Pref. ..	4½	4½	2 15/16	—	7 18 2
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	6	7	2½	—	9 2 10
South Metropolitan Pref... ..	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	6½	—	9 10 6
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	83½	—	7 3 9
do. Def...	1½	1½	17½	—	8 11 6
Chile Telephone	6	6	5¼	—	6 6 8
Cuba Sub. Ord.	7	7	7¼	—	9 6 8
Eastern Extension	10	10	16⅝	—	6 0 4
Eastern Tel. Ord.	10	10	167½	—	5 19 6
Globe Tel. and T. Ord.	10	10	16⅝	—	6 0 4
do. do. Pref.	6	6	9¼	—	6 9 9
Great Northern Tel.	22	24	25⅝	—	8 11 6
Indo-European	10	10	85	—	7 2 10
Marconi	25	25	2¼	—	—
Oriental Telephone Ord.	12	12	2 3/16	—	*6 13 0
United R. Plate Tel.	8	8	6½	—	6 13 4
West India and Panama	Nil	Nil	½	—	Nil.
Western Telegraph..	10	10	16⅝	— ¼	*6 0 4
Home Rails.					
Central London Ord. Assented ..	4	4	48½	+3	8 16 10
Metropolitan	1½	1½	26	— ½	6 17 8
do. District	Nil	Nil	18½	—1½	Nil
Underground Electric Ordinary ..	Nil	Nil	2½	— ¼	Nil
do. do. "A" ..	Nil	Nil	7/-	—6d.	Nil
do. do. Income ..	4	2	80½	—	2 9 4
Foreign Trams, &c.					
Anglo-Arg. Trams, First Pref. ..	6½	12½	2¼	— 1/16	10 0 0
do. do. 2nd Pref. ..	Nil	5½	2⅝	—	9 11 4
do. do. 5 % Deb. ..	5	5	65¼	—1	7 12 8
Brazil Tractions	Nil	Nil	32½	—2	Nil
British Columbia Elec. Rly. Pfce.	5	5	66	—	8 18 6
do. do. Preferred	5	6	63½	—	*8 15 0
do. do. Deferred	3	8	61¼	—	*11 17 6
do. do. Deb. ..	4½	4½	69½	—	7 2 10
Mexico Trams 5 per cent. Bonds..	Nil	Nil	62½	—	Nil
do. 6 per cent. Bonds..	Nil	Nil	23½	—	Nil
Mexican Light Common	Nil	Nil	11¼	—	Nil
do. Pref.	Nil	Nil	18½	–	Nil
do. 1st Bonds	Nil	Nil	70½	—4	Nil
Manufacturing Companies.					
Babcock & Wilcox	16	16	2⅜	—	6 14 6
British Aluminium Ord.	10	10	15/9	—6d.	12 14 0
British Insulated Ord.	15	10	1 9/16	—	9 12 0
Callenders	15	15	1½	—	10 0 0
" 6½ Pref.	6½	5½	17/6	—	7 8 7
Crompton Ord.	10	10	16/3	—	12 6
Edison-Swan	10	10	11/3	—	—
do. do. 5 per cent. Deb. ..	5	5	70	—	7 2 10
Electric Construction	10	10	16/3	— 1/16	12 6 2
English Electric	8	8	12/-	—	13 6 8
Do. Pref.	6	6	14/6	—	8 5 6
Gen. Elec. Pref.	6½	6½	16/6	—6d.	7 17 7
do. Ord.	10	10	1 1/16	—	*9 8 2
Henley	15	15	1⅜	—	10 18 2
do. 4½ Pref.	4½	4½	8¼	—	6 18 6
India-Rubber	10	10	1⅜	—	—
Met.-Vickers Pref.	8	8	1 13/16	—	8 16 10
Siemens Ord.	10	10	1	—	*10 0 0
Telegraph Con.	20	20	20½	—	*5 17 0

* Dividends paid free of Income Tax.

THE RELATIONSHIP BETWEEN EFFICIENCY AND WORKING COSTS OF SMALL MOTORS AND GENERATORS.

By E. G. KENNARD, A.M.I.E.E.

(*Concluded from page 773*).

The improvement due to increase of rated speed is illustrated by the curve in fig. 4 for 5-kW d.c. shunt-wound machines, where the efficiency is seen to increase from 83 per cent. at 250 r.p.m. to 92 per cent. at 2,000 r.p.m., representing a reduction in power at full load of 0·45 kW.

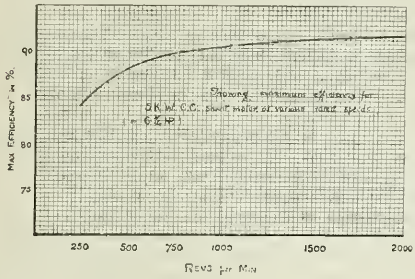

Fig. 4.—Efficiency and Speed.

In order to establish a reliable basis on which to estimate the total working costs, it becomes necessary to divide machines into three different classes :—

(*a*) Those for intermittent working, such as lifts, &c.

(*b*) Those running all day on a variable load, driving machine tools, &c.

(*c*) Those running continuously on a steady load, charging accumulators, driving fans, pumping plant, &c.

In class (*a*) where the total number of running hours per year is not large, high efficiency is not important, especially if the price of the motor is increased thereby.

In class (*b*) small no-load losses, and high efficiency at ¾ load, are essential to obtain low working costs.

Those in class (*c*) require the maximum efficiency at the normal working load.

As an estimate of the total number of hours per annum worked by motors in (*b*) and (*c*) classes, a fair value will be obtained taking 48 hours per week and 50 weeks per year, giving a total of 2,400 hours per annum.

The following simple formula is then obtained :—

Running costs per year in £ = kW input × 2,400 hours × pence per unit/240.

Running costs per year in £ = kW input × pence per unit × 10.

When estimating the running costs for machines working with a variable load, it is convenient to assume that the average load for the year is one-half the full rated load ; the kW input will, therefore, be approximately—

No load kW input + full load kW input/2.

Having established what is claimed to be a reasonable basis on which to estimate the running costs of electrical machinery, in order to estimate the standing costs or capital charges some figures based on representative prices are necessary before total working costs can be prepared.

Taking the average of present-day prices of British manufacturers, the prices of new machines may be taken as approximately 200 per cent. greater than the pre-war values.

In accordance with the foregoing, the curves shown in fig. 5 have been prepared, showing prices for d.c. machines of standard make at various speeds and outputs. A machine specially built to obtain higher values of efficiency will cost more than the price shown in fig. 5, and these have been estimated to cost some 20 per cent. more. The most striking feature concerning the values shown in fig. 5 is the economy in first cost it is possible to effect by the use of high speeds. For example, the prices of a standard 3·75-kW machine (or 5-h.p. motor rating) are £116, £74, and £48, at speeds of 500, 1,000 and 2,000 r.p.m. respectively, and the ratio of prices for other outputs are approximately in the same proportion.

With regard to the question of standing charges, these cannot be estimated so accurately as the running costs. Prices of machines are unstable, likewise rates of interest on capital, also the question of the annual sum to be charged for depreciation is a debatable one. This amount should cover the cost of running repairs, and also provide for replacement when the machine is obsolete. The present bank rate of interest is 6½ per cent. per annum, the cost of repairs should not exceed 3½ per cent. per annum, and allowing for the scrap value of a machine, 5 per cent. per annum should cover the cost of depreciation. These costs added together make a total annual charge of 15 per cent. of the capital outlay, enabling the annual capital charge for any particular rating to be determined from the prices shown in fig. 5. In the case of high-efficiency machines, as shown previously, when rated in agreement with the Engineering Standards Association's rules, full load occurs at from 25 per cent. to 50 per cent. above the point of maximum efficiency according to the rated speed. It will be seen from the curves in fig. 1 that the drop in efficiency from ¾ to full load only amounts to some 2 per cent., so that if advantage is taken of the increased rating, the high-efficiency machines will cost no more than standard ones at the lower temperature rating. As an alternative, high-efficiency machines may be employed with the full-load rating at their maximum efficiency, the capital costs then being increased by some 20 per cent., this course being justified in some cases where long running periods are necessary. It is evident that in cases where increased efficiency incurs a corresponding increase in capital charges, it will be important to take into consideration the number of hours the machine will be in use ; if the choice lies between, first, a motor of high efficiency and high first cost ; and, secondly, a motor of low efficiency and low first cost, then the number of working hours per annum at which both machines will have the same working costs (*i.e.*, current costs and capital charges), may be determined by the following formula :—

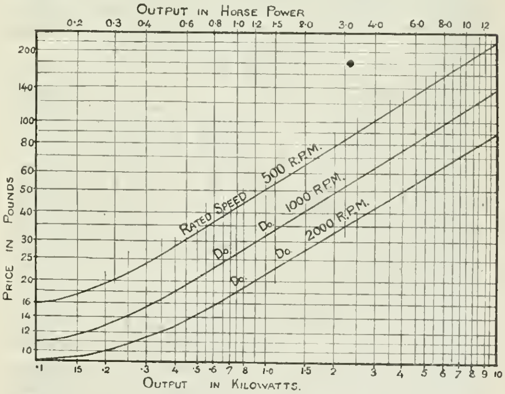

Fig. 5.—Approximate Present-day Prices of Standard Continuous Current Machines.

Number of hours = difference of capital charges in pence per year / difference of current costs in pence per hour.

For example, suppose it is required to select a 5-h.p. motor (1,000 r.p.m.) to run for approximately 500 hours per annum from mains where the cost of current is 3d. per unit. One motor has a guaranteed efficiency of 78 per cent., and is priced at £75, and the other 85 per cent., and priced at £80.

At 15 per cent. per annum the capital charges for each motor are 2,700 and 2,880 pence respectively. At 3d. per unit the costs for current for each motor are 14·3 and 13·15d. per hour.

Then the number of hours per annum for equal cost
= (2,880 − 2,700)/(14·3 − 13·15) = 137 hours,
and as it is required to use the motor for 500 hours, it will be more economical to install the efficient motor at a higher first cost. This formula may be applied to any machine under the class (*a*) heading, where the number of hours is approximately known. For motors working under a variable load, machines having their maximum efficiency at ¾ load should be used wherever possible, as not only are capital costs reduced, but at light loads the efficiency curve is considerably higher. Estimating the average load on a machine working at a variable output to be one-half of its full rated load, then the fall in efficiency due to variable load conditions is 2¼ per cent. in the first case, to 5¼ in the second case (values obtained from curves in fig. 1).

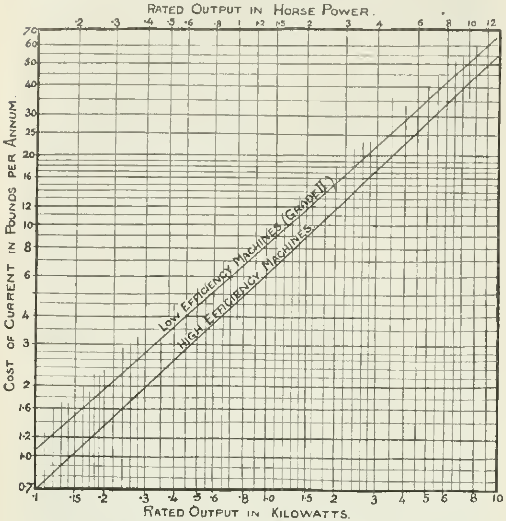

Fig. 6.—Running Costs (Current only) per Year of 2,400 Hours for Machines Working on Variable Load Based on Current per Unit, and an Average between Light and Full Load.

Curves have been prepared in fig. 6 showing the total cost of current per year for high and low-efficiency machines working at a mean load of one-half the rated full load, the number of hours being taken at 2,400.

As the curves show the costs at 1d. per kW-hour, at other rates for power the cost is obtained as a direct multiple of these values. From fig. 6 it will be found that the saving per annum varies from £0·5 for a ¼-h.p. motor to £10 for a 12-h.p. motor where a h.e. machine is used in place of a l.e. one. As the present price of power averages 3d. per unit, for the average power user these figures may be increased threefold.

Returning now to motors in class (*c*), where machines are run at a constant load, in most cases it will be preferable to employ a machine loaded at its maximum efficiency; this will avoid the practice of always running at high temperature, and also leave a margin for overloads. Where machines designed for high efficiency are employed, it will occasion an extra capital charge as compared with standard-type machines, and these costs are estimated to be some 20 per cent. greater. It is, therefore, necessary to take capital charges into account in estimating possible economies for class (*c*) machines.

On the 15 per cent. per annum basis these charges vary (for a standard motor at 1,000 r.p.m.) from £1·75 for a ¼-h.p. motor, to £21 for a 12-h.p. motor.

Where the motors are in use for the normal period of 2,400 hours per year, these charges expressed in pence per unit consumed by the motor would be ·55d. for the ¼ h.p., and ·175d. for the 12 h.p., indicating that the capital charges are not a large percentage of the total working cost at prevailing prices for electricity supply. In fig. 7 two curves are drawn representing the total working costs for high- and low-efficiency (Grade II) machines working at full load for a working period of 2,400 hours per year, and on a basis of current at 3d. per kW-hour. Although the h.e. machines are debited with 20 per cent. increase on capital charges a considerable yearly saving is obtainable by their use.

For a small rated output of 0·2 kW (or ¼ h.p.), a saving of £1·8 per annum could be effected, and for a 10-kW (or 13 h.p.), a saving of £48 per annum. There are, of course, many motors in use with higher efficiency values than the Grade II machines, but even taking machines classed under Grade I approximately one-half of the above values would be obtained.

Having shown the economical possibilities of single machines of higher efficiency, it is evident that the question of efficiency is of still greater importance in connection with the motor-generator, where a double source of loss exists.

Various forms of motor-generators are now very largely used for a variety of purposes including accumulator charging, kinema projection arc lamps, electro-plating, electric welding, conversion of a.c. to d.c., &c.

In addition to motor-generators for accomplishing these purposes, there are (*a*) rotary converters; (*b*) auto-motor-generators or series connected machines; and (*c*) double-wound armatures for d.c. (sometimes called dynamotors). It is surprising to find the somewhat limited extent to which these more efficient types of machines are employed for conversion purposes.

The main objection to the use of (*a*) and (*c*) type machines is on the ground of restricted voltage control, although for many uses this is not highly important. Series connected motor-generators are to be recommended for stepping-down direct-current voltages where the ratio of conversion does not exceed 4 to 1, and where a certain amount of voltage regulation is required. This method has been employed to a small extent for kinema projection arcs, stepping down from 220 V to 70 V, and this arrangement might also be applicable to battery charging. It is especially suitable for a reduction of the voltage in the ratio of 2 to 1, as would be required for charging a 44-cell automobile battery from a 200-V main. Suppose that the charging rate be 2 kW, the cost of charging will be approximately the same whether charging direct from the main with a series resistance, or using an ordinary Grade II motor-generator. The following formula is useful for determining the proportion of generator output to total

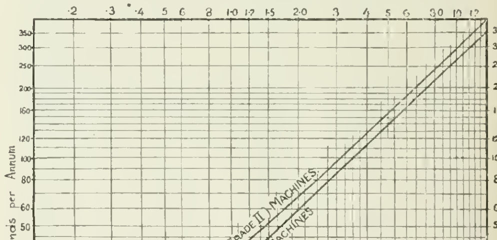

Fig. 7.—Total Working Costs per Year (2,400 hrs.). for Machines Running at Full Rated Output, and Using Current at 3d. per Unit.

secondary output where series-connected machines are used—

$$D = T/(1 + 1/R\,E).$$

Where D = dynamo output in watts.
T = total watts output required from secondary circuit.
R = ratio, motor volts ÷ dynamo volts.
E = overall efficiency of set.

Applying this formula to the case suggested above—

$$D = 2{,}000/(1 + 1/{\cdot}74) = 850 \text{ watts},$$

E being based on the combined efficiency of two h.e. machines at 2,000 r.p.m. (approx. 86 per cent. each).

Total watts from 200-V main = 2,300.

Overall efficiency is approximately 86 per cent., whereas charging from the main through a resistance would only yield 50 per cent. overall efficiency.

Allowing the capital charges at £7·2 and £1, the following annual costs at 3d. per unit (2,400 hours) are obtained :—

Series connected motor-generator, £77·2
Direct from mains through resistance, £121,

resulting in a net saving of £44 per annum.

The advantages of moderately high speeds have already been referred to, allowing both a gain in efficiency and a reduction in capital costs. For many commercial uses, speeds above 1,000 r.p.m. cannot be profitably employed for motor driving, owing to the difficulty of arranging suitable couplings without employing reduction gear.

Where motor-generators are concerned, however, full advantage can be taken of high speeds, although at present even for small machines below 1 kW output, 1,000 r.p.m. appears to be the standard speed. In fig. 8 curves have been prepared showing the working costs per annum for various types of motor-generators on the basis of current at 3d. per unit.

Some remarkable reductions are noticeable between the working costs for Grade II machines at 1,000 r.p.m., and h.e. machines at 2,000 r.p.m. (Curves A and B).

For example, for the smallest type of machine of 100-watts output, as commonly employed for charging automobile ignition accumulators, the cost per annum falls from £12·6 to £8. Then taking a somewhat larger machine of 1 kW output as might be used for plating purposes, the annual costs fall from £68 to £16. Lastly, noting the values for a machine of 10 kW output, the annual working cost falls from £500 to £385.

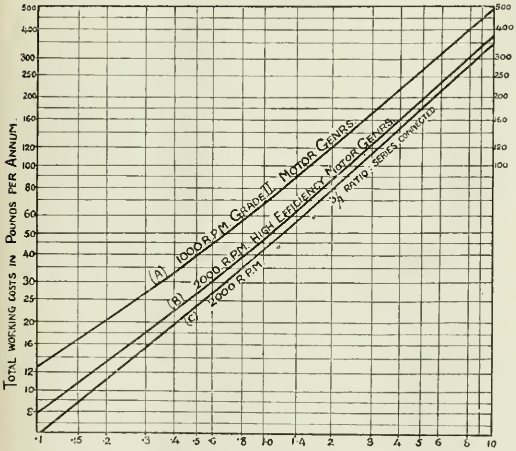

Fig. 8.—Annual Working Costs for Motor Generators (2,400 hrs.) on a Basis of Current for Motor Side at 3d. per Unit.

If in the latter case where, for example, the motor-generator is required for welding purposes, the voltage ratio is approximately 3/1, then a further reduction to £300 could be obtained by using a series connected machine.

In fig. 9 some curves are drawn showing the actual cost of current at the generator terminals after the capital costs have been met, and the losses in the machines paid for; these are based on power current to the motor terminals being obtained at the uniform rate of 3d. per unit.

It would no doubt be surprising to many users of motor-generators to know that the actual cost of their regenerated current was two or three times the initial cost of the power, and for the small 100-watt charging machine, over four times the initial cost.

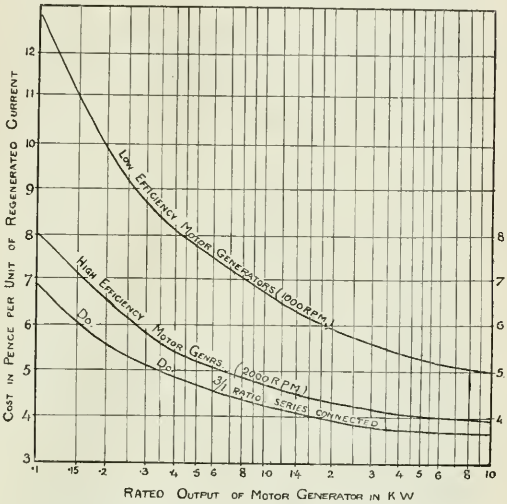

Fig. 9.—Curves Showing the Cost of Current in Pence per Unit from the Secondary Side of a Motor Generator, the Price of Power Current to the Primary Side being 3d. per Unit.

These curves also illustrate the advantage of using machines of higher efficiency, the difference between the two curves being very marked.

It has been found necessary to limit the scope of this investigation to direct-current machines, but some data relating to standard a.c. machines are given in Table II, and may be cited as indicating the direction in which a choice of machines for economical working may be looked for. The particulars given in this table relate to machines of 5 h.p., 50 ~ and 1,400 r.p.m.

TABLE II.

Type of motor.	Full load efficiency.	Approx. prices.
Induction, three-phase, sq. cage ...	86 %	£70
Induction, three-phase, wound rotor	84 %	£80
Induction, one-phase, sq. cage ...	81 %	£88
Induction, one-phase, wound rotor	79 %	£100
Repulsion, one-phase	75 %	£130

It is seen from this table that three-phase are preferable to single-phase motors, and that squirrel-cage rotors are more efficient than wound rotors. Wound rotors should only be employed where starting-current and torque conditions necessitate their use, and the repulsion-type motor where starting against considerable load is required.

For motor-generator work the squirrel-cage induction motor should meet most requirements.

In concluding this article it is pointed out that in many cases hard and fast rules cannot be adhered to in effecting a reduction of working costs, and a careful study of the following points is necessary before a decision can be arrived at :—

(*a*) Extent and nature of load.
(*b*) Number of working hours per annum.
(*c*) Purchase price of machine.
(*d*) Maker's guaranteed efficiency curve.
(*e*) Cost of current in district where machine is to be installed.

However, certain facts have been established which should prove of use when laying out plant to the best economical advantage, and these are summarised below:—

1. An increase in rating of machines at present in stock up to the 90° F. limit (in accordance with the Engineering

Standards Association's decision such temperatures can be safely employed) would generally result in improved "all-day" efficiency.

2. An increase in the first cost of a machine in many cases will be justified to obtain higher efficiency.

3. High speeds up to reasonable working limits should be employed where driving conditions do not prohibit their use.

4. The use of series-connected motor-generators offers considerable reductions in working costs where the ratios between primary and secondary voltages are favourable.

5. Low-efficiency machines are best suited for operations in districts where the price of power is low, or where the number of working hours per year is small.

REVIEWS.

Ozone. By E. K. Rideal, M.B.E., M.A., Ph.D. Pp. viii+198; 24 figs. London: Constable & Co., Ltd. 1920. Price 12s. net.

This book forms the second published section of the late Mr. B. Blount's "Treatise of Electro-Chemistry," which is intended to comprise a comprehensive series of separate monographs based on the chapters of Mr. Blount's well-known text-book. The scheme is an ambitious one, but it was worth the attempt, and it deserves success.

The present book is by one of our younger electrochemists, a gifted and promising investigator, from whom much is expected. It is gratifying that the attractions of a professorship at the University of Illinois were not proof against the call of his native land, and Dr. Rideal is now teaching electro-chemistry at Cambridge, where we hope he will found a vigorous school of that branch of physical chemistry. Dr. Rideal has exceptional gifts as an expounder, not the least of which are his lucidity of style and his grasp of fundamentals, and his talent for teaching finds a ready outlet in the volume before us. The book, however, is not, in our view, well balanced. While no doubt ozone is in itself a substance of considerable interest, whether from the chemical point of view as an allotrope of oxygen, or from the electrical point of view as an accompaniment of many types of discharge, nevertheless its chief claim to general attention lies in its remarkable properties as an oxidising agent—in other words, in its industrial applications—and yet to these the author devotes only about one-fifth, just one chapter, of his book. We are far from underrating the importance of what appears to be purely academic discussion, but we do feel that if some of the space devoted to the consideration of theoretical methods of producing ozone, such as thermal or electrolytic methods, had been devoted to a fuller and more critical account of its use or possibilities, say, in the oil, fat, and wax industries, or in organic chemistry generally, the book, excellent as it is, would have been far more helpful and stimulating.

The electrical engineer, as such, will find Chapter VII the most interesting in the book, as it deals with the formation of ozone by the action of the silent discharge in air—at present the only method of manufacture that has attained technical importance, although the quartz mercury-vapour lamp ozoniser has possibilities worthy of scrutiny. The theoretical discussion in this chapter is well handled, and the conditions favourable to maximum production are brought out with precision and clearness. The accounts of the various ozonisers in use, however, are descriptive on the whole rather than critical. Possibly there do not exist sufficient quantitative data on which to base a critical discussion. There is much scope for further experimental study of the industrial preparation of ozone.

In the field of application the most extensive use of ozone at present is for the sterilisation of water. We are told that over fifty sets of plant are in operation for this purpose; but while ozone may perhaps continue to be used in certain cases for completing the sterilising process, it is likely that electrolytic hypochlorite or chlorine—far cheaper products—are destined to replace ozone in course of time.

Of great interest is the discussion of the *rationale* of air-purification by means of ozone, a process which must be assumed to be beneficial in view of its extending use on the London tube railways and elsewhere, but which nevertheless is at present difficult to explain in a satisfactory manner. We can hardly accept the view sometimes put forward that the effect is purely psychological, but yet no evidence exists that the small quantities of ozone used can be germicidal—except in the air which actually passes through the ozoniser.

It is clear that the remarkable properties and the future possibilities of ozone give it an interest quite out of proportion to its actual importance.

Dr. Rideal's book will, therefore, make a strong appeal to those whose imagination is stimulated by the promise of what may be, rather than by the more prosaic performance of what actually is.

In Introduction to Technical Electricity. By S. G. Starlino, B.Sc., A.R.C.Sc. Pp. 181; figs. 158 London. MacMillan & Co., Ltd. Price 3s 6d. net

Tho publishers' note at the beginning of this work points out that the Education Act of 1918 will call for a large extension of elementary school work, and their Life and Work Series is meant to supply this demand. The volume on technical electricity by Mr. Starling has been specially written with a view to treating the subject in a manner suitable for young students. It is clearly written, and the subject matter is likely to make a very direct appeal to all readers. Since the book is primarily for class work many simple illustrative experiments are described, and there are several test questions at the end of each chapter. The book could be read without much difficulty by a private student, although a fair knowledge of chemistry and some elementary algebra are presupposed. It would add to the value of the book if a price list of the instruments and materials for the experiments were given, as many keen students are prevented by local circumstances or by temperament from attending organised courses. The scope of the book includes Electric Circuits, Ohm's law, Primary and Secondary Cells, Induced Currents, and these subjects are illustrated in a very practical way. The only criticism which the reviewer has to offer is that the machines shown in the figures are completely out of date and can now be found only in museums. The Elihu Thomson supply meter shown in fig. 149 has no potential resistance other than that of the armature, and although this may be rather beyond the scope of the readers, it is an error, and should be corrected. It would be better to describe a mercury motor meter as this type is far commoner in Britain than the commutator type. On the whole the book is very good, and can confidently be recommended.

Elementary Telegraphy. By H. W. Pendry. Second edition. Pp. 237; 189 figs. London: Sir Isaac Pitman & Sons, Ltd. Price 7s. 6d. net.

This book, written especially to meet the requirements of the first grade of the subject in the syllabus of the City and Guilds Institute, can be recommended confidently as a first text book in the art and science of telegraphy. In the ten years which have elapsed since the first appearance of the book there have been various advances in practice, and these the author takes into account—so far as they fall within the province of the book—by describing later apparatus and including new and revised diagrams. As the book is intended primarily for students a feature which will be generally appreciated is the appending of exercises to each chapter and the inclusion of the City and Guilds examination questions for the years 1908-1920 inclusive. It cannot be emphasised too strongly that the solution of definite problems is the best means of testing and establishing knowledge. A welcome addition from the reader's point of view would be the inclusion of answers to all the numerical problems.

Commencing with an introductory treatment of the fundamental principles of electricity and magnetism, particularly as bearing upon telegraphy, the author proceeds to deal with primary batteries and secondary cells as used in telegraphy. Telegraph instruments are then described, attention being confined to the simpler equipment, all of which is well illustrated by photographs, by diagrams where necessary, and by connection diagrams in every case. Telegraph lines, overhead and underground, are next considered, all the main constructional components being described and illustrated and good practical treatment being given to the main principles of erection and operation. Testing instruments and the simpler line tests are also considered in this chapter.

The simpler systems of manual telegraphy, duplex working, central and universal battery systems, and various developments in this field are discussed in Chapter V, whilst the final chapter contains useful miscellaneous information on earth currents, and the protection of line and apparatus.

The general verdict on this book will be that it is a volume with a definite purpose which is very well fulfilled.

Telegraphy. By T. E. Herbert. Fourth edition, revised. 1,019 pages, 638 figures. London: Sir Isaac Pitman & Sons, Ltd. Price 18s. net.

In reviewing this monumental work, long since familiar to every telegraph engineer, it is unnecessary to do more than notice the additions to the text in the new edition. In general, the work remains the finest and most comprehensive treatment available for the telegraph engineer, dealing as it does with the fundamental principles of magnetism and electricity; primary and secondary cells; circuit laws and calculations; current, voltage and resistance measurements; all the apparatus and circuits employed in various telegraph systems; and the construction and testing of overhead and underground lines.

Several pages describing the Kleinschmidt keyboard perforator have been added to Chapter X on the Wheatstone automatic system. Chapter XVII on secondary cells has been overhauled, some additional information being incorporated. The chemistry and physical phenomena of the action are considered, plate and cell constructions are described at considerable length, and very sound recommendations are made concerning the treatment of cells.

Appendix C, dealing with the Gulstad relay, has been re-written with the incorporation of much information of special interest now that the G-relay is adopted on so many long and difficult circuits. The G-relay has been, of course, the P.O. standard relay with the addition of auxiliary windings employing the Gulstad principle. The vibrating relay increases the working margin on long high-speed Wheatstone circuits and increases the rate of transmission on some of the long underground and submarine cables by 50 per cent. The use of G-relays on the London-Newcastle quadruple duplex Baudot line (358 miles, KR−103,700) has dispensed with the repeater formerly required at Warrington.

Though amplifying valves are not yet employed on telegraph circuits in this country, there can be no doubt that their remarkable properties will soon be utilised. The author has, therefore, wisely gone ahead of present practice in this country and provided in the addendum a very useful treatment of the thermionic relay—its principle, construction and application.

No great success has yet been obtained in evolving formulæ which will enable the working speed of a cable circuit to be calculated directly. There are many factors which cannot well be taken into account mathematically, hence the actual speed is lower than that indicated by formulæ, and the only safe practice is to base estimates upon the rate of working in circuits of similar construction but different length. In aerial lines the determining factor is the value of the received current, and the author gives an excellent *résumé* of J. L. Taylor's researches in this field. Atmospheric conditions in this country make the loss of current due to low insulation the limiting factor determining the permissible length of overhead telegraph wires.

The addendum concludes with a description of the vibroplex and an unbiased estimate as to its value in preventing telegraphist's cramp. The device, which is used considerably in America, consists of a lever which is moved to the left to send a dash, and which is held over to the right for varying periods, whilst the requisite number of dots is sent automatically by the vibration of a weighted spring. It is a question whether telegraphist's cramp is not due generally to faulty technique on the part of the operator, and whether the risk of cramp cannot be virtually eliminated by the use of double current keys instead of single current keys on busy circuits.

In conclusion, it may be asserted that this volume remains the classic work on telegraphy both for engineers in practice and for students, who will be interested to know that the book is recommended by the C. & G. examiners.

RECENT DEVELOPMENTS IN TURBINE PRACTICE.

Discussion at Newcastle-on-Tyne.

Mr. K. Baumann's paper on the above subject, which was abstracted in our issues of April 15th and 22nd, was discussed by members of the North-Eastern Centre of the Institution of Electrical Engineers on May 9th.

Mr. F. W. Gardner, in opening the discussion, characterised the paper as essentially controversial, saying that many of the conclusions arrived at must on that account be open to question. The point of primary interest was its bearing on the old controversy which still raged round the relative merits of the two great types of turbine, *i.e.*, impulse and reaction. The next point was the author's dislike for the tandem turbine. At the outset he belittled the performance of tandems with a two-flow exhaust by ruthlessly dividing the output by two, although the fundamental virtue of a tandem machine was its adaptability for the two-flow arrangement. The speaker referred to the tandem as a means of increasing the output at a given speed beyond the maximum attainable efficiently with a single cylinder. The alternative was the multi-exhaust described in the paper. That, he suggested, added appreciably to the length, weight, and complexity of the turbine and, therefore, to its cost. The paper contained no evidence to show that a multi-exhaust could be as effective as a two-flow tandem machine in keeping down leaving losses. The blade height that could be used with a given mean diameter and stress was greater in the tandem, as the complication of an abrupt change of section half-way up the blade was not required. Further, the multi-exhaust necessitated the introduction of a labyrinth of idle blades and guide passages, the losses in which must be considerable. The multi-exhaust undoubtedly marked an advance upon a single exhaust, but some more concrete evidence of its actual performance was required before they could share the author's optimism about its efficiency. The paper showed that a given area through the last row was best obtained by adopting a tall blade on a small disk—that was, by making the ratio of blade height over diameter as large as possible; and in that respect the reaction turbine had an advantage over the impulse type, because the limiting value of that ratio depended, finally, on the possibility of providing against blade vibration rather than on the theoretical value of the stress in the material. Vibration was most effectively prevented by binding the blades together at frequent intervals along their length, and that could be done without appreciable loss of efficiency in reaction blades, as the velocity of the steam at the inlet edge was comparatively low with that type. Also the spread of the blades at the tips could be made greater with reaction blading without serious loss of efficiency. There was another reason why a tandem arrangement was advantageous. The practice of reheating the steam at the stage where the initial superheat disappeared was developing, and might very soon be widely adopted for large plant. In that case, the whole of the steam had to be withdrawn from the turbine and then returned for the remainder of the expansion, and the turbine, therefore, automatically became a two-cylinder machine. The same applied in a lesser degree where steam was bled from the turbine at two or more points for heating the boiler-feed water, as it seemed improbable that all the necessary belts for steam extraction and also a multi-exhaust could be crowded into the span of a single shaft, at all events if the exhaust were of the more complicated type foreshadowed in the description. The section of the paper dealing with the correction factors which had to be applied to reduce the actual steam conditions of a test to the design standards had been very carefully and thoroughly worked out. A comparison of the new curve given for the vacuum correction with that given in the author's earlier paper showed clearly how the leaving losses had increased in importance with the increase in the size of turbo-alternators. Such curves had been in use by designers for a long time, but had not, he thought, previously been published, and the author's new curve should be of much service for general purposes, though in supplying correction charts for large plant the manufacturer would prefer to treat each case individually, since the curve was applicable only to plant rated strictly in accordance with the author's definition of economic rating, and it was hardly possible to include all the widely differing cases occurring in practice accurately in a single curve.

Mr. T. Waite was not very much concerned about the question of impulse or reaction turbines referred to by the last speaker, but was more interested in the matter of breakdown. The matter of maximum size of the turbine depended largely, to his mind, upon the kind of system to be used. Despite all the technical skill used, breakdowns did occur and, so far as electrical undertakings were concerned, the first point was reliability, and that being so the maximum size of any turbine should be just such as, in the case of breakdown, would permit of the load being carried within the capacity of the remaining plant. He agreed with the author that the factor of safety should be increased with the size of the turbine, and favoured the figure of 15 per cent., for their experience was that 10 per cent. did not provide a sufficient margin. With regard to the author's remarks on the by-passing of steam, he pointed out that the turbine was not designed to run on overload long, and those who permitted this were not looking after their business well.

Mr. Dowson drew attention to the fact that it had always been the policy to aim at reliability first, and after that economy. When the author read his former paper in 1912 they were thought to be falling away because they were below the speed figures given. In 1915 their maximum surface speed was 500 ft., while that of the impulse turbine was much higher. They had always used ordinary carbon steel, and one of the features of the Parsons turbine in this country was its simplicity. Regarding the author's remarks on the factor of safety in the large turbine, he did not think anyone could say anything against the reaction design in the way of lowering that factor. That question also brought out that of tandem turbines, which were introduced first as reaction machines, and he thought that the value of that design was quite understood. With regard to the multi-exhaust, which he admitted was very ingenious, he did not quite agree with the justification put forward by the author, because in a given power station they did not necessarily want to install as large a turbine as they could. He thought the better way was to use a higher vacuum, which under present circumstances, should not present any great difficulties.

Electrically-Treated Seed.—Mr. A. H. Forder, contractor for the electricity supply for Laura, South Australia, has during the past two years treated seed wheat and oats with electricity for experimental purposes. Mr. H. L. Tomlinson, of Taplan, near Loxton, sowed the electrified seed alongside wheat of the same variety treated in the ordinary way (pickled). Each was given the same chance. In growth right through the electrified seed was superior, and at the finish went 31 bushels to the acre against 27. Mr. Tomlinson considers it would be a good plan to electrify all the seed reaped from the experimental plot, and sow again this year on clean land for the purpose of carrying the experiments further. The grain resulting from the electrically-treated seed seems to be much improved, and is free from smut.—*The Leader*, Melbourne.

A MARCONI WIRELESS TELEPHONE SET FOR AIRCRAFT.

A pamphlet recently published by Messrs. Marconi's Wireless Telegraph Co., Ltd., gives a full description of a combined wireless telephone transmitter and receiver for installation on aircraft for communication to ground stations or other aircraft.

The chief characteristic of the set is that it combines in one box both transmitter and receiver (fig. 1), connected permanently by cables to a small control set (fig. 2). This control unit can be mounted conveniently to the hand of the user, while the set proper can be installed in the most convenient position. A small wind-driven generator supplies all power for transmission, both h.p. at 1,500 V and 0.1 A, for the oscillatory circuits, and l.p. at 7 V and 5 A for the valve filaments of the receiver; a "send-receive" switch is used for changing over. An accumulator floats across the l.p. supply terminals, but does not actually supply power, acting merely as a voltage regulator when the generator varies in speed, and it also helps to smooth out the ripple on the generator commutator. The generator is of unusual design, and consists of two entirely separate machines in one case, driven by a common shaft, the axes of the machines being parallel. The h.p. machine is simply a common type of self-excited d.c. generator. The other machine, with its separate magnetic field, has two commutators, the forward one giving a high-pressure supply. The second commutator gives 7 or 8 V, and is used for the self-excitation of its field windings. By this arrangement the l.p. machine runs continuously, while the h.p. machine can be switched on or off without disturbing the l.p. supply. On transmission, therefore, the l.p. machine power is diverted to the transmitting valve filaments and the h.p. machine is switched on by completing the circuit from its l.p. commutator to its field coils, but on reception the h.p. is switched off and the l.p. machine power diverted to the receiving valve filaments. The design is such that generator noise on reception is negligible. A l.p. smoothing condenser is connected across the l.p. terminals to help eliminate noise.

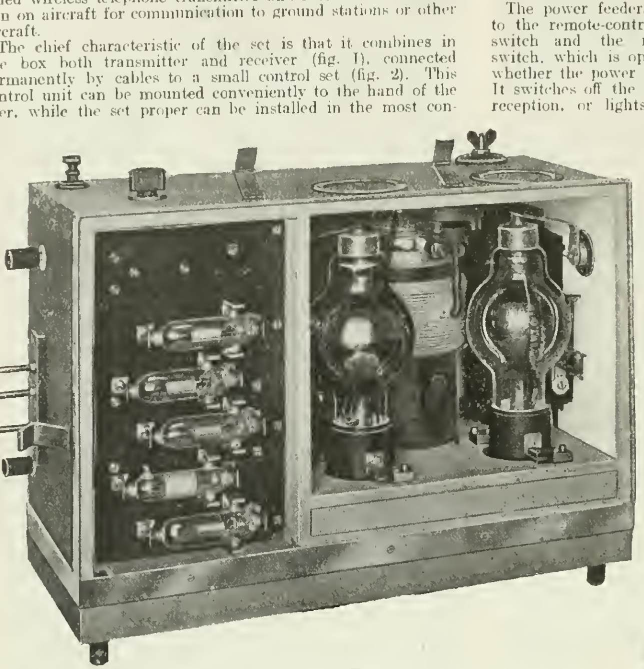

Fig. 1.—Receiver and Transmitter.

Power is fed from the generator by a five-way cable consisting of four wires bunched in an outer aluminium braided covering, the latter forming one of the conductors, to a smoothing condenser. This condenser is connected across the positive h.p. and the negative common earth (the braided covering). The condenser smoothes out the h.p. ripple, and the containing box carries a plug junction for the power feeders. This enables the generator wires to be disconnected quickly from the main wiring of the apparatus if the generator is to be removed from its mounting on the machine.

The power feeders lead on from the smoothing condenser to the remote-control unit, which mounts the send-receive switch and the receiver adjustment. The send-receive switch, which is operated by the central handle, determines whether the power shall be carried to transmitter or receiver. It switches off the h.p. and lights the receiver filaments on reception, or lights the transmitting filaments and applies the h.p. to the transmitting oscillating and control circuits on transmission, and furthermore, appropriately changes over the aerial. The two remaining handles apply to the receiver and control the tuning condenser for adjusting to the correct wave-length and a resistance for cutting down the loudness of the speech when flying near a ground station.

The transmitter consists of the usual oscillatory circuits for the generation of continuous waves and the low frequency control circuits for modulating the intensity of these waves. The former circuits comprise a power valve with reaction and aerial coils. A wave-length switch cuts in or out a certain part of the aerial coil. Thus every set is capable of radiating two wave-lengths; with the standard windings these are 900 metres for the aircraft wave and 600 metres for communication with ships or land stations. The control circuits embody a microphone transformer, choke, and control valve for amplifying the voltage variations of the microphone transformer and superimposing these on the h.p. supply.

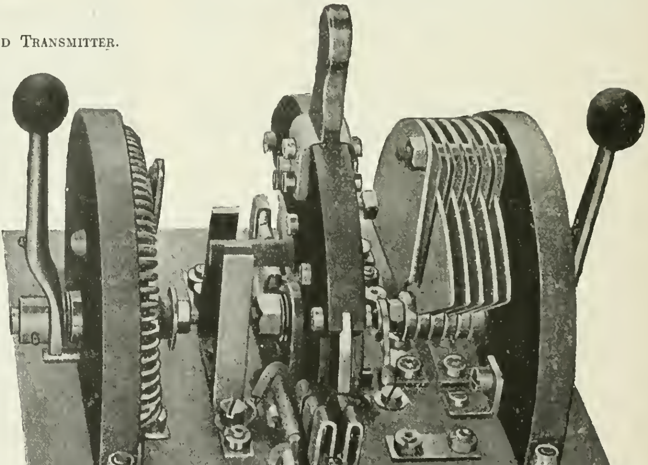

Fig. 2.—Control Unit.

The receiver is a five-valve circuit consisting of three high-frequency amplifying valves, one detector valve, and a note magnifier. The valves are lighted from the commutator of the l.p. generator and fed with h.p. power from a battery. The condenser in the control unit gives fine variations of wave-length about a fixed length. When used as an operator-controlled set, however, it is possible to obtain wave-lengths of from 450 to 1,000 metres by the use of an induction tapping switch, which provides a coarse wave-length adjustment, the finer changes being given by the movement of the condenser in the control unit. The aerial circuit is inductively coupled to the first high-frequency valve through a so-called aperiodic coil. This coil, when loosely coupled to the aerial circuit, has a natural wave-length equal to that of the standard to be worked to. On tightening the couple, however, the mutual inductance of the aerial and aperiodic coil tends to bring in two possible resonance points, one higher and one lower than the wave obtained with loose coupling. Thus, by varying the coarse wave-length switch in combination with the control condenser, the aerial circuit is tuned. The whole of the high-frequency circuits are screened in one metal box and the aperiodic and aerial coils are screened themselves from the high-frequency transformers. Reaction is arranged for so that the set can be made to oscillate and work as an auto-heterodyne circuit for the reception of continuous waves, or can be given increased sensitivity for the reception of weak signals by increasing the reaction.

The high-frequency transformers are damped very heavily so that the reaction adjustment is fully controllable from the appropriate handle, and is not greatly affected hy wave-length changes or filament brightness. Low resistance telephones are used connected across the secondary terminals of a step-down iron-core transformer so that there is no danger of demagnetising the telephones by the anode current through the note-magnifying valve. The telegraph unit has a key, buzzer, and switch. In one position the key is arranged to cut up the continuous waves into Morse by opening and closing the grid resistance, and so will give continuous wave transmission. In the second position of the switch a buzzer replaces the microphone, the control valve becomes operative, and an interrupted continuous wave is sent out. A third contact on the switch short-circuits the key and throws the microphone into circuit in place of the buzzer.

To enable the user to hear his own voice above the noise of the engines, and thus correct any tendency to shout, the secondary of the microphone transformer at its "earth" end is connected in series with the telephones of the receiver. This impairs the sensitivity of neither the transmitter nor receiver.

The generator, in cases of emergency, can be run from an accumulator as a motor-generator, but this means additional weight for the machine. The total weight of the apparatus described is 63.5 lb. The largest part of the equipment measures 14.5 in. by 6.75 in. by 10 in. It will be seen from these figures that the whole of the equipment adds hut a negligible quantity to the weight carried by the machine in which it is installed.

THE BRITISH SCIENCE GUILD.

The fifteenth annual meeting of the Guild was held, by kind permission of the Warden and Court of Assistants, in the Goldsmiths' Hall on June 8th.

In presenting the annual report, Lord Montagu of Beaulieu, K.C.I.E., C.S.I. (president), made reference to the industrial questions still awaiting a solution, and reiterated the oft-expressed opinion that only increased output could restore the nation to a normal basis. To secure this increased production the scientific habit of mind must be inculcated into the minds of workers and masters alike. This would lead to a wider outlook, and lead them to seek the truth. Science aimed at truth. Since the banishment from the Garden of Eden, the success of men in ninety-nine cases out of a hundred, had been due to hard work aided by science; by men working a little harder than their fellows. The speaker sympathised with Lord Robert Cecil's views upon the working of the League of Nations, but he thought the possibility of success in this direction was still far off. To bring about the necessary state of mind education, in which science would play a prominent part, was needed. Science was becoming of more and more importance to the individual as well as to the nation. Turning to the report, Lord Montagu spoke with regret of the loss to science caused by the deaths of Sir Norman Lockyer and Sir William Mather, who had been foremost in furthering the success of the Guild. The work of the Guild during the year was then briefly reviewed.

An important activity during the year had been the preparation of a catalogue of British scientific and technical books. This catalogue was the most comprehensive of its kind in existence, and contained particulars as to the anthor, title, size, date of last edition, publisher, and price of every volume on science and technology (with the exception of elementary school books) now in publishers' lists. More than six thousand titles had been classified.

The committee had had under consideration the utilisation of science in public departments. It urged that technical and scientific officers should have a status in every way equal to that accorded to the "administrative staff," and that the scale of their salaries should, in order to correspond with the measure of their responsibilities, be raised to the same standard as that of the "administrative staff."

In order to make the work of the Guild more generally known outside London, and to increase its membership and thereby its influence, the interest of the members in the provinces had been enlisted in the establishment of local branches or "groups," which would assist in carrying on the main work of the Guild, and also engage upon local problems. Steps were being taken to establish such groups in Birmingham, Bristol, Cardiff, Dublin, Dundee, Leeds, Leicester, Liverpool, Manchester, and Newport (Mon.).

Meetings of Rotary Clubs had been addressed at Bristol (by Sir Richard Gregory) and at Brighton and Portsmouth (by Mr. J. J. Robinson). Several of them had already joined the Guild, and in others the decision to do so awaited confirmation. A conference between representatives of these clubs and local "groups" of the Guild with the Executive Committee was being arranged for July.

A sub-committee had been appointed to inquire into the position of the manufacture of British laboratory ware, porcelain, filter paper, and microscopes, as regarded supply, cost, and quality, in comparison with imported goods. In December last the representatives of the manufacturers of optical instruments gave evidence to the committee on the position of the British optical industry as affected by German competition.

A conference on "Science and Labour in the Modern State" had been suggested. A meeting was held between the Parliamentary Committee of the Guild and representatives of the Labour Party last July, at which the idea of such a conference was approved; but owing to the disturbed industrial conditions, it had been necessary to postpone further action for the present.

Upon the motion of Lord Avebury, seconded by Sir John Cockburn, K.C.M.G., the report was adopted, and the following were elected vice-presidents: The Lord Mayor of London, the Very Rev. William R. Inge, C.V.O. (Dean of St. Paul's), and Sir Richard A. S. Redmayne, K.C.B.

Dean Inge then addressed the meeting, taking as his subject "The Road to Ruin and the Way Out." He said that a diagnosis of social and industrial disease was the first necessity, and having made this, he found that the strike was the most serious feature. Science and religion were solutions of the existing unrest. Christianity, like science, said that they must get their values right, and religious idealism did not draw them away from happiness and progress.

Sir Richard A. S. Rermayne spoke on "The Importance of Research in the Development of the Mineral Industries."

The present state of the civilised world was, he said, economically, paradoxical. The necessity for commodities was very great, yet the production of them was so costly that industry was languishing for lack of orders. The explanation lay, he thought, in a combination of circumstances: A feeling of insecurity due to unsettled political and financial conditions. Hence, a disposition to conserve rather than to utilise in commercial ventures such capital as was available; the incidence of rate of exchange; the high cost of production consequent on the high cost of living and the higher standard of comfort demanded by the labouring classes (and rightly so demanded) than formerly obtained, and the lower and still apparently decreasing productive power of labour. The first two conditions would in part right themselves in process of time as the various political problems were solved, or partly solved, and rates of exchange would then tend towards the normal; but a very great deal depended upon the last two conditions, as the future position of production was not easy to forecast. The solution was the discovery by research of cheaper means of production, and, by research, to create new outlets. The cost of production of coal could be reduced by the wider application of the most up-to-date methods of "getting," in transporting and using coal. In some of our largest industries coal, next to wages, was the highest item of cost. The way of research, therefore, appeared to be along the lines of the more efficient *use* of coal. The economic utilisation of low-grade fuels was a matter of great moment. There were in this, as in all coal-producing countries, vast quantities of coal which it did not pay to work owing to the low price realisable thereon. Probably the use of so-called colloidal fuel offered a solution, and would render their use practicable and profitable.

The low temperature carbonisation of coal, too, was at present occupying the minds of many investigators, and might lead to the more extensive use of low-grade fuels.

The stores of liquid mineral oil would not last for ever; indeed, it was probable that the next fifty years would see, if not the complete exhaustion of this source of oil, at any rate a near approach to it. They must turn, therefore, towards distillation of oil-bearing mineral—oil shales and coal—to take the place of the present petroleum supplies.

The available reserves of high-grade iron ores in Great Britain were nearer exhaustion than were the coal supplies. More and more, too, the world would have to turn to the poorer grade of ore—a wide field was offered for research work in devising economic methods for its reduction.

Mr. Picard, in his presidential address to the Institution of Mining and Metallurgy in 1919, said in the province of general metallurgy the increasing use of the Cottrell process deserved special mention.

In the work of research the universities were peculiarly fitted to take an important—a leading—part. The Department of Scientific and Industrial Research might well endow university scientific research on chemical, metallurgical, and engineering work, supervising and co-ordinating and publishing the results.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Contactor Arc Splitter.

Inasmuch as magnetic control apparatus is now used for the control of electrical machinery in practically every industry, and as the reliability of any such system is directly dependent upon the reliability of the contactor, the latter in turn depending upon the proper functioning and durability of the contact tips, a new device recently developed by the Westinghouse Electric International Co., of East Pittsburgh, Pa., U.S.A., should be of considerable interest. By the use of an "arc splitter" it is said that the life of contactor tips used in conjunction with electric control equipment can be doubled. The improvement consists of a refractory element which is so placed in the arc box of the magnetic blow-out as to project into the path of the arc. This projection forces the arc to pass around it, and thereby lengthens its path. The lengthening of the arc increases its resistance and causes it to rupture more rapidly, and, in addition, the travel of the arc over the surface of the splitter tends to cool the arc gases, which also causes the arc to rupture more rapidly. Quick arc rupture reduces the wear on the contacts and thus increases the life and reliability, not only of the contactor, but of the entire control system.

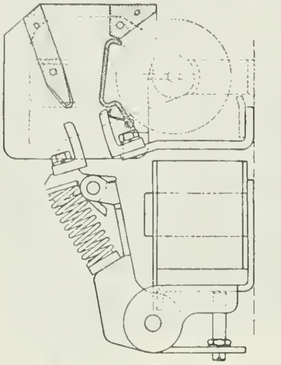

Fig. 1.—Magnetic Blow-out Contactor with Arc Splitter.

As shown in fig. 1, the arc splitter is placed immediately above the contactor tips. A transverse magnetic field is produced by the magnetic blow-out where the arc occurs, and the action of the arc in this field is similar to that which takes place in a motor when a current-carrying conductor is placed in a magnetic field. The conductor, which in this case is the arc, moves in the same direction as it would in an electric motor, and the arc is forced out by this movement and consequently lengthened. The action not only lengthens the arc, but also forces it against the splitter which accentuates this action.

A New Method of Stage Lighting.

Lighting is an enormously influential factor in the production of modern stage plays; especially in plays of a spectacular nature and in those which appeal chiefly to the visual sense, lighting is *all* important. A play may be made or marred by light, and the producer, as a rule, knows exactly what he wants in the way of lighting effects; but, until recently, he has not been able to get the necessary apparatus. Where results in advance of the common standard have been achieved, they have usually been due to ingenious improvisations by the stage electrician.

The new system of stage lighting designed and manufactured by the British Thomson-Houston Co., Ltd., Mazda House, 77, Upper Thames Street, E.C. 4, is, however, claimed to be free from the common defects of, and as a consequence more effective and adaptable than, the traditional method.

Briefly described, the new equipment is a combination of three elements—the X ray mirror reflector, the Mazda gasfilled lamp, and a metal framework to hold coloured gelatine slides. The required number of units, each consisting of a lamp, reflector, and colour slide, are assembled in a specially-designed metal trough.

B.T.H. stage lighting equipment is supplied in four different patterns, viz., (*a*) concentrating battens which are intended for the intense illumination of particular sections of the stage. They are equipped with "Jupiter" X-ray reflectors and with either 100 or 200-watt Mazda gasfilled lamps. Using 100-watt lamps, this form of batten gives a downward illumination of 1,000 c.p. per lamp, that is, a batten containing 30 100 watt lamps would project a light of 30,000 c.p. on to the stage; (*b*) for the general illumination of the stage distributing battens (fig. 2), equipped with "Scoop" X-ray reflectors and 100 or 60-watt Mazda gasfilled lamps are recommended, while (*c*) special "E. 60" X-ray reflectors and 60-watt gasfilled lamps are used in the float and proscenium strip. Fig. 3 illustrates footlights.

It is said that in many cases the installation of B.T.H. equipment may be expected to bring about increases in overall efficiency of up to 200 per cent. Another economical advantage is that a smaller number of larger lamps can be used, thereby reducing the expense of replacements and maintenance, and the fact that in the new system it is not necessary for the lamps themselves to be coloured, saves them from a great deal of the handling and consequent breakage to which such lamps are commonly exposed.

From the colour standpoint the system under review is superior to earlier methods. Colour effects are obtained by the use of gelatine slides; over the mouth of each reflector is fitted a sliding frame into which the gelatine is slipped, and it is very easy to change the colours about as desired in a few seconds by the substitution of one set of slides for another.

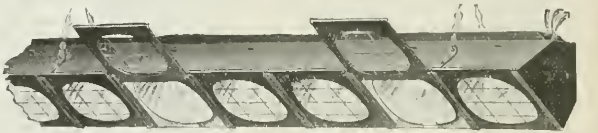

Fig. 2.—B.T.H. X-ray Distributing Batten.

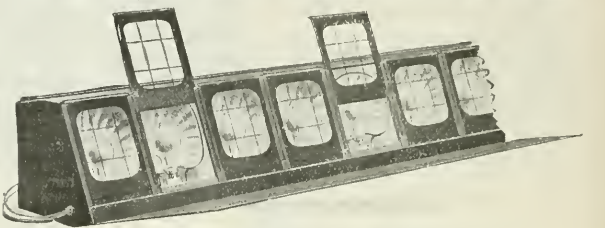

Fig. 3.—B.T.H. X-ray Footlights.

The B.T.H. system has already been installed in two of the leading London theatres, and the equipment for several other theatres is now being made. We understand, by the way, that this company is busy with the manufacture of other few seconds by the substitution of one set of slides for another. able utility in the theatrical world.

The 'Priory'" Ceiling Fitting.

We have received from The Priory Electrical Engineering Co., Ltd., Bath Street, Birmingham, a sample of a new type of ceiling fitting which they have introduced. This fitting, which is illustrated in fig. 4, comprises a rectangular brass

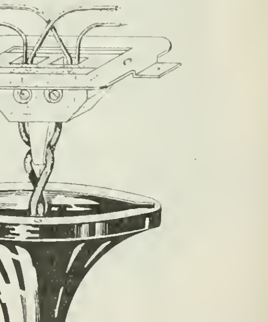

Fig. 4. The "Priory" Ceiling Fitting.

clamping plate provided with a lug at each end and holes for screws to fix it to a ceiling. A block of insulating material is held by two retaining pieces forming part of the plate, and in this block two terminals are fitted. The other part, completing the device, is a metal cone which fits over the block and plate; two recesses on an inner rim fit over the end lugs of the brass clamping plate, and the cone is turned until two small stops on the lugs engage with corresponding holes in the rim. An insulating bush is fitted in the entry hole at the apex of the cone. The cone is made in various finishes, as Florentine bronze, old brass, &c., and is very effective in appearance. The chief advantages claimed for the new fitting are an absence of breakable parts and a reduction in the labour necessary for fixing the device.

A Neon Lamp Adapter.

The Neon lamp has at present only been generally developed in a ¼-c.p. size, and for this reason is not suitable for ordinary lighting purposes. It is, therefore, necessary to make arrangements for a more powerful lamp as well, the Neon lamp being used only when little illumination is required. To obviate the necessity of changing lamps for this purpose, Electrical Utilities, Ltd., has recently brought out a double adapter in which two lamps, one Neon and one ordinary type, can be fixed. It is fitted with an internal switch actuated by a metallic bar and cords are attached to the bar enabling either of the lamps to be switched on easily. The device is called the "Dim-Bright" adapter.

Celastoid.

A new safety celluloid entitled "Celastoid" has been introduced by the British Cellulose & Chemical Manufacturing Co., Ltd., of 8, Waterloo Place, S.W.1; it is claimed that this material has the good qualities of ordinary celluloid without the bad ones. It is non-explosive, non-porous, non-hygroscopic, can be worked, moulded, drilled, &c., with ease, and takes a high polish; it can be jointed with acetone solution and similar solvents, and can be supplied transparent or of any desired colour, in sheets, rods, and tubes. It has a dielectric strength of 720,000 volts per centimetre. Amongst the varied uses to which it has already been put are electric light fittings and bowls, covering telephone receivers, and fan blades.

A New Electrical Vulcaniser—Correction.—Owing to an addition to a proof the final sentence of the description in our last issue read: "The illustration is reproduced from the motor." We intended, of course, to acknowledge our indebtedness to our contemporary of that name.

THE FARADAY SOCIETY.

THE PROBLEM OF THE FUEL CELL.

The possibilities of converting the potential energy stored up in carbon or coal directly into electrical energy, through the medium of a primary battery, seem to exercise a perennial fascination on inventors. This is not to be wondered at when we recollect that the best means of transformation at our disposal—gas-producer, gas engine, and dynamo—only yields a 25 per cent. return, while the more usual construction of boiler, steam engine, and dynamo reduces the figure to 10 or 15 per cent. The prize awaiting the inventor—or the exploiter—of the successful fuel-cell is assuredly beyond the dreams of avarice. In the meantime many have attempted the solution, and if none has succeeded, the trial has yielded results of considerable interest to the electrical engineer, and certain promising avenues of advance have been indicated that are well worthy of further exploration. The paper on this subject, therefore, read before the Faraday Society on May 9th by Dr. E. K. Rideal and Mr. U. R. Evans served a useful purpose in focusing interest and discussion on fuel-cells, and in summing up for us the attempts of the past and the possibilities of the immediate future.

The authors classified fuel-cells under the headings of: (1) Direct; (2) semi-direct; and (3) indirect fuel-cells. In the first class solid fuel is burnt, but the electrodic reactions are so slow that polarisation is very great, and this has so far prevented the construction of a useful cell. Most of the cells are too well known to call for description here, excepting the Baur and Ehrenberg type, in which a carbon box is the anode, fused borax the electrolyte, and fused silver saturated with air the cathode, equivalent to an oxygen electrode. The cell yields 0.95 volt which drops to 0.5 volt when yielding a current of 90 milliamps.

The Read cell is also interesting. In this, thin gold foil is the cathode, and fused borax containing manganese (added as manganese dioxide) is the electrolyte. A battery of six cells has been constructed in series, built one on the top of the other, in a rather ingenious manner. The whole cell is contained in a shallow Battersea crucible, which arrangement provides in the cathode compartment a large surface area of contact between the fused bath and the atmosphere, with a view to maintaining the manganese in the oxidised condition. Air is not bubbled through the liquid. The attackable material at the anode is powdered coal, in which a graphite electrode cut into the form of a grid is embedded, and serves to put the whole into electrical contact with the external circuit.

Each cell of this battery gave an e.m.f. of 0.9 volt, and a current of 185 milliamps. over a 4⅓ ohms resistance falling at the end of an hour to 157 milliamps. This current is not unsatisfactory considering the size of cell used, but the drop is very significant.

In the second type of cell the coal is converted into a gaseous fuel, carbon monoxide, or hydrogen, and the gas used in the cell. The famous Grove gas cell is an example of this type, and an improved form of it was long ago made by Mond and Sanger in which very large electrode areas were provided to minimise polarisation. The use of platinum in this cell puts it out of court. Baur and Ehrenberg have also constructed cells of this type, using nickel saturated with carbon monoxide or hydrogen as positive electrode, fused borax as electrolyte, and molten silver containing oxygen as negative electrode. With the former gas polarisation was rapid, but the hydrogen cell giving 1 volt on open circuit dropped only to 0.5 volt when providing a current of 60 milliamps.

The indirect fuel cells are either of the oxygen-reduction type or the metal-anode type. A typical cell is that of Jungner, improved by Taitelbaum. In the former two carbon electrodes are immersed in warm concentrated sulphuric acid in separate compartments. The cathode is graphite, and air is forced into the cathode compartment; the anode is lumps of carbonaceous matter. The acid in the cathode chamber contains an oxygen-carrier such as nitric oxide, that in the anode chamber becomes charged with sulphur dioxide due to reaction between the acid and the fuel. In Taitelbaum's variety salts of metals which exist in two states of oxidation (*e.g.*, Fe, Hg, Cc, Th, and V) act as oxygen carriers, and the metal is kept in a highly oxidised condition in the one compartment by the action of the air, and in the reduced condition in the other by the action of the fuel—coal gas, acetylene, or similar fuels. On the whole vanadium was the most promising metal to employ, and in one cell at 200 deg. G. a voltage of 0.65 was obtained which, however, dropped to 0.2 volt with a current of 100 milliamps. At 250 deg. G. the voltage was 0.35.

Much interesting experimental work in this direction has been done by Nernst, who has aimed at producing an oxidation and reduction cell which would work at from 40 to 60 deg. C., and appears to favour titanium, thallium, and cerium. He has also suggested the use of chlorine gas, produced (and regenerated) by the Deacon process, as the oxidising agent in certain fuel cells. The production of current by the recombination of the hydrogen and chlorine produced at electrolytic alkali works is suggested as a promising field for investigation.

Nernst would seem to be of the opinion that the most important factor in an indirect cell is the velocity with which the fuel will reduce the metal to the lower state of oxidation and the velocity with which the air will oxidise the metal in the other compartment. Unless the reducing and oxidising reactions can keep pace with the production of current, it is clear that the cell will, sooner or later, cease to work, when the materials originally added will have become exhausted. The authors point out that polarisation depends both on the electrode area and the cell volume, and it is the second factor which introduces the element of time.

Dr. Rideal and Mr. Evans next described the experimental work they themselves have recently carried out. One part of this dealt with the trial of fused electrolytes which are not oxidising agents. One example was "phosphate glass mixture" consisting of one part sodium pyrophosphate and two parts potassium dihydrogen phosphate. This mixture when fused dissolves most oxides readily (to form "glosses"), and it formed a ready medium for studying the oxidising and reducing effects already referred to. A cell built up on this principle, however, was not very promising in consequence of polarisation effects, and this line of advance was abandoned.

Finally, the authors experimented on the metal-anode type of cell. At first thoughts this would not be called a fuel-cell; it becomes one indirectly (as, indeed, does every primary battery) if carbon or coal be used for reducing the oxidised anode. It was found that tin being easily reduced from its compounds was a likely metal to experiment with, and a series of cells was made with this metal and also with lead. The tin cells were hopeful. The one which gave the best results contained dilute hydrochlorine acid with a cast tin anode in the outer jar and a carbon electrode inside a porous pot as the cathode, immersed in a solution of hydrochloric acid and ferric chloride. Air was bubbled continuously through this mixture. It was found that when the ferric chloride was regenerated at the suitable rate, depending on the current flowing, a steady voltage of about 0.66 resulted. There was less polarisation at 80 to 100 deg. C., but other difficulties arose which probably could be overcome. Unfortunately the experiments have had to be abandoned for the time being, and there the matter stands.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

15,543. "Electric switches and fuses." W. L. Barber and Midland Electric Manufacturing Co. June 6th.

15,587. "Cutters for removing insulation from electric wires." V. S. King June 6th.

15,591. "Control systems for electric motors." Metropolitan-Vickers Electrical Co., Ltd. June 6th. (United States, June 9th, 1920.)

15,607. "X-ray tubes." W. E. Schall. June 6th.

15,611. "Means for generating thermodynamic energy." H. Richardson. June 6th.

15,618. "Electric flashing apparatus." W. J. Mellersh-Jackson (Bossard Railway Signal Corporation). June 6th.

15,625. "Tidal hydro-electric engine." P. Bowie. June 6th.

15,631. "Electric locomotives." H. Clough and Greenwood & Batley, Ltd. June 7th.

15,645. "Magneto-electric machines." R. Bosch Akt.-Ges. June 7th. (Germany, June 7th, 1920.)

15,648. "Electric connections." H. Moon. June 7th.

15,654. "Sparking-plugs." Igna Engineering Co., Ltd., and H. R. Wilks. June 7th.

15,670. "Electro-magnetic chucking device." F. Krupp Akt.-Ges. June 7th. (Germany, July 24th, 1920.)

15,681. "Automatic cut-outs." J. Richards. June 7th.

15,722. "Multiple electro-mechanical relay for equilibrated polyphase electric circuits." A. Balducci. June 7th.

15,737. "Power plants." British Thomson-Houston Co., Ltd. (General Electric Co.). June 7th.

16,746. "Electric water-heater." F. H. Austen. June 7th.

15,759. "Automatic voltage selector." J. Henderson. June 8th.

15,782. "Electric heating appliance." W. Smith and J. T. Smith. June 8th.

15,805. "Electro-magnetic apparatus for recording sound." A. F. Sykes. June 8th.

15,811. "Time-controlled electric switch-operating devices." G. S. James. June 8th.

15,823. "Electric insulators." Metropolitan-Vickers Electrical Co., Ltd. June 8th. (United States, July 7th, 1920.)

15,826. "Electric cables or conductors." J. Drennam. June 8th.

15,827. "Cooling apparatus for oil transformers." Akt.-Ges. Brown, Boveri et Cie. June 8th. (Switzerland, December 9th, 1920.)

15,829. "Insulating compositions and coverings." G. W. Orrock. June 8th.

15,838. "Automatic telegraph systems." Western Electric Co., Ltd. June 8th. (United States, July 1st, 1920.)

15,844. "Multiple fuse." J. Szykier. June 8th. (Germany, June 9th, 1920.)

15,846. "Combined plug receptacles and switches." British Thomson-Houston Co., Ltd. (General Electric Co.). June 8th.

15,860. "Illuminable advertising-devices for telephone call-boxes, &c." O. Schowiog. June 8th.

15,869. "Electro-magnetic stop motions for textile machinery." C. Smith, E. W. Varley, N. Whitehead, W. Whitehead, and W. & J. Whitehead. June 9th.

15,886. "Ignition commutators for internal-combustion engines." S. J. Murphy. June 9th.

15,891. "Apparatus for recording and checking telephone calls." G. W. Humphrey. June 9th.

15,911. "Electro-magnetic chucking devices." F. Krupp Akt.-Ges. June 9th. (Germany, July 26th, 1920.)

15,917. "Piezo-electric devices." A. F. R. Cotton. June 9th.

15,927. "Alternating-current electricity meters, &c." Ferranti, Ltd., S. Z. de Ferranti and G. Wall. June 9th.

15,928. "Alternating-current electricity meters, &c." Ferranti, Ltd., S. Z. de Ferranti, and G. Wall. June 9th.

15,929. "Direct-current electricity meters of the mercury motor type." Ferranti, Ltd., S. Z. de Ferranti and G. Wall. June 9th.

15,932. "Generator." D. Suchostawer. June 9th.

15,940. "Suspension device for overhead conductor wires for electric railways, &c." Sir P. Dawson and F. W. Fawdry. June 9th.

15,973. "Enclosed electric cartridge fuse of the dust-filled type." C. H. Moss. June 9th.

15,988. "Turbo-generator for road vehicles." W. Holmes and H. Phillips. June 10th.

15,990. "Fitting for clamping and connecting electric cables in wiring, &c., systems." British Insulated & Helsby Cables, Ltd., F. A. Cole and H. Leicester. June 10th.

15,995. "Appliance for reflecting electric arc of a kinematograph lamp upon a screen, &c." W. Holmes. June 10th

16,003. "Brush-holders in dynamo-electric machinery." J. W. Drake and G. A. Kirk. June 10th.

16,009. "Electric fuses and fuse-boards." P. B. Handley. June 10th.

16,010. "Electric terminals." P. B. Handley. June 10th.

16,011. "Electric switches." P. B. Handley. June 10th.

16,030. "Junction box for intercommunication telephone systems." E. G. Brown. June 10th.

16,034. "Incandescent electric lamps." A. C. Hyde. June 10th.

16,035. "Incandescent electric lamps." A. C. Hyde. June 10th.

16,036. "Liquid electric motor starter." R. F. Baerlocher. June 10th.

16,037. "Telephone exchange systems." L. Polinkowsky and Western Electric Co., Ltd. June 10th.

16,047. "Electric irons." A. Ruelland. June 10th.

16,062. "Flow meters." British Thomson-Houston Co., Ltd. (General Electric Co.). June 10th.

16,065. "Electric switches and switch holders." H. Garde. June 10th.

16,121. "Apparatus for use with train control, &c., systems." Automatic Telephone Manufacturing Co., Ltd., and A. F. Bound. June 11th.

16,148. "Electrolytic treatment of metalliferous materials containing tungsten or molybdenum." E. N. Craig, Durelco, Ltd., and R. E. Pearson. June 11th.

16,156. "Electric signalling." Eastern Telegraph Co., Ltd., and F. E. Pernot. June 11th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

19,852. "Electrical resistance elements." W. Travis and T. H. Watson & Co. (of Sheffield), Ltd. August 13th, 1919. (163,727.)

24,115. "Telephone transmission systems." E. C. R. Marks (Macfarlane Communications Corporation). October 2nd, 1919. (163,728.)

24,556. "Contact for thief alarms or other electrically-operated devices." F. Gresnall. October 8th, 1919. (163,729.)

24,599. "Electrical resistances." A. Lyon & Wrench, Ltd., W. Engelke, and J. C. Todman. October 8th, 1919. (163,730.)

29,887. "Mine signalling apparatus." H. Houghton and Chadburn's (Ship) Telegraph Co., Ltd. December 1st, 1919. (163,736.)

30,020. "Electric current limiting devices." J. Cleary and G. J. Philpot. May 27th, 1920. (163,737.)

31,927. "System and apparatus for enabling a movable object to pursue an electrically staked-out route in a more precise way than by means of visual points of reference." W. A. Loth. December 19th, 1919. (163,741.)

32,701. "Galvanic elements." F. Bocker and A. Eichhoff. December 30th, 1919. (163,744.)

1920.

974. "Electron discharge devices." British Thomson-Houston Co., Ltd (General Electric Co.). January 12th, 1920. (163,745.)

5,173. "Transmitters for electric recording and signalling systems." J. S. Wilson (A. B. Buckley). February 20th, 1920. (163,773.)

5,496. "Ignition devices for internal-combustion engines and the like." W. Pickard and D. R. Dobson. February 24th, 1920. (163,786.)

5,555. "Method of and means for operating tipping gear upon vehicles electrically." P. F. Smith, E. H. Dine and F. R. Stocks. February 24th, 1920. (163,792.)

5,560. "Ignition magnetos for internal-combustion engines." H. Lucas and H. W. F. Ireland. February 24th, 1920. (163,794.)

5,578. "Construction of the field magnets of dynamo-electric machines." G. Schroeder. February 24th, 1920. (163,796.)

5,611. "Electrical control apparatus for lighting systems and the like." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). February 25th, 1920. (163,800.)

5,785. "Telephone systems using call indicators." Automatic Telephone Manufacturing Co., Ltd. (Automatic Electric Co.). February 26th, 1920 (Cognate applications, 12,291/20, 29,153/20, and 31,298/20.) (163,807.)

5,813. "Receivers for wireless telegraphy and telephony." E. Houghton and Portholme Aircraft Co., Ltd. February 26th, 1920. (163,810.)

5,845. "Fuse and junction or terminal boxes for electric-lighting installations." J. Stone & Co., Ltd. (M. Walton). February 26th, 1920. (163,812.)

6,101. "Apparatus for subjecting substances of molecular matter to the electrostatic stress of a high-tension electric discharge." F. G. Niece and R. M. Leggett. February 28th, 1920. (163,823.)

7,142. "Systems of electric ship propulsion." British Thomson-Houston Co., Ltd. (General Electric Co.). March 9th, 1920. (163,838.)

7,361. "Systems of electric motor control." British Thomson-Houston Co., Ltd. (General Electric Co.). March 3rd, 1920. (163,845.)

7,631. "Secret contact electric switch devices for preventing the theft of motor-vehicles." F. Peart and A. H. Ruddle. March 15th, 1920. (163,847.)

7,809. "Gasfilled electric incandescent lamp." Siemens & Halske Akt.-Ges. September 20th, 1913. (140,427.)

8,177. "Radio navigational apparatus and the like." J. Erskine-Murray and J. Robinson. March 19th, 1920. (163,855.)

8,778. "Magneto-electric apparatus." A. Burlat and A. Renaudin March 26th, 1919. (140,791.)

9,721. "Spark plugs." L. S. Flatau. April 7th, 1920. (163,875.)

11,392. "Electrically-operated rivetting, pressing, stamping, and the like machines." E. Adamson. April 24th, 1920. (Addition to 120,651.) (163,887.)

12,716. "X-ray plates and the like." L. A. Levy and A. L. Landau. May 7th, 1920. (Cognate application 30,292/20.) (163,903.)

13,182. "Electric regulating switches." M. Mansell. May 12th, 1920. (163,907.)

14,652. "Induction electricity supply meters." A. Schuster. August 15th, 1918. (143,928.)

14,851. "Tone arms and amplifiers for talking-machines." A. E. Roberts. December 2nd, 1920.) (163,917.)

16,618. "Electric push-button switches." W. T. Ohrstrom. June 19th, 1920. (163,925.)

18,910. "High-frequency signalling." Western Electric Co., Ltd. March 3rd, 1916. (146,988.)

21,868. "Terminals for binding-posts for electric wires." J. T. Callaway and S. A. Callaway. July 21st, 1920. (163,934.)

29,903. "Sparking-plugs." A. W. Armstrong. October 22nd, 1920. (163,959.)

34,536. "Sparking-plugs for internal-combustion engines." F. Monin. December 8th, 1919. (154,932.)

35,308. "Process for feeding electric traction lines supplied with direct current." E. Sorelli. December 15th, 1919. (155,296.)

35,931. "Means for detecting damaged ramps in train electrical control systems." R. Haddan (J. B. Regan). November 7th, 1919. (Divided application on 158,669.) (163,962.

1921.

1,242. "Sparking-plugs." L. Siegl. July 26th, 1919. (157,330.)

5,755. "Electricity meters." Chamberlain & Hookham, Ltd., and S. James. November 20th, 1919. (Divided application on 162,015.) (163,963.)

9,195. "Process for suppressing upper-harmonic anode currents in metal vapour rectifiers fed through polyphase transformers." Akt.-Ges. Brown, Boveri et Cie. April 1st, 1920. (160,815.)

An Electrically-Driven Merchant Vessel.—The Cosmopolitan Steamship Co. has recently put into service the steamer *Invincible*, which has been converted to electric drive. The *Journal of Commerce*, quoting an American paper, says that the electrical equipment installed in the *Invincible* is similar to that in the *Eclipse*, and to that to be installed in the *Archer*, now in the Tebo Co.'s yards for conversion. This equipment consists of a 3-phase, 2,300-volt induction motor, driven by an a.c. 3-phase turbo-generator of the rigid-frame, three-bearing construction type. Two 35-kW, engine-driven, d.c. exciters are installed and one control board with rheostats, switches, and instruments. The motor is self-contained, having its bearings supported from its own frame. The weight complete is about 98,500 lb. The rotor weighs 34,600 lb., and the frame weighs 63,900 lb. Mounted on top of the rotor is a removable steel hood, which is part of the motor ventilating system.

The motor has two bearings, and was handled as a complete assembled unit. The generator was handled as two parts, the frame and the rotor. The frame was first fixed and bolted to the foundation, after which the rotor was inserted, lined, and the coupling made up.

The main motor is ventilated by a 14,000 c.f. motor-driven induction fan, which is placed near the after engine room bulkhead. All fan ducts, auxiliary condenser piping, and other fittings are carried clear of the space between the motor and turbo-generator to permit the removal of the motor and shield without disturbing any fixtures

The control apparatus in the engine room consists of several panels on which are mounted all switches, fuses, rheostats, and other instruments. The frame of this control unit furnishes a mounting for a group of main circuit contactors which are both mechanically and electrically operated. There are no levers or other mechanical linkages of any kind passing between this control and the other engine room apparatus.

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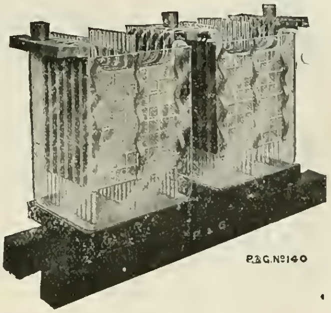

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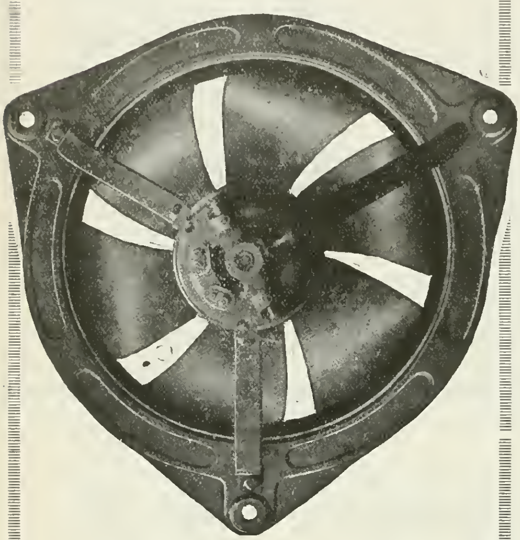

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CONTRACTORS' COLUMN.

[The following information is published in the interests of electrical contractors and others who are seeking for openings for new business. Considerable expense is incurred in the production of this column, and every care is taken to ensure that the information is new and accurate, but it will be understood that in a matter where so many correspondents are engaged, and where the amount of information to be handled is very large, this cannot always be guaranteed. If alleged inaccuracies are reported to the Editors, they will be fully investigated.]

ABERDEEN.—Alterations to Oldmill Hospital; Architect, H.M. Office of Works, 3, Parliament Square, Edinburgh.

BEXHILL.—Detached house in Belle Hill; G. H. Gray, Sea Road. Detached house in Richmond Road, detached residence, Westville Road, three detached houses, Warwick Road; J. E. Maynard, Collington Avenue. Three detached houses in Collington Avenue; G. E. Mathews, Collington Avenue. Detached bungalow in Jameson Road; F. Smee, Jameson Road. Conversion into flats two houses, West Parade; J. B. Wall, Devonshire Road.

BANGOR (Co. Down, Ireland).—Baptist church; Rev. D. Burrows, pastor.

BANGOR.—34 houses, for Ogwen R.D.C.; J. Hughes Roberts, clerk to the Council, Tanylyawent Offices.

BIRCHINGTON (Thanet).—Conversion of "The Hall" into orphanage, for the directors of Spurgeon's Homes, London.

BIRKENHEAD (Heswall).—Extension of police station, for County Standing Joint Committee; H. Beswick, County Architect, Chester. Showrooms, &c., for J. G. Edwards, motor engineer, Trinity Street.

BLACKPOOL.—Club house, for the Blackpool North Shore Golf Club; J. K. Stead, secretary.

BOLTON-UPON-DEARNE (Yorks.).—Alterations, Angel Hotel; Newbald & Hartley, architects and surveyors, 1, Barstow Square, Wakefield.

BOSTON.—Conversion of Norton House into tuberculosis hospital (£6,000), for Hollands C.C.; the clerk.

BURSLEM.—Institute, for Trustees. Hamilton Road Primitive Methodist schools.

CADISHEAD.—Extension of Congregational Church; Rev. W. J. Rees, pastor.

CHESTER.—Memorial hall at Farndon; E. W. Ince, secretary to the Committee, Farndon.

COVENTRY.—Roman Catholic school, Stoke; Rev. J. J. Walsh.

DUMFRIES.—Extensions, for Robinson Bros., drapers.

DUNDEE.—Rebuilding of dressing and pattern shops, Lilybank Foundry, for the Caledon Shipbuilding and Engineering Co., Ltd.

EDINBURGH.—Alterations to Pilton Hospital; H.M. Office of Works, 3, Parliament Square.

FALKIRK.—Warehouses, M. Cockburn's Gowanbank Ironworks, Grahamston (£1,200); the manager.

FIFESHIRE.—Additions, Crawford Priory Mansion House; Lord Cochrane of Cults; Crawford Priory.

GLASGOW.—Model dairy farm for Corporation; city engineer.

GUISBOROUGH (Yorks.).—24 houses, for the U.D.C.; H. Kilburn, surveyor.

HEMSWORTH (Yorks.).—30 houses, Hemsworth-Highfield (No. 2) Housing Scheme; W. T. Lynam, architect, Council Offices.

HEYWOOD.—88 houses, Barley Hall site; J. T. Proffitt & Sons, architects, Memorial Road, Walkden, near Manchester.

HUDDERSFIELD.—46 houses, Grove Place site, Long Lane, Dalton; H. Sutcliffe, borough architect, 1, Peel Street.

KING'S LYNN.—30 houses, for the T.C.; borough surveyor

LEEDS.—Reinstatement, Kirkstall Forge, Ltd.; proprietors.

MOTHERWELL.—Conversion of Wishaw Pavilion into picture house (£8,000); manager, Wishaw Pavilion, Ltd.

MYLOR.—Schools, for the Church of England; trustees.

NEW MALDEN.—Extensions; Pastor, Congregational Church.

NORTHAMPTON.—Warehouse, Newland, for Berridge Bros., wholesale drysalters.

OAKHAM.—Alterations to the elementary schools; managers.

OLDHAM.—Sorting office; District Surveyor, H.M. Office of Works, New Bridge Street, Manchester.

RAINHAM (Kent).—Additions; Pastor, Congregational Church.

RENFREWSHIRE.—Rebuilding Southbar Mansion House; R. Sutherland, Southbar, Erskine Ferry.

RUGELEY.—Housing scheme; surveyor to U.D.C., Council Offices.

RYDE (Havenstreet).—Alterations to Longford House, with electric light work, for the Isle of Wight C.C.; S. R. Cocks, county surveyor, St. Thomas Street.

SEVENOAKS.—21 houses, for the R.D.C.; P. F. Potter, architect, 49, London Road.

SHEFFIELD.—Kinema theatre; P. A. Hinchliffe, architect, 14, Regent Street, Barnsley.

SKYE.—Mansion House at Skeabost, Skye, for Duncan MacLeod, whisky blender, Glasgow.

TAUNTON.—74 houses, for the T.C.; I. F. Shellard, borough engineer.

TEDDINGTON.—Works, for the Vinora Cabinet Works, Munster Road; Mr. Breading, owner (£10,000).

THORNTON (near Blackpool).—Additions to Mission Church, Heys Street; Rev. C. N. Sergeant.

TODMORDEN (Yorks.).—Reinstatement, Todmorden Motor Co.; H. Simpson & Co.

WAKEFIELD.—Remodelling of Agbrigg sewage disposal works; borough surveyor. Warehouse in Gill's Yard and Strafford Square, for Kilkenny Bros. Extension at economiser works, Calder Vale Road, for E. Green & Son.

WALSALL.—Additional pavilion at Pelsall Hall Sanatorium; borough surveyor.

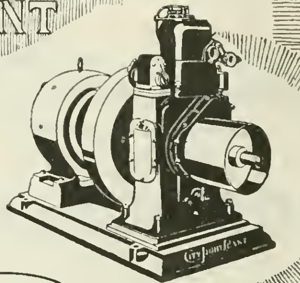
WEST HARTLEPOOL.—Alterations to warehouse, for North-Eastern Railway Co.; A. Pollard, architect, York.

WHITBY.—Residence, Carr Hill Lane, for Rev. Philip Drewitt; A. E. Young, architect.

WITNEY (Oxon.).—Extensions, for the trustees of the Wesleyan Church.

WREXHAM.—Adaptation of premises in Grosvenor Road as offices, clinic, &c., for Denbighshire Education Committee; county architect.

YORK (Whixley).—Houses and farm buildings; County Land Agent, County Hall, Wakefield.



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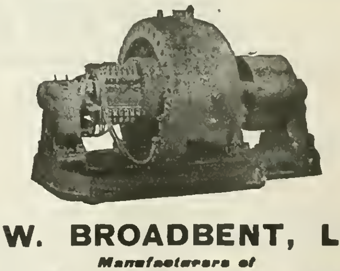

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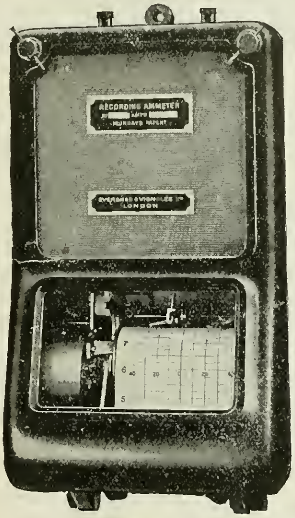

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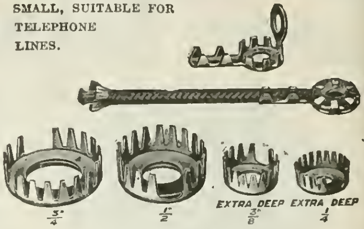

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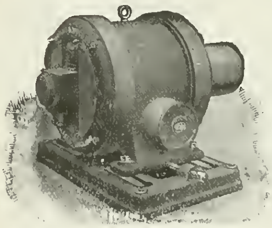

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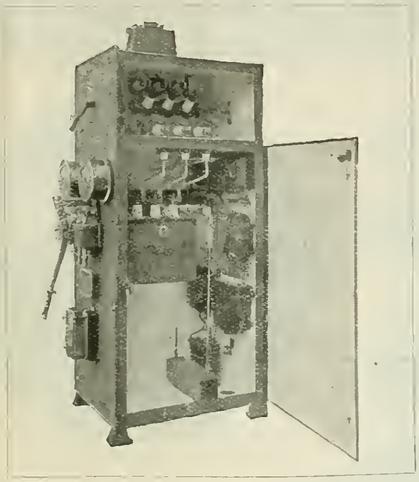

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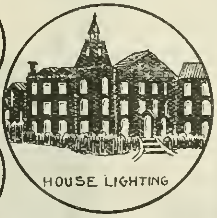

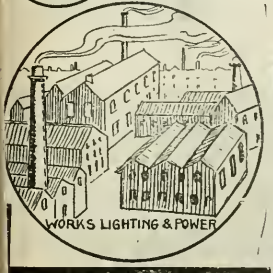

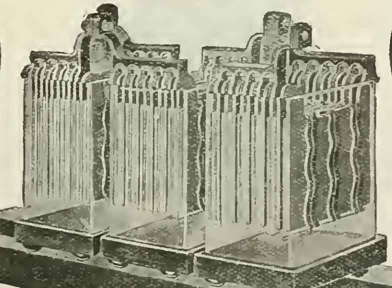

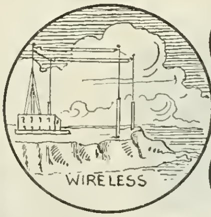

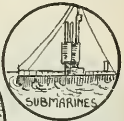

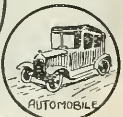

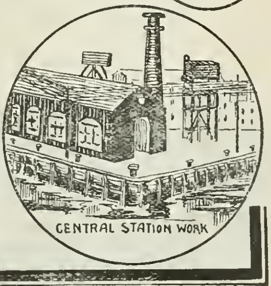

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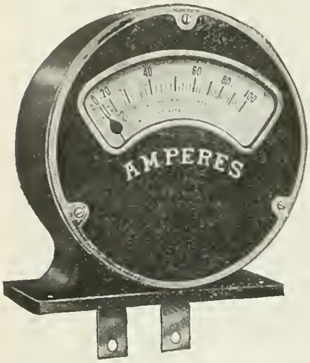

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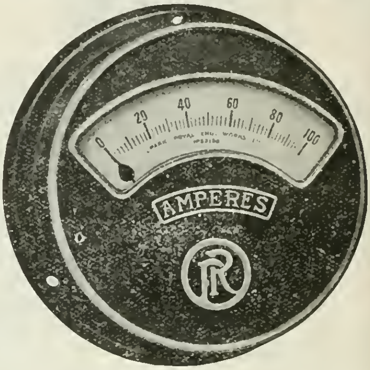

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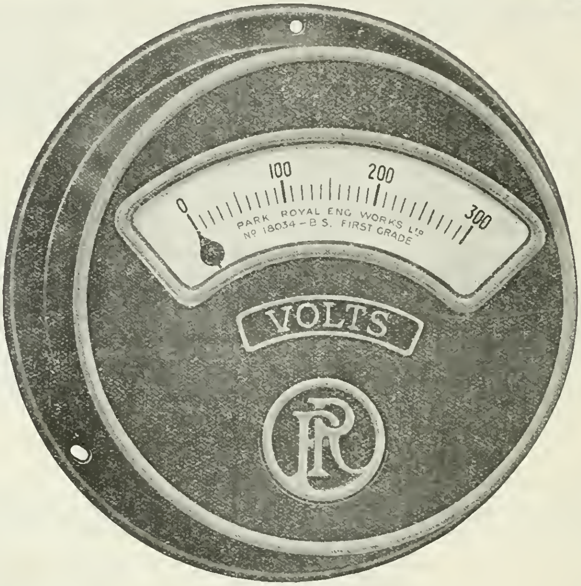

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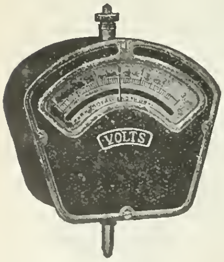

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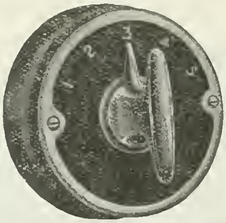

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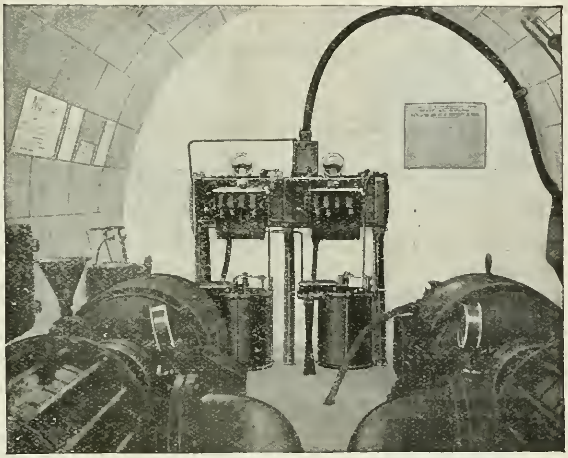

THIS illustration shows an Underground Pumping Plant in a colliery. The Control is Ellison Unit-type Switchgear, comprising busbar chamber with armoured cable fittings, automatic oil break circuit breaker, and an oil-cooled rotor starter for each motor. We shall be glad to receive enquiries from Engineers for Electric Control Gear and Switchgear for use with pumping plant.

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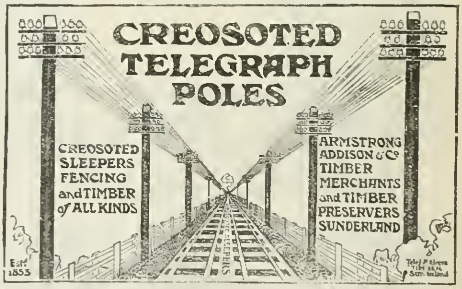
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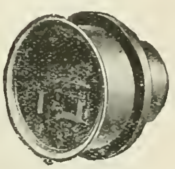

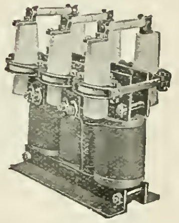

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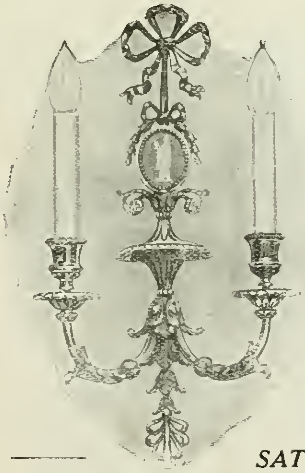

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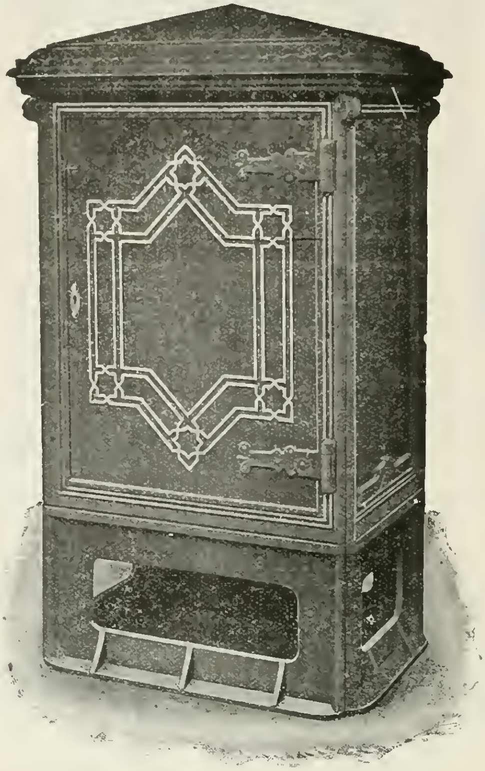

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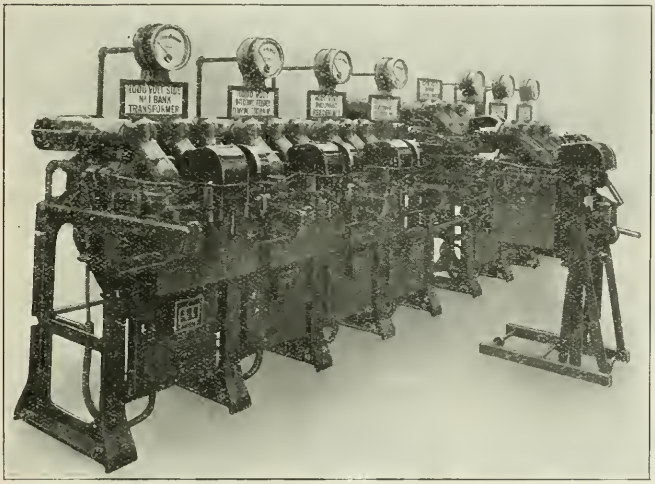

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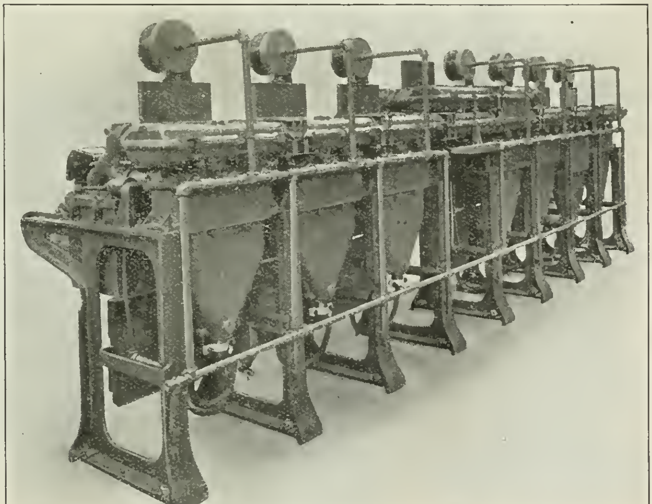

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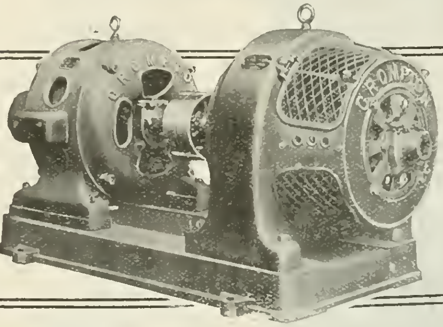

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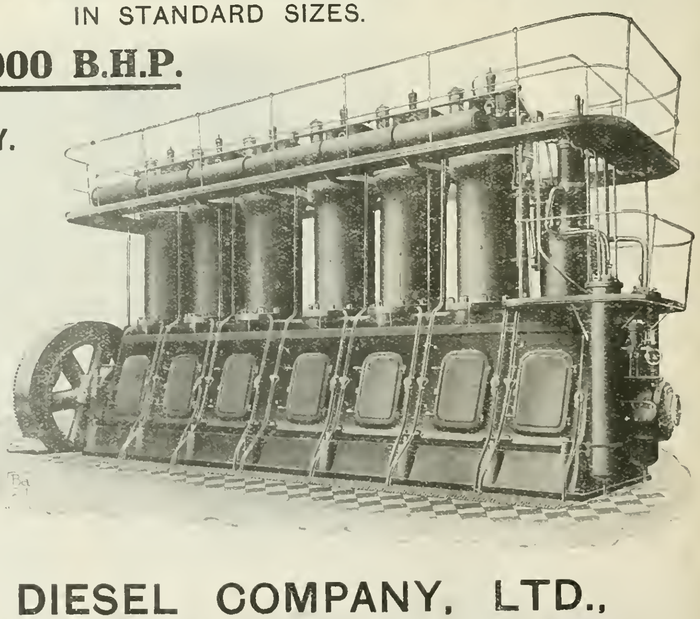

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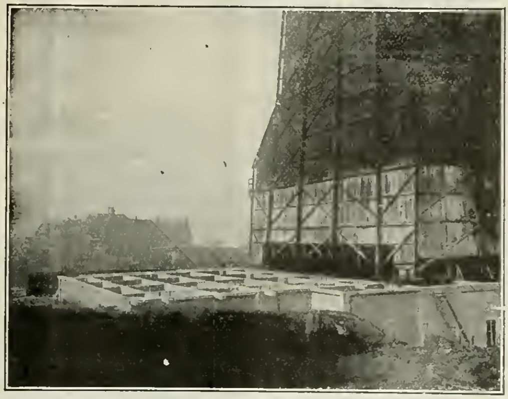

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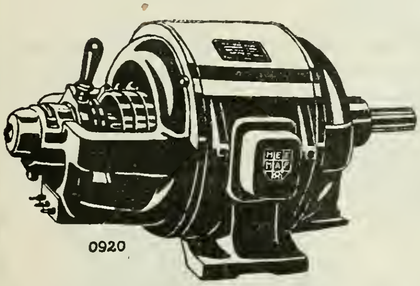

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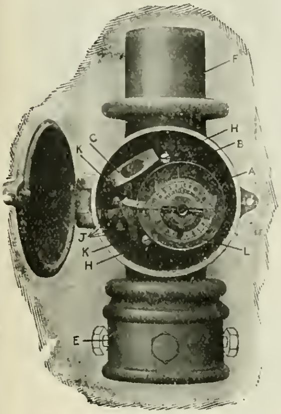

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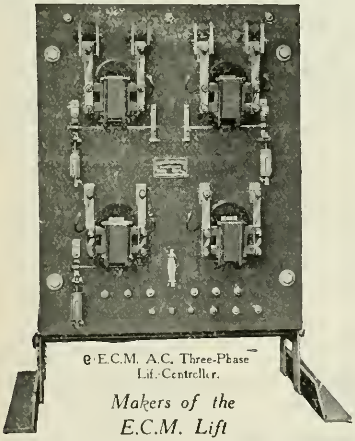

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JUNE the rose month is here, but rosiness seems confined to its strict floral meaning. The selling outlook is wintry in its blackness. Buyers are very, very wary ; they are more discriminating than ever. But there's a silver lining even to an unrosy June. People to-day are demanding quality ; inferior apparatus is pushed aside in disgust. Jackson cookers and heaters are as popular as ever, and our trade friends are bringing more and more customers to our showrooms. They appreciate our methods of business, they know that a customer who has bought Jackson apparatus will come again for other things. They also know that the discount on every sale made in Sloane Street is credited to their account, whether they bring the customer themselves or send him along to see the demonstration for himself.

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Full particulars of trade terms and schemes of dealer-assistance on request.

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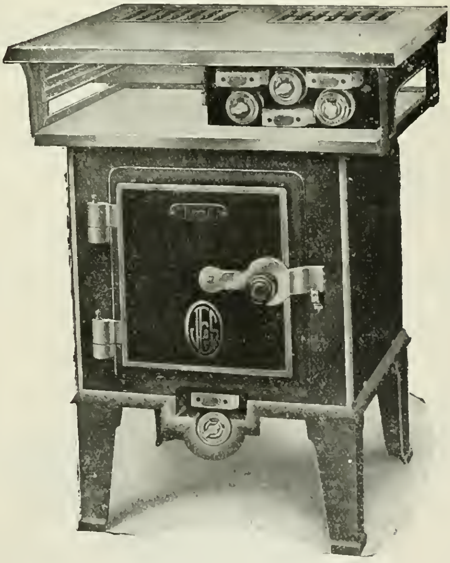
ELECTRIC COOKERS & HEATERS



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CLASSIFIED INDEX OF ADVERTISEMENTS.

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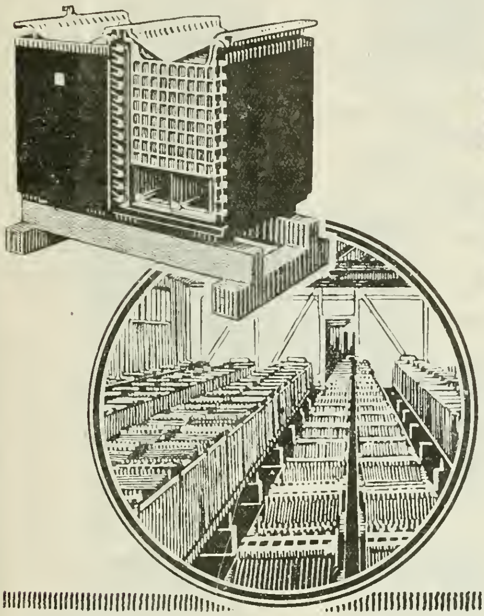

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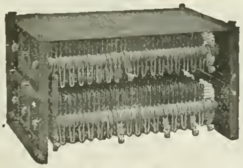

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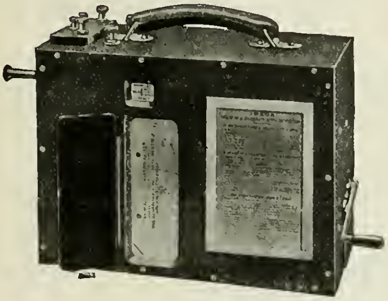

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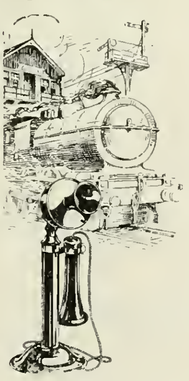

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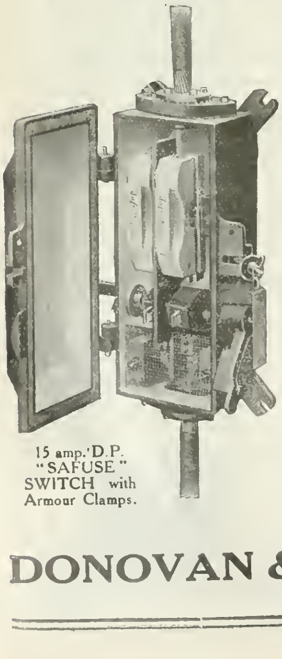

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